Dates: Filed, Issued, Expiration (Projected)	**Patent # : Number and USPTO Web link**	**Assignee: Company Name, Country (at Issue-date)**	**Patent Title, Abstract, Illustrative claims, Tags for: *[presumptive composition of matter], [presumptive process/method]:* Heating processes, Cooling processes**
Filed: June 29, 2012 Issued: June 21, 2016 Expires: June 2032	9,373,433	Assignee: General Electric Company (Niskayuna, NY)	Nanocomposite permanent magnets and methods of making the same **Abstract** A method of making a nanocomposite permanent ***magnet*** is provided. The method comprises applying an extreme shear deformation to hard magnetic phase nanoparticles and soft magnetic phase nanoparticles to align at least a portion of the hard phase magnetic particles and to produce a nanocomposite permanent ***magnet***. The invention claimed is: 1. A method of making ***[presumptive process/method]*** a nanocomposite permanent ***magnet,*** comprising: applying shear deformation to hard magnetic phase nanoparticles and soft magnetic phase nanoparticles to align at least a portion of the hard phase magnetic particles and to produce a nanocomposite permanent ***magnet*** further comprising degassing the hard and soft magnetic phase nanoparticles prior to applying the shear deformation to form a degassed composite mixture of the hard magnetic phase nanoparticles and soft magnetic phase nanoparticles; wherein the step of applying the shear deformation comprises; disposing the degassed composite mixture in a ductile conduit; degassing the ductile conduit; sealing the ductile conduit after degassing;

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			disposing the ductile conduit in a deformation container; and transmitting a shear strain to the ductile conduit via the deformation container to produce the nanocomposite permanent ***magnet***. 2. The method of claim 1, wherein the hard magnetic phase particles comprise samarium cobalt, neodymium iron boron, samarium iron nitrogen, iron platinum, cobalt platinum, iron palladium, cobalt palladium, aluminum nickel cobalt, barium-hexaferrite, strontium-hexaferrite, manganese bismuth, manganese aluminum,or combinations thereof.
Filed: September 22, 2014 Issued: June 14, 2016 Expires: September 2034	9,368,277	Assignee: DAIDO STEEL CO., LTD. (Aichi, Japan)	Method for producing RFeB-based ***magnet*** **Abstract** Provided is a method for producing an RFeB-based ***magnet,*** the method including: disposing a nozzle so as to be opposed to an attachment surface of a base material that is a sintered ***magnet*** or hot-plastic worked ***magnet*** composed of an RFeB-based ***magnet*** containing a light ***rare earth*** element R.sup.L that is at least one element selected from the group consisting of Nd and Pr, Fe, and B; ejecting a mixture, from the nozzle, obtained by mixing an organic solvent and an R.sup.H-containing powder containing a heavy ***rare earth*** element R.sup.H that is at least one element selected from the group consisting of Dy, Tb and Ho so as to attach the mixture to the attachment surface; and heating the base material together with the mixture. What is claimed is: 1. A method for producing ***[presumptive process/method]*** an RFeB-based ***magnet,*** the method comprising: disposing a nozzle so as to be opposed to an attachment surface of a base material, which is held by a base material holding unit so that the attachment surface faces upward, which has an upwardly

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			convex arc shape in a cross-section, and which is a sintered ***magnet*** or hot-plastic worked ***magnet*** composed of an RFeB-based ***magnet*** containing a light ***rare earth*** element R.sup.L that is at least one element selected from the group consisting of Nd and Pr, Fe, and B; transporting the base material holding unit using a base material transporting unit so that the base material holding unit is immediately below a nozzle head of the nozzle; extruding a mixture, which is obtained by mixing an organic solvent, which is a silicone grease or flowable paraffin, and an R.sup.H-containing powder containing a heavy ***rare earth*** element R.sup.H that is at least one element selected from the group consisting of Dy, Tb and Ho, from the nozzle, by moving a valve element or a piston or by pressure when receiving an electrical signal, while moving the nozzle with respect to the attachment surface so as to attach the mixture to the attachment surface; transporting the base material holding unit away from immediately below the nozzle head of the nozzle using the base material transporting unit; transporting, using the base material transporting unit, a subsequent base material holding unit, which holds base material that has an attachment surface facing upward, so that the subsequent base material holding unit is immediately below the nozzle head of the nozzle and so that the mixture is attached to an attachment surface of a plurality of base materials; and heating the base material together with the mixture. 5. A method for producing an RFeB-based ***magnet,*** the method comprising: disposing a nozzle so as to be opposed to an attachment surface of a base material that has an upwardly convex arc shape in a cross-section and is a sintered ***magnet*** or hot-plastic worked ***magnet*** composed of an RFeB-based ***magnet*** containing a light ***rare earth*** element R.sup.L that is at least one element selected from the group consisting of Nd and Pr, Fe, and B; extruding a mixture, which is obtained by mixing an organic solvent and an R.sup.H-containing powder containing a heavy ***rare earth*** element R.sup.H that is at least one element selected from the group consisting of Dy, Tb and Ho, from the nozzle while moving the nozzle with respect to the attachment surface so as

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			to attach the mixture to the attachment surface; and heating the base material together with the mixture.
Filed: July 12, 2011 Issued: June 14, 2016 Expires: July 2031	9,368,276	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	Method for producing R-T-B-based sintered magnets **Abstract** A method for producing a sintered R-T-B based ***magnet*** includes the steps of: providing a sintered R-T-B based ***magnet*** body 1; providing an RH diffusion source including a heavy ***rare-earth*** element RH (which is at least one of Dy and Tb) and 30 mass % to 80 mass % of Fe; loading the sintered R-T-B based ***magnet*** body 1 and the RH diffusion source 2 into a processing chamber 3 so that the ***magnet*** body 1 and the diffusion source 2 are movable relative to each other and are readily brought close to, or in contact with, each other; and performing an RH diffusion process in which the sintered ***magnet*** body 1 and the RH diffusion source 2 are heated to a processing temperature of more than 850.degree. C. through 1000.degree. C. while being moved either continuously or discontinuously in the processing chamber. The invention claimed is: 1. A method for producing ***[presumptive process/method]*** a sintered R-T-B based ***magnet,*** the method comprising the steps of: providing a sintered R-T-B based ***magnet*** body; providing a solid RH diffusion source including a heavy ***rare-earth*** element RH (which is at least one of Dy and Tb) and 40 mass % to 60 mass % of Fe, the solid RH diffusion source having a solid physical shape; loading the sintered ***magnet*** body and the solid RH diffusion source into a processing chamber so that the ***magnet*** body and the solid RH diffusion source are movable relative to each other and are readily brought in contact with each other; and performing an RH diffusion process in which the sintered ***magnet*** body and the solid RH diffusion source are heated to a processing temperature

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			of more than 850.degree. C. through 1000.degree. C. while being moved either continuously or discontinuously in the processing chamber, and changing a point of contact between the sintered ***magnet*** body and the solid RH diffusion source by rotating the processing chamber; wherein the RH diffusion process is carried out with a stirring aid member introduced into the processing chamber, the stirring aid member being made of zirconia, silicon nitride, silicon carbide, boron nitride or a ceramic that includes any combination of zirconia, silicon nitride, silicon carbide, and boron nitride; and the sintered ***magnet*** body, the solid RH diffusion source and the stirring aid member are stirred in the processing chamber during the RH diffusion process. 2. The method of claim 1, wherein the processing temperature is 870.degree. C. to 1000.degree. C.
Filed: March 30, 2011 Issued: May 24, 2016 Expires: March 2031	9,350,203	Assignee: TDK Corporation (Tokyo, Japan)	***Rare earth*** sintered ***magnet,*** method for producing the same, motor, and automobile **Abstract** Provided is a ***rare earth*** sintered ***magnet*** 10 comprising a group of main phase grains 2 each composed of an R-T-B-based ***rare earth magnet*** comprising a core 4 and a shell 6 covering the core 4, wherein a thickness of the shell 6 is 500 nm or less, R includes a light ***rare earth*** element and a heavy ***rare earth*** element, and a Zr compound 8 is present in a grain boundary phase 7 of the group of main phase grains 2 and/or the shell 6. Also provided are a motor comprising the ***rare earth*** sintered ***magnet*** 10 and an automobile comprising the motor. The invention claimed is: 1. A ***rare earth*** sintered ***magnet*** comprising ***[presumptive composition of***

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			matter], a group of main phase grains each composed of an R-T-B-based ***rare earth magnet*** comprising a core and a shell covering the core, wherein a thickness of the shell is 500 nm or less, R includes a light ***rare earth*** element and a heavy ***rare earth*** element, and a Zr compound is present in the shell. 2. The ***rare earth*** sintered ***magnet*** according to claim 1, wherein a Ga compound is further present in the grain boundary phase of the group of main phase grains. 3. The ***rare earth*** sintered ***magnet*** according to claim 1, wherein a content of an oxygen element is 2500 ppm or less and a content of a carbon element is 500 ppm or more and 1500 ppm or less in the ***rare earth*** sintered ***magnet***.
Filed: January 6, 2010 Issued: April 26, 2016 Expires: January 2030	9,324,485	Assignee: DAIDO STEEL CO., LTD. (Aichi-Ken, Japan)	Material for anisotropic ***magnet*** and method of manufacturing the same **Abstract** A material for anisotropic ***magnet,*** comprising, **[presumptive composition of matter],** (1) a Pr-T-B--Ga-based composition containing Pr: 12.5 to 15.0 atomic percent, B: 4.5 to 6.5 atomic percent, Ga: 0.1 to 0.7 atomic percent, and the balance of T and inevitable impurities, wherein T is Fe or obtained by substituting Co for a portion of the Fe; and having, (2) a degree of magnetic alignment of 0.92 or more, wherein the degree of magnetic alignment is defined by remanence (Br)/saturation magnetization (Js); and (3) a crystal grain diameter of 1 .mu.m or less What is claimed is: 1. A hot plastically deformed anisotropic magnet having aligned axes of easy magnetization of crystal grains of the magnet, the anisotropic magnet comprising: (a) a T-based composition consisting of R, B, Ga, and a balance of T and inevitable impurities, wherein R is Pr or Pr that is optionally substituted

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			with at least one element selected from the group consisting of Nd, Dy, and Tb; wherein an amount of R is 12.5 to 15 atomic percent; an amount of B is 4.5 to 6.5 atomic percent; and an amount of Ga is 0.1 to 0.7 atomic percent; (b) a degree of magnetic alignment of 0.92 or more, wherein the degree of magnetization is defined by remanence (Br) / saturation magnetization (Js), wherein the remanence (Br) is 1.20 T or more, and a coercivity is 1600 kA/m or more; and (c) flattened crystal grains having a crystal grain diameter of 1 μm or less, and wherein R contains at least 50 atomic percent of Pr. 2. A hot plastically deformed anisotropic ***magnet*** having aligned axes of easy magnetization of crystal grains of the ***magnet,*** the anisotropic ***magnet*** comprising (1) a T-based composition consisting of R, B, Ga, at least one element selected from the group consisting of Cu and Al, and a balance of T and inevitable impurities, wherein R is Pr or Pr that is optionally substituted with at least one element selected from the group consisting of Nd, Dy, and Tb; wherein an amount of R is 12.5 to 15 atomic percent; an amount of B is 4.5 to 6.5 atomic percent; and an amount of Ga is 0.1 to 0.7 atomic percent; wherein T is Fe or Fe partially substituted with Co, and having (2) a degree of magnetic alignment of 0.92 or more, wherein the degree of magnetization is defined by remanence (Br) / saturation magnetization (Js), wherein the remanence is 1.20 T or more, and a coercivity is 1600 kA/m or more; and (3) flattened crystal grains having a crystal grain diameter of 1 .mu.m or less, and wherein R contains at least 50 atomic percent of Pr. 3. A method **[presumptive process/method]** of manufacturing a ***magnet*** comprising: dissolving an alloy to form a molten alloy; rapidly-quenching the molten alloy forming a ribbon; pulverizing the ribbon to form an alloy powder; cold-pressing the alloy powder to form a cold-pressed body; pre-heating the cold-pressed body under a temperature of 500.degree. C. to 850.degree. C. to obtain a pre-heated cold-pressed body; hot-forming the pre-heated cold-

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			pressed body to obtain a hot-formed body; and performing a hot plastic deforming to the hot-formed body to form an anisotropic ***magnet*** according to claim 1 1. A hot plastically deformed anisotropic ***magnet*** having aligned axes of easy magnetization of crystal grains of the ***magnet,*** the anisotropic ***magnet*** comprising: (1) a T-based composition consisting of R, B, Ga, and a balance of T and inevitable impurities, wherein R is Pr or Pr that is optionally substituted with at least one element selected from the group consisting of Nd, Dy, and Tb; wherein an amount of R is 12.5 to 15 atomic percent; an amount of B is 4.5 to 6.5 atomic percent;
Filed: April 13, 2011 Issued: April 19, 2016 Expires: April 2031	9,314,843	Assignee: SUMITOMO ELECTRIC INDUSTRIES, LTD. (Osaka, Japan)	Powder for ***magnet*** **Abstract** The present invention provides a powder for a ***magnet*** which can form a ***rare earth magnet*** having excellent magnetic characteristics and which has excellent moldability, a method for producing the powder for a ***magnet,*** a powder compact, and a ***rare earth***-iron-boron-based alloy material. The invention claimed is: 1. A powder compact produced by**[presumptive process/method]** compacting the powder for a ***magnet,*** comprising: each of magnetic particles constituting the powder for the ***magnet*** being composed of **[presumptive composition of matter]** less than 40% by volume of a hydrogen compound of a ***rare earth*** element, an iron-containing material, and the balance composed of unavoidable impurities, wherein: said hydrogen compound of the ***rare earth*** element consists of the ***rare earth*** element and hydrogen; the iron-containing material consists of iron and an iron-boron alloy consisting of iron and boron; a phase of the hydrogen compound of the ***rare earth*** element and a phase of the

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			iron-containing material are present adjacent to each other; the distance between the phases of the ***rare earth*** element hydrogen compound adjacent to each other with the phase of the iron-containing material interposed therebetween is 3 .mu.m or less; the relative density of the powder compact is 85% or more; and the phase of the hydrogen compound is granular, and the granular hydrogen compound of a ***rare earth*** element is dispersed in the phase of the iron-containing material. 2. A ***rare earth***-iron-boron-based alloy material produced by heat-treating the powder compact according to claim 1 in an inert atmosphere or a reduced-pressure atmosphere. 3. A ***rare earth***-iron-boron-based alloy material produced by heat-treating the powder compact according to claim 1 in an inert atmosphere or a reduced-pressure atmosphere, the alloy material comprising a mixed-phase material including a ***rare earth***-iron-boron alloy phase and at least one phase selected from an iron phase, an iron-boron alloy phase, or a ***rare earth***-iron alloy phase. 4. A ***rare earth***-iron-boron-based alloy material produced by heat-treating the powder compact according to claim 1 in an inert atmosphere or a reduced-pressure atmosphere while applying a magnetic field of 4 T or more, wherein in an X-ray diffraction pattern measured for a surface having a normal direction parallel to the direction in which the magnetic field is applied, the relative intensity of a diffraction peak appearing at a crystal interplanar spacing of 0.202 nm to 0.204 nm is 70 or more.
Filed: March 13, 2013 Issued:	9,299,486	Assignee: Kabushiki Kaisha Toshiba (Tokyo, Japan)	Permanent ***magnet,*** and motor and power generator using the same **Abstract** In one embodiment, a permanent ***magnet*** includes a ***magnet*** main body and a

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March 29, 2016 Expires: March 2033			surface portion provided on a surface of the ***magnet*** main body. The ***magnet*** main body has a composition expressed by a composition formula 1: R(Fe.sub.p1M.sub.q1Cu.sub.r1Co.sub.1-p1-q1-r1).sub.z1. The surface portion has a composition expressed by a composition formula 2: R(Fe.sub.p2M.sub.q2Cu.sub.r2Co.sub.1-p2-q2-r2).sub.z2. In the composition formulas 1 and 2, R is at least one element selected from ***rare earth*** elements, M is at least one element selected from Ti, Zr and Hf, p1 and p2 are 0.25 to 0.45, q1 and q2 are 0.01 to 0.05, r1 and r2 are 0.01 to 0.1, z1 is 6 to 9, and z2 satisfies 0.8.ltoreq.z2/z1.ltoreq.0.995. What is claimed is: 1. A permanent magnet, comprising **[presumptive composition of matter**] : a magnet main body having a composition expressed by a composition formula 1: R(Fe.sub.p1M.sub.q1Cu.sub.r1Co.sub.1-p1-q1-r1).sub.z1 where, R is at least one element selected from rare-earth elements, M is at least one element selected from Ti, Zr, and Hf, p1 is a number satisfying 0.25.ltoreq.p1.ltoreq.0.45 (atomic ratio), q1 is a number satisfying 0.01.ltoreq.q1.ltoreq.0.05 (atomic ratio), r1 is a number satisfying 0.01.ltoreq.r1.ltoreq.0.1 (atomic ratio), and z1 is a number satisfying 6.ltoreq.z1.ltoreq.9 (atomic ratio); and a surface portion, provided on a surface of the magnet main body, having a composition expressed by a composition formula 2: R(Fe.sub.p2M.sub.q2Cu.sub.r2Co.sub.1-p2-q2-r2).sub.z2 where, R is at least one element selected from rare-earth elements, M is at least one element selected from Ti, Zr, and Hf, p2 is a number satisfying 0.25.ltoreq.p2.ltoreq.0.45 (atomic ratio), q2 is a number satisfying 0.01.ltoreq.q2.ltoreq.0.05 (atomic ratio), r2 is a number satisfying 0.01.ltoreq.r2.ltoreq.0.1 (atomic ratio), and z2 is a number satisfying 0.8.ltoreq.z2/z1.ltoreq.0.995 (atomic ratio). 2. The permanent magnet according to claim 1, wherein at least part of the

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			surface portion has a composition where q2 in the composition formula 2 satisfies 0.5.ltoreq.q2/q1.ltoreq.0.95. 3. The permanent magnet according to claim 1, wherein the magnet main body comprises a metallic structure including a cell phase having a Th.sub.2Zn.sub.17 crystal phase, and a cell wall phase surrounding the cell phase. 4. The permanent magnet according to claim 3, wherein the magnet main body is provided with a sintered compact comprising the metallic structure.
Filed: September 29, 2011 Issued: March 22, 2016 Expires: Sept 2031	9,293,252	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	R-T-B sintered ***magnet*** manufacturing method **Abstract** Problem: To provide a heavy ***rare-earth*** element RH diffusion process **[presumptive process/method]** that contributes greatly to mass production. [Solution] A method for producing a sintered ***magnet*** includes the steps of: providing a sintered R-T-B based ***magnet*** body; providing an RH diffusion source which is made of at least one of a fluoride, an oxide and an oxyfluoride that each include Dy and/or Tb; loading the sintered R-T-B based ***magnet*** body and the RH diffusion source into a process chamber so that the ***magnet*** body and the diffusion source are movable relative to each other and are readily brought close to, or into contact with, each other; and performing an RH diffusion process in which the sintered R-T-B based ***magnet*** body and the RH diffusion source are heated to a processing temperature of 800.degree. C. through 950.degree. C. while being moved either continuously or discontinuously in the process chamber. The invention claimed is: 1. A method for producing a sintered R-T-B based magnet, the method

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			comprising the steps of: providing a sintered R-T-B based magnet body; providing an RH diffusion source which is made of at least one of a fluoride, an oxide and an oxyfluoride that each include Dy and/or Tb; loading the sintered R-T-B based magnet body and the RH diffusion source into a process chamber so that the magnet body and the diffusion source are movable relative to each other and are readily brought close to, or into contact with, each other; and performing an RH diffusion process in which the sintered R-T-B based magnet body and the RH diffusion source are heated to a processing temperature of 800.degree. C. through 950.degree. C. while being moved either continuously or discontinuously in the process chamber so that the magnet body and the diffusion source are moved relative to each other and are brought close to, or into contact with, each other; wherein in the RH diffusion process, the process chamber is heated by a heater that is arranged around an outer periphery of the process chamber, the sintered R-T-B based magnet body and the RH diffusion source that are loaded into the process chamber are also heated, and the temperature of the sintered R-T-B based magnet body and the RH diffusion source is maintained within a range of 800.degree. C. to 950.degree. C.; the RH diffusion process step is carried out using a stirring aid member loaded into the process chamber; and the stirring aid member is made of zirconia, silicon nitride, silicon carbide, boron nitride, or a ceramic that includes any combination of zirconia, silicon nitride, silicon carbide, boron nitride.
Filed: May 14, 2008 Issued: March 15, 2016 Expires:	9,287,027	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	Rare earth metal-based permanent magnet **Abstract** An objective of the present invention is to provide a rare earth metal-based permanent magnet with improved adhesion properties. A rare earth metal-based permanent magnet of the present invention as a means for achieving the objective has a laminated plating film, and is characterized in that the plating

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May 2028			film comprises [**presumptive composition of matter**] as an outermost surface layer a SnCu alloy plating film having a film thickness in a range from 0.1 .mu.m to 2 .mu.m, the composition of the SnCu alloy plating film is 35 mass % or more but less than 55 mass % of Sn and the rest being Cu, and a base plating film having two or more layers including at least a Ni plating film and a Cu plating film which are formed as the lower layer under the SnCu alloy plating film, and among the base plating film, the Ni plating film is located just below the SnCu alloy plating film. A joined structure fabricated using the rare earth metal-based permanent magnet of the present invention exhibits favorable initial adhesion strength when combined with a silicone-based adhesive, and is less deteriorated in adhesion strength even after a moisture resistance test. The invention claimed is: 1. A rare earth metal-based permanent magnet having a laminated plating film, characterized in that the plating film comprises as an outermost surface layer a SnCu alloy plating film having a film thickness in a range from 0.1 .mu.m to 2 .mu.m, the composition of the SnCu alloy plating film is 35 mass % or more but less than 55 mass % of Sn and the rest being Cu, and a base plating film having two or more layers including at least a Ni plating film and a Cu plating film which are formed as the lower layer under the SnCu alloy plating film, and among the base plating film, the Ni plating film is located just below the SnCu alloy plating film. 2. The rare earth metal-based permanent magnet as claimed in claim 1, wherein the film thickness of the Cu plating film provided as one of the base plating films is in a range from 3 .mu.m to 17 .mu.m. 3. The rare earth metal-based permanent magnet as claimed in claim 1, wherein the film thickness of the Ni plating film provided as one of the base

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			plating films is in a range from 2 .mu.m to 8 .mu.m.
Filed: March 15, 2012 Issued: March 8, 2016 Expires: March 2032	9,281,107	Assignee: NITTO DENKO CORPORATION (Osaka, Japan)	***Rare-earth*** permanent ***magnet*** and method for manufacturing ***rare-earth*** permanent ***magnet*** **Abstract** There are provided a ***rare-earth*** permanent ***magnet*** and a manufacturing method **[presumptive process/method]** thereof capable of preventing deterioration of ***magnet*** properties. In the method, ***magnet*** material is milled into ***magnet*** powder. Next, a mixture is prepared by mixing the ***magnet*** powder and a binder made of long-chain hydrocarbon and/or of a polymer or a copolymer consisting of monomers having no oxygen atoms. Next, the mixture is formed into a sheet-like shape so as to obtain a green sheet. After that, the green sheet is held for a predetermined length of time at binder decomposition temperature in a non-oxidizing atmosphere so as to remove the binder by causing depolymerization reaction or the like to the binder, which turns into monomer. The green sheet from which the binder has been removed is sintered by raising temperature up to sintering temperature. Thereby a permanent ***magnet*** 1 is obtained. The invention claimed is: 1. A manufacturing method of a rare-earth permanent magnet comprising steps of: milling magnet material into magnet powder: preparing a mixture by mixing the magnet powder and any one of three kinds of binders a binder made of a long-chain hydrocarbon or a binder made of a polymer or a copolymer consisting of one or more kinds of monomers selectable from possible monomers expressed with a general formula (2) ##STR00005## (R.sub.1 and R.sub.2 represent a hydrogen atom, a lower alkyl group, a phenyl group or a vinyl group) or a binder obtained by mixing the long-chain hydrocarbon and either the polymer or the copolymer; obtaining a green sheet by forming the

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			mixture into a sheet-like shape, the mixture is formed by employing a hot melt coating in which the mixture is heated to melt, and turns into a fluid state and then is spread; removing the binder by holding the green sheet for a predetermined length of time at binder decomposition temperature in a non-oxidizing atmosphere so that a residual carbon content contained in the permanent magnet after sintering is 1500 ppm or less and a residual oxygen content contained in the permanent magnet after sintering is 2000 ppm or less; and sintering the green sheet from which the binder has been removed by raising temperature up to sintering temperature.
Filed: July 13, 2011 Issued: March 8, 2016 Expires: July 2031	9,281,105	Assignee: Toyota Jidosha Kabushiki Kaisha (Toyota-shi, Aichi-ken, Japan)	Permanent ***magnet*** and method of producing permanent ***magnet*** **Abstract** A permanent ***magnet*** has a grain structure that includes a main phase and a grain boundary phase that is primarily composed of a first metal. A second metal that enhances the coercivity of the permanent ***magnet*** and a third metal that has a lower standard free energy of oxide formation than the first metal and the second metal are diffused in the permanent ***magnet,*** and the third metal is present in the form of an oxide in the grain boundary phase. The invention claimed is: 1. A permanent magnet that has a grain structure that comprises **[presumptive composition of matter]** a main phase and a grain boundary phase which is primarily composed of a first metal, the permanent magnet wherein a second metal that enhances the coercivity of the permanent magnet and a third metal that has a lower standard free energy of oxide formation than the first metal and the second metal are diffused in the permanent magnet, and the third metal is present in the form of an oxide in the grain boundary phase; wherein the second metal does not form an oxide; wherein the third metal is substantially not present in the main phase; and wherein the third metal oxide is present at

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			triple points where three regions of the grain boundary phases meet. 2. The permanent magnet according to claim 1, wherein the first metal is **neodymium or praseodymium.** 3. The permanent magnet according to claim 2, wherein the second metal is any one of **dysprosium**, **terbium** or **holmium**, and the third metal is either **yttrium or scandium.** 4. A permanent magnet that has a grain structure that comprises a main phase and a grain boundary phase which is primarily composed of a first metal, the permanent magnet comprising: a second metal that enhances the coercivity of the permanent magnet; and a third metal that has a lower standard free energy of oxide formation than the first metal and the second metal, wherein: both densities of the second metal and the third metal are richer in the grain boundary phase than in the main phase; and the third metal is present in the form of an oxide in the grain boundary phase; wherein the second metal does not form an oxide; wherein the third metal is substantially not present in the main phase; and wherein the third metal oxide is present at triple points where three regions of the grain boundary phases meet. 5. A permanent magnet that has a grain structure composed of a main phase and a grain boundary phase, comprising: a first metal as a primary metal that composes the main phase; a second metal that is diffused in the permanent magnet and enhances coercivity of the permanent magnet; and a third metal, which is diffused in the permanent magnet and has a lower standard free energy of oxide formation than the first metal and the second metal, wherein the third metal is present in the form of an oxide in the grain boundary phase; wherein the second metal does not form an oxide; wherein the third metal is substantially not present in the main phase; and wherein the third metal oxide is present at triple points where three regions of the grain boundary phases

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			meet.
Filed: November 25, 2013 Issued: March 1, 2016 Expires: November 2033	9,275,795	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	Corrosion-resistant ***magnet*** and method for producing the same **Abstract** An object of the present invention is to provide an R--Fe--B based sintered ***magnet*** having on a surface thereof a chemical conversion film with higher corrosion resistance than a conventional chemical conversion film such as a phosphate film, and a method for producing the same. The corrosion-resistant ***magnet*** of the present invention as a means for achieving the object is characterized by comprising a chemical conversion film containing at least Zr, Nd, fluorine, and oxygen as constituent elements and not containing phosphorus directly on a surface of an R--Fe--B based sintered ***magnet,*** wherein R is a ***rare-earth*** element including at least Nd. The invention claimed is: 1. A method for producing **[presumptive process/method]** a corrosion-resistant magnet, characterized in that a chemical conversion film containing at least Zr, Nd, Fe, fluorine, and oxygen as constituent elements and not containing phosphorus is formed on a surface of an R--Fe--B based sintered magnet, wherein R is a rare-earth element including at least Nd. 2. A method for producing a corrosion-resistant magnet, characterized in that an R--Fe--B based sintered magnet, wherein R is a rare-earth element including at least Nd, is subjected to a heat treatment at a temperature range of 450.degree. C. to 900.degree. C., and then a chemical conversion film containing at least Zr, Nd, fluorine, and oxygen as constituent elements and not containing phosphorus is formed on a surface thereof. 3. A production method according to claim 2, characterized in that the heat treatment is performed with the magnet being housed in a heat-resistant box.

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Filed: July 30, 2009 Issued: March 1, 2016 Expires: July 2029	9,275,794	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	Corrosion-resistant ***magnet*** and method for producing the same **Abstract** An object of the present invention is to provide an R--Fe--B based sintered ***magnet*** that exhibits excellent corrosion resistance and maintains excellent adhesion strength to an adherend even under severe conditions, and a method for producing the same. A corrosion-resistant ***magnet*** of the present invention as a means for achieving the object is characterized by comprising a chemical conversion film containing at least Zr, V, Al, fluorine, and oxygen as constituent elements and not containing phosphorus over a surface of an R--Fe--B based sintered ***magnet*** with a film made of Al or an alloy thereof therebetween. The invention claimed is: 1. A method for producing **[presumptive process/method]** a corrosion-resistant ***magnet*** characterized by comprising vapor depositing a film made of Al or an alloy thereof on a surface of an R--Fe--B based sintered ***magnet*** at a first average film formation rate set at 0.1 .mu.m/min to 0.4 .mu.m/min until one-third of a desired film thickness is reached and then at a second average film formation rate of 0.2 .mu.m/min to 1 .mu.m/min, the second average film formation rate being always higher than the first average film formation rate, and then forming, on the surface of the deposited film, a chemical conversion film containing at least Zr, V, Al, fluorine, and oxygen as constituent elements and not containing phosphorus, wherein the corrosion-resistant ***magnet*** is characterized in that a region of an outer-surface-side half of the thickness of the chemical conversion film has a higher Zr content than a region of a ***magnet***-side half of the thickness of the chemical conversion film

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Filed: July 5, 2010 Issued: March 1, 2016 Expires: July 2030	9,272,955	Assignee: TDK CORPORATION (Tokyo, Japan)	Ferrite magnetic material **Abstract** An object of the present invention is to provide a ferrite magnetic material capable of providing a permanent magnet in which high Br and HcJ are kept, and which has a high Hk/HcJ. A ferrite magnetic material in accordance with a preferred embodiment has a ferrite phase having a hexagonal structure and has a main composition represented by Ca.sub.1-w-x-yR.sub.wSr.sub.xBa.sub.yFe.sub.zM.sub.mO.sub.19 (R is at least one element of rare earth elements (including Y) essentially including La, and Bi, and M is at least one element of Co, Mn, Mg, Ni, Cu, and Zn essentially including Co), where 0.25<w<0.65, 0.01<x<0.45, 0.0002<y<0.011, y<x, 8<z<11, 1.0<w/m<2.5, and 0.017<m/z<0.065 are satisfied. The total amount of a Si component is 0.1 to 3 mass % based on the amount of the main composition, and respective elements satisfy the relationship of 1.5.ltoreq.[(Ca+R+Sr+Ba)-(Fe+M)/12]/Si.ltoreq.3.5. The invention claimed is: 1. A ferrite magnetic material [**presumptive composition of matter**] having a main phase comprising a ferrite phase having a hexagonal structure, wherein the ferrite magnetic material has a main composition represented by the following formula (1): Ca.sub.1-w-x-yR.sub.wSr.sub.xBa.sub.yFe.sub.zM.sub.mO.sub.19 (1) (where in the formula (1), R is at least one element selected from the group consisting of rare earth elements (including Y) and Bi, and includes at least La, and M is at least one element selected from the group consisting of Co, Mn, Mg, Ni, Cu, and Zn, and includes at least Co), w, x, y, z, and m in the formula (1) satisfying the following formulae (2), (3), (4), (5), (6), (7), (8), and (10): 0.25<w<0.65 (2) 0.05.ltoreq.x<0.2 (3) 0.0002<y<0.011 (4) y<x (5) 8<z<11 (6) 1.0<w/m<2.5 (7) 0.017<m/z<0.065 (8), and 0.05<(1-w-x-y)<0.59 (10), the ferrite magnetic

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			material includes at least a Si component as a sub-component, the total amount of the Si component being 0.1 to 3 mass % based on the amount of the main composition, and the mole ratios of Ca, R, Sr, Ba, Fe, M, and Si satisfy the following formula (9): 1.5.ltoreq.[(Ca+R+Sr+Ba)-(Fe+M)/12]/Si.ltoreq.3.5. (9) 2. A magnet comprising the ferrite magnetic material according to claim 1, the magnet having an arc segment shape, and having a central angle of the shape of 30.degree. or more. 3. The magnet according to claim 2, wherein the central angle is 60.degree. or more
Filed: January 4, 2012 Issued: February 23, 2016 Expires: Jan 2032	9,267,217	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	Production method for R--Fe--B based sintered magnet having plating film on surface thereof **Abstract** An object of the present invention is to provide a production method for an R--Fe--B based sintered magnet having a plating film excellent in adhesiveness on the surface thereof, by conducting a series of processes of acid cleaning and smut removal as pretreatments of an R--Fe--B based sintered magnet, and the subsequent plating treatment effectively without causing trouble. The production method of the present invention includes a series of processes of acid cleaning and smut removal of a magnet as pretreatments, and the subsequent plating treatment is conducted consistently with a state, in which the magnet is placed in a barrel made of synthetic resin. The smut removal is conducted by ultrasonic cleaning of the magnet with rotating the barrel in water in which the dissolved oxygen amount is set to 0.1 ppm to 6 ppm by degassing. The invention claimed is:

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			1. A production method [**presumptive process/method**] for an R--Fe--B based sintered magnet having a plating film on the surface thereof, wherein a series of processes of acid cleaning and smut removal of a magnet as pretreatments of a plating treatment, and the subsequent plating treatment is conducted consistently with a state, in which the magnet is placed in a barrel made of synthetic resin, and wherein the smut removal is conducted by ultrasonic cleaning of the magnet with rotating the barrel in water in which a dissolved oxygen amount is set to 0.1 ppm to 6 ppm by performing a degassing. 2. The production method described in claim 1, wherein an oscillation frequency of ultrasonic wave in the ultrasonic cleaning is set to 20 kHz to 100 kHz. 3. The production method described in claim 1, wherein the pH of a plating bath in the plating treatment is 9 or more.
Filed: Jan 25, 2013 Issued: February 9, 2016 Expires: Jan 2033	9,257,227	Assignee: TOYOTA JIDOSHA KABUSHIKI KAISHA (Aichi, JP)	Method for manufacturing rare-earth magnet **Abstract** Provided is a manufacturing method of a rare-earth magnet with high coercive force, including a first step of pressing-forming powder as a rare-earth magnet material to form a compact S, the powder including a RE-Fe--B main phase MP (RE: at least one type of Nd and Pr) and a RE-X alloy (X: metal element) grain boundary phase surrounding the main phase; and second step of bringing a modifier alloy M into contact with the compact S or a rare-earth magnet precursor C obtained by hot deformation processing of the compact S, followed by heat treatment to penetrant diffuse melt of the modifier alloy M into the compact S or the rare-earth magnet precursor C to manufacture the rare-earth magnet RM, the modifier alloy including a RE-Y (Y: metal element and not including a heavy rare-earth element) alloy having a eutectic or a RE-rich hyper-eutectic composition.

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			What is claimed is: 1. A method for manufacturing [**presumptive process/method**] a rare-earth magnet, comprising the steps of: first step of pressing-forming powder as a rare-earth magnet material to form a compact, the powder including a RE-Fe-B main phase and a RE-X alloy grain boundary phase surrounding the main phase, wherein RE is at least one type of Nd and Pr, and X is a metal element; and second step of bringing a modifier alloy into contact with the compact, followed by heat treatment to penetrant-diffuse melt of the modifier alloy into the compact to manufacture the rare-earth magnet, the modifier alloy including a Nd--Pr--Cu alloy or a Nd--Pr--Al alloy as an alloy having a eutectic composition including Nd and Pr or a Nd, Pr-rich hyper-eutectic composition, and the heat treatment in the second step is performed at a temperature in a range of from 480 to 580.degree. C.
Filed: March 28, 2011 Issued: January 26, 2016 Expires: March 2031	9,245,674	Assignee: Grirem Advanced Materials Co., Ltd. (Beijing, China)	*Rare-earth* permanent magnetic powder, bonded *magnet*, and device comprising the same **Abstract** A *rare-earth* permanent magnetic powder, a bonded *magnet*, and a device comprising the bonded *magnet* are provided. The *rare-earth* permanent magnetic powder is mainly composed of 7-12 at % of Sm, 0.1-1.5 at % of M, 10-15 at % of N, 0.1-1.5 at % of Si, and Fe as the balance, wherein M is at least one element selected from the group of Be, Cr, Al, Ti, Ga, Nb, Zr, Ta, Mo, and V, and the main phase of the *rare-earth* permanent magnetic powder is of TbCu.sub.7 structure. Element Si is added into the *rare-earth* permanent magnetic powder for increasing the ability of SmFe alloy to from amorphous structure, and for increasing the wettability of the alloy liquid together with the addition of element M in a certain content, which enables the alloy liquid prone to be injected out of a melting device. The average diameter of the *rare-earth* permanent magnetic powder is in the range of 10-100 .mu.m, and the

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			rare-earth permanent magnetic powder is composed of nanometer crystals with average grain size of 10-120 nm or amorphous structure. What we claim is: 1. A rare-earth permanent magnetic powder, wherein the rare-earth permanent magnetic powder consists essentially **[presumptive composition of matter]** of 7.about.12 at % 0 of Sm, Fe, M, 0.1.about.1.5 at % Si and 5.about.20 at % of N, Fe is as the balance, M consists essentially of 0.1.about.3 at % of Zr and 0.1.about.1.5 at % of R, wherein R is selected from the group consisting of Be, Cr, Al, Ti, Ga, Nb, Ta, Mo, and V, part of element Sm in the rare-earth permanent magnetic powder is replaced by other rare-earth elements and the other rare-earth accounts for 0.about.10 at %, part of element Fe in the rare-earth permanent magnetic powder is replaced by element Co and Co accounts for 0.about.30 at %, and at least 80 vol % of the rare-earth permanent magnetic powder is TbCu.sub.7 phase, and wherein the atomic ratio of R to Zr is in the range of 0.05.about.0.5.
Filed: September 10, 2010 Issued: January 26, 2016 Expires: September 2030	9,242,296	Assignee: KABUSHIKI KAISHA TOYOTA CHUO KENKYUSHO (Nagakute, Japan)	Rare earth magnet material and method for producing the same **Abstract** A method for producing a rare earth magnet material which allows efficient Dy or the like diffusion into an inside thereof. This method includes a preparation step of preparing a powder mixture of magnet powder including one or more rare earth elements including neodymium, boron, and the remainder being iron; and neodymium fluoride powder; a heating step of heating a compact of the powder mixture and causing oxygen around magnet powder particles to react with the fluoride powder, thereby obtaining a lump rare earth magnet material in which neodymium oxyfluoride is wholly distributed. The fluoride powder traps oxygen enclosed in the powder mixture and fixes the oxygen as

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			stable NdOF. When Dy is diffused into this rare earth magnet material, Dy smoothly enters into its inside without being oxidized at grain boundaries. Consequently, coercivity of the entire rare earth magnet material can be efficiently increased without wasting scarce Dy The invention claimed is: 1. A method for producing a rare earth magnet material, **[presumptive process/method]**:comprising: a preparation step of preparing a powder mixture of: magnet powder being powder of a magnet alloy comprising a first rare earth element (hereinafter referred to as "R1") which is one or more rare earth elements, boron (B), and the remainder being iron (Fe) and inevitable impurities with or without a reforming element; and fluoride powder being powder of a fluoride, at least one of the magnet powder and the fluoride powder containing neodymium (Nd); a heating step of heating a compact of the powder mixture, thereby obtaining a lump rare earth magnet material in which neodymium oxyfluoride which is a reaction product of oxygen or an oxide in the vicinity of particles of the magnet powder and the fluoride is distributed over all parts including not only a surface part but also an inner part thereof; and a diffusing step of diffusing a diffusing element comprising a third rare earth element (hereinafter referred to as "R3") which is one or more rare earth elements, from a surface to the inner part of the rare earth magnet material, wherein the diffusing element is dysprosium (Dy) or terbium (Tb), a ratio of fluoride powder to be mixed in the magnet powder relative to 100 atomic % of the total powder mixture is 0.1 to 10 atomic %, and the preparing step comprises adjusting the amount of the fluoride powder to be mixed in the powder mixture in accordance with an estimated amount of oxygen atoms to be contained in the rare earth magnet material
Filed: January 25,	9,230,733	Assignee: TOYOTA JIDOSHA	Method for manufacturing *rare-earth* magnet

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2013 Issued: January 5, 2016 Expires: January 2033		KABUSHIKI KAISHA (Aichi, Japan)	**Abstract** Provided is a manufacturing method of a *rare-earth* magnet with high coercive force, including a first step of pressing-forming powder as a *rare-earth* magnet material to form a compact S, the powder including a RE-Fe--B main phase MP (RE: at least one type of Nd and Pr) and a RE-X alloy (X: metal element) grain boundary phase surrounding the main phase; and second step of bringing a modifier alloy M into contact with the compact S or a *rare-earth* magnet precursor C obtained by hot deformation processing of the compact S, followed by heat treatment to penetrant diffuse melt of the modifier alloy M into the compact S or the *rare-earth* magnet precursor C to manufacture the *rare-earth* magnet RM, the modifier alloy including a RE-Y (Y: metal element and not including a heavy *rare-earth* element) alloy having a eutectic or a RE-rich hyper-eutectic composition. What is claimed is: 1. A method **[presumptive process/method]**: for manufacturing a ***rare-earth*** magnet, comprising the steps of: first step of pressing-forming powder as a ***rare-earth*** magnet material to form a compact, the powder including a RE-Fe-B main phase and a RE-X alloy grain boundary phase surrounding the main phase, wherein RE is at least one type of Nd and Pr, and X is a metal element; and second step of bringing a modifier alloy into contact with the compact, followed by heat treatment to penetrant-diffuse melt of the modifier alloy into the compact to manufacture the ***rare-earth*** magnet, the modifier alloy including a Nd--Pr--Cu alloy or a Nd--Pr--Al alloy as an alloy having a eutectic composition including Nd and Pr or a Nd, Pr-rich hyper-eutectic composition, and the heat treatment in the second step is performed at a temperature in a range of from 480 to 580.degree. C
Filed: July 1, 2011	9,230,721	Assignee: Korea Institute of	Method for preparing R-Fe-B-based rare earth magnetic powder for a bonded magnet, magnetic powder prepared by the method, method for producing a

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Issued: January 5, 2016 Expires: July 2031		Machinery and Materials (Daejeon, Korea)	bonded magnet using the magnetic powder, and bonded magnet produced by the method **Abstract** A method of preparing R--Fe--B-based rare earth magnetic powder for a bonded magnet and magnetic powder prepared thereby, and a method of manufacturing a bonded magnet using magnetic powder and a bonded magnet manufactured thereby. Further, a method of preparing R--Fe--B-based rare earth magnetic powder having improved magnetic properties including grinding rare earth sintered magnet products as a raw material, performing a hydrogenation process where a ground product is charged into a furnace, and the furnace is then filled with hydrogen and a temperature of the furnace is increased, performing a disproportionation process where the temperature of the furnace is further increased in the same hydrogen atmosphere above, performing a desorption process where hydrogen is exhausted from an inside of the furnace, and performing a recombination process where hydrogen in the inside of the furnace is exhausted, and magnetic powder prepared thereby, and a method of manufacturing a bonded magnet. The invention claimed is: 1. A method of preparing **[presumptive process/method]** R--Fe--B-based rare earth magnetic powder having improved magnetic properties, the method comprising: coarse grinding rare earth sintered magnet products as a raw material; performing a hydrogenation process in which a ground product obtained through the coarse grinding is charged into a tube furnace, and the tube furnace is then filled with hydrogen and a temperature of the tube furnace is increased; performing a disproportionation process in which the temperature of the tube furnace is further increased in the same hydrogen atmosphere as that of the hydrogenation process; performing a desorption process in which hydrogen is exhausted from an inside of the tube furnace; and performing a

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			recombination process in which hydrogen in the inside of the tube furnace is vacuum exhausted after the desorption process is performed, wherein the recombination process is performed after the desorption process and the disproportionation process and desorption process are repeated one time. 2. **The method** as set forth in claim 1, wherein the rare earth sintered magnet products, are process scraps generated during manufacturing processes of rare earth magnets and R--Fe--B-based rare earth sintered magnet products recovered from defective products or wasted products.
Filed: May 24, 2011 Issued: December 29, 2015 Expires: May 2031	9,224,526	Assignee: Utron Kinetics, LLC (Manassas, VA USA)	Magnet construction by combustion driven high compaction **Abstract** A neo magnet is constructed by mixing a neo magnet powder with about 1% added two-part electrical insulating resin powder. The mixed powders are placed in a die and precompacted under about 20 tsi when filling a combustion chamber with a pressurized combustible gas and air mixture. The gas is ignited and rapidly drives a punch in to the die forming a solid magnet having a density of 6.1 g/cm.sup.3 or more. The solid magnet is heat treated to cure the resin and is coated with a polymer, zinc, aluminum or gold. Before precompacting a lubricated core rod in place in the die producing a thin-walled, neo ring magnet having a length to wall thickness aspect ratio. We claim: 1. Composition **[presumptive composition of matter]**, comprising a compact thin walled rare earth magnet made of a composite powder and 1% by weight of epoxy resin precompressed at about 20 tons per square inch and compressed at 150 tons per square inch to a density greater than or equal to 6.1

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			grams/cm.sup.3 and heat treated to a curing temperature of the resin, wherein the composite powder comprises a samarium--cobalt alloy powder, wherein powder comprises about 85-95% by weight 4,4'-Isopropylidenediphenol-epichlorohydrin polymer and about 1-10% by weight cyanoguanidine. 2. The composition of claim 1, wherein the magnet is coated with zinc, nickel or gold plating. 3. The composition of claim 1, wherein the magnet has a ring shape and has a length to wall thickness aspect ratio of about 16.7 or more and a density of about 6.10 g/cm.sup.3 or more
Filed: January 18, 2013 Issued: December 15, 2015 Expires: January 2033	9,212,409	Assignee: Cook Medical Technologies LLC (Bloomington, IN, USA) University of Limerick (Limerick, Ireland)	Mixture of powders for preparing a sintered nickel-titanium-rare earth metal (Ni-Ti-RE) alloy **Abstract** A mixture of powders for preparing a sintered nickel-titanium-rare earth (Ni--Ti--RE) alloy includes Ni--Ti alloy powders comprising from about 55 wt. % Ni to about 61 wt. % Ni and from about 39 wt. % Ti to about 45 wt. % Ti, and RE alloy powders comprising a RE element. The invention claimed is: 1. A mixture of powders **[presumptive composition of matter]**, for preparing a sintered nickel-titanium-rare earth (Ni--Ti--RE) alloy, the mixture comprising: Ni--Ti alloy powders comprising from about 55 wt. % Ni to about 61 wt. % Ni and from about 39 wt. % Ti to about 45 wt. % Ti and comprising a mixture of first and second binary alloy powders of different weight percentages of Ni and Ti; and RE alloy powders comprising a RE element.

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			2. The mixture of claim 1, wherein the first binary alloy powders comprise about 56 wt. % Ni and about 44 wt. % Ti and the second binary alloy powders comprise about 60 wt. % Ni and about 40 wt. % Ti. 3. The mixture of claim 1, wherein a weight ratio of the first binary alloy powders to the second binary alloy powders is from about 70:30 to about 30:70. 4. The mixture of claim 3, wherein a weight ratio of the first binary alloy powders to the second binary alloy powders is about 40:60 to about 50:50. 5. The mixture of claim 1, wherein the RE alloy powders comprise at least one additional element. 6. The mixture of claim 5, wherein the at least one additional element is a dopant element or an additional alloying element selected from the group consisting of: B, Al, Cr, Mn, Fe, Ni, Co, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, TI, Pb, Bi, Po, V, other rare earth elements, and Y. 16. **A method** of forming a sintered nickel-titanium-rare earth (Ni--Ti--RE) alloy, the method including: adding Ni--Ti alloy powders and RE alloy powders to a powder consolidation unit including an electrically conductive die and punch connectable to a power supply, the Ni--Ti alloy powders including from about 55 wt. % Ni to about 61 wt. % Ni and from about 39 wt. % Ti to about 45 wt. % Ti and comprising a mixture of first and second binary alloy powders of different weight percentages of Ni and Ti, the RE alloy powders including a RE element; heating the powders to a sintering temperature of from about 730.degree. C. to about 840.degree. C.; applying a pressure of from about 60 MPa to about 100 MPa to the powders at the sintering temperature; and forming a sintered Ni--Ti--RE alloy.

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			20. The method of claim 16, further including hot working the sintered Ni--Ti--RE alloy at a temperature of at least about 730.degree. C. to form a hot worked Ni--Ti--RE alloy component, and further including cold drawing the hot worked Ni--Ti--RE alloy component to form a Ni--Ti--RE alloy wire having a diameter of about 2 mm or less.
Filed: May 10, 2011 Issued: November 24, 2015 Expires: May 2031	9,196,403	Assignee: SUMITOMO ELECTRIC INDUSTRIES, LTD. (Osaka, Japan)	Powder for magnetic member, powder compact, and magnetic member **Abstract** The present invention provides a powder for a magnetic member being excellent in moldability and difficult to oxidize, a powder compact produced from the powder, and a magnetic member suitable for a raw material of a magnetic member such as a rare earth magnet. A powder for a magnetic member includes magnetic particles 1 which constitute the powder for a magnetic member and each of which is composed of less than 40% by volume of a hydrogen compound 3 of a rare earth element, and the balance composed of an iron-containing material 2 which contains iron and an iron-boron alloy containing iron and boron. The hydrogen compound 3 of a rare earth element is dispersed in a phase of the iron-containing material 2. An antioxidant layer 4 having a low-oxygen permeability coefficient is provided on the surface of each of the magnetic particles. The invention claimed is: 1. A powder **[presumptive composition of matter]**for a magnetic member used for a raw material, the powder comprising: magnetic particles which constitute the powder for a magnetic member, wherein: each of the magnetic particles is composed of less than 40% by volume of a hydrogen compound of a rare earth element, and the balance composed of an iron-containing material, the iron-containing material contains iron and an iron-boron alloy containing

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			iron and boron, the hydrogen compound of a rare earth element is dispersed in a phase of the iron-containing material, an antioxidant layer having an oxygen permeability coefficient (30.degree. C.) of less than 1.0.times.10.sup.-11 m.sup.3m/(sm.sup.2Pa) is provided on the periphery of each of the magnetic particles, the antioxidant layer is composed of a resin, the rare earth element is at least one selected from the group consisting of Nd, Pr, Ce, and Y, a heat-resistant precursor layer is provided on the surface of each of the magnetic particles, and the heat-resistant precursor layer includes a rare earth source material composed of at least one of a compound and an alloy which contains at least one rare earth element of Dy and Tb and does not contain oxygen, and the antioxidant layer which covers at least a portion of the rare earth source material. 7. The powder for a magnetic member according to claim 1, wherein the rare earth source material is at least one selected from the group consisting of hydrides, iodides, fluorides, chlorides, bromides, intermetallic compounds, and alloys thereof. 8. The powder for a magnetic member according to claim 1, wherein the rare earth source material is granular, and particles of the source material are fixed to the surface of each of the magnetic particles through the antioxidant layer
Filed: December 16, 2010 Issued: November 17, 2015 Expires: December	9,190,196	Assignee: TOYOTA JIDOSHA KABUSHIKI KAISHA (Aichi-ken, Japan)	Rare earth magnet and manufacturing method therefor **Abstract** A rare earth magnet of the invention has a composition represented by the compositional formula R.sub.aH.sub.bFe.sub.cCo.sub.dB.sub.eM.sub.f, where: R is at least one rare earth element including Y; H is at least one heavy rare earth element from among Dy and Tb; M is at least one element from among Ga, Zn, Si, Al, Nb, Zr, Ni, Cu, Cr, Hf, Mo, P, C, Mg, and V; 13.ltoreq.a.ltoreq.20; 0.ltoreq.b.ltoreq.4; c=100-a-b-d-e-f; 0.ltoreq.d.ltoreq.30;

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2030			4.ltoreq.e.ltoreq.20; 0.ltoreq.f.ltoreq.3, and has a structure constituted by a main phase: a (RH).sub.2(FeCo).sub.14B phase, and a grain boundary phase: a (RH)(FeCo).sub.4B.sub.4 phase and a RH phase, with a crystal grain size of the main phase of 10 nm to 200 nm. The invention claimed is: 1. A rare earth magnet comprising **[presumptive composition of matter]** : a composition represented by the compositional formula R.sub.aH.sub.bFe.sub.cCo.sub.dB.sub.eM.sub.f, where: a, b, c, d, e and f are atomic percentages; R is at least one rare earth element including Y; H is at least one heavy rare earth element from among Dy and Tb; M is at least one element from among Ga, Zn, Si, Al, Nb, Zr, Ni, Cu, Cr, Hf, Mo,P, C, Mg, and V; 13.ltoreq.a.ltoreq.20; 0.ltoreq.b.ltoreq.4; c=100-a-b-d-e-f; 0.ltoreq.d.ltoreq.30; 4.ltoreq.e.ltoreq.20; 0.ltoreq.f.ltoreq.3, and including a structure constituted by a main phase: a (RH).sub.2(FeCo).sub.14B phase, and a grain boundary phase: a (RH)(FeCo).sub.4B.sub.4 phase and a RH phase, with a crystal grain size of the main phase of 10 nm to 200 nm, wherein when a volume of the grain boundary phase to the earth magnet is within a range of from greater than 0% to less than 15%, a ratio of a volume the (RH)(FeCo).sub.4B.sub.4 phase to a volume of the grain boundary phase is within a range of from greater than 0% to less than 50%, when the volume fraction of the grain boundary phase to the rare earth magnet is 15% to 23%, the ratio of the volume of the (RH)(FeCo).sub.4B.sub.4 phase to the volume of the grain boundary phase is 15% to 80%, and when the volume fraction of the grain boundary phase to the rare earth magnet is more than 23%, the ratio of the volume of the (RH)(FeCo).sub.4B.sub.4 phase to the volume of the grain boundary phase is 30% to 80%. 6. **A method for manufacturing** a rare earth magnet, comprising: rapidly cooling and solidifying an alloy melt including a composition represented by

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			the compositional formula R.sub.aH.sub.bFe.sub.cCo.sub.dB.sub.eM.sub.f, where: a, b, c, d, e and f are atomic percentages; R is at least one rare earth element including Y; H is at least one heavy rare earth element from among Dy and Tb; M is at least one element from among Ga, Zn, Si, Al, Nb, Zr, Ni, Cu, Cr, Hf, Mo, P, C, Mg, and V; 13.ltoreq.a.ltoreq.20; 0.ltoreq.b.ltoreq.4; c=100-a-b-d-e-f; 0.ltoreq.d.ltoreq.30; 4.ltoreq.e.ltoreq.20; 0.ltoreq.f.ltoreq.3, thereby creating a structure constituted by a main phase: a (RH).sub.2(FeCo).sub.14B phase, and a grain boundary phase: a (RH)(FeCo).sub.4B.sub.4 phase and a RH phase, with a crystal grain size of the main phase of 10 nm to 200 nm, wherein when a volume fraction of the grain boundary phase to the rare earth magnet is within a range of from greater than 0% to less than 15%, a ratio of a volume the (RH)(FeCo).sub.4B.sub.4 phase to a volume of the grain boundary phase is within a range of from greater than 0% to less than 50%, when the volume fraction of the grain boundary phase to the rare earth magnet is 15% to 23%, the ratio of the volume the (RH)(FeCo).sub.4B.sub.4 phase to the volume of the grain boundary phase is 15% to 80%, and when the volume fraction of the grain boundary phase to the rare earth magnet is more than 23%, the ratio of the volume the (RH)(FeCo).sub.4B.sub.4 phase to the volume of the grain boundary phase is 30% to 80%
Filed: May 25, 2012 Issued: November 3, 2015 Expires: May 2032	9,177,705	Assignee: TDK CORPORATION (Tokyo, Japan)	Sintered ***rare earth magnet,*** method of producing the same, and rotating machine **Abstract** A sintered ***rare earth magnet*** rotating machine and method improve temperature properties and strength having an excellent corrosion resistance. The sintered ***rare earth magnet*** includes at least a main phase composed of R.sub.2T.sub.14B (R represents at least one ***rare earth*** element of Nd, Pr or both and T represents at least one transition metal element including Fe or Fe and Co) compound and a grain boundary phase containing a higher proportion of R than the main phase, wherein the main phase includes a heavy ***rare earth***

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			element (one of Dy, Tb or both), at least part of main phase grains of the main phase included in the sintered ***rare earth magnet*** includes at least the following regions, low, high and intermediate concentration regions. These regions exist in order of low, high, and intermediate concentration regions, from low concentration region towards the grain boundary phase in the main phase grains. The invention claimed is: 1. A sintered rare earth magnet, comprising : **[presumptive composition of matter]** a main phase composed of R.sub.2T.sub.14B, where: R comprises as a main component one or more rare earth element selected from: Nd, Pr, and Nd and Pr, and T represents one or more transition metal element selected from: Fe, and Fe and Co; and a grain boundary phase containing a higher proportion of R than the main phase; wherein: the main phase includes one or more heavy rare earth element selected from: Dy, Tb, and Dy and Tb; at least a part of main phase grains of the main phase includes at least three regions where the concentration of the heavy rare earth elements differs, the three regions being: a low concentration region where the concentration of the heavy rare earth elements is the lowest in three regions, a high concentration region where the concentration of the heavy rare earth elements is the highest in three regions, and an intermediate concentration region where the concentration of the heavy rare earth elements is higher than the low concentration region and is lower than the high concentration region, the three regions exist in order of the low concentration region, the high concentration region, and the intermediate concentration region, from the low concentration region in the main phase grain toward the grain boundary phase; an area ratio of the high concentration region with respect to the main phase is from 1 to 35%; main phase grains wherein the high concentration region contacts an overall periphery of the low concentration region and the intermediate concentration region contacts an overall periphery of the high concentration region exist at 5% or more in the

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			sintered rare earth magnet, an average concentration value of the heavy rare earth element in the intermediate concentration region is determined as the average concentration value of the heavy rare earth element from the maximum concentration of the heavy rare earth element to the grain boundary phase, and a value of the following formula (A) is in a range of 0.2 to 0.8: (.gamma.-.alpha.)/(.beta.-.alpha.) (A) where: .alpha.=the minimum concentration of the heavy rare earth element in the main phase, .beta.=the maximum concentration of the heavy rare earth element in the main phase, and .gamma.=the average concentration value of the heavy rare earth element in the intermediate concentration region. 5. A sintered rare earth magnet, comprising: a main phase composed of R.sub.2T.sub.14B, where: R comprises as a main component one or more rare earth element selected from: Nd, Pr, and Nd and Pr, and T represents one or more transition metal element selected from: Fe, and Fe and Co; and a grain boundary phase containing a higher proportion of R than the main phase; wherein: the main phase includes one or more heavy rare earth element selected from: Dy, Tb, and Dy and Tb; at least a part of main phase grains of the main phase includes at least three regions where the concentration of the heavy rare earth elements differs, the three regions being: a low concentration region where the concentration of the heavy rare earth elements is the lowest in three regions, a high concentration region where the concentration of the heavy rare earth elements is the highest in three regions, and an intermediate concentration region where the concentration of the heavy rare earth elements is higher than the low concentration region and is lower than the high concentration region, the three regions exist in order of the low concentration region, the high concentration region, and the intermediate concentration region, from the low concentration region in the main phase grain toward the grain boundary phase; an average area ratio of the high concentration region with respect to the main phase is 5% or more; main phase grains wherein the

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			high concentration region contacts an overall periphery of the low concentration region and the intermediate concentration region contacts an overall periphery of the high concentration region exist at 5% or more in the sintered rare earth magnet, an average concentration value of the heavy rare earth element in the intermediate concentration region is determined as the average concentration value of the heavy rare earth element from the maximum concentration of the heavy rare earth element to the grain boundary phase, and a value of the following formula (A) is in a range of 0.2 to 0.8: (.gamma.-.alpha.)/(.beta.-.alpha.) (A) where: .alpha.=the minimum concentration of the heavy rare earth element in the main phase, .beta.=the maximum concentration of the heavy rare earth element in the main phase, and .gamma.=the average concentration value of the heavy rare earth element in the intermediate concentration region.
Filed: September 26, 2008 Issued: November 3, 2015 Expires: September 2028	9,175,376	Assignee: HITACHI METALS, LTD. (Tokyo, Japan)	Method for producing surface-modified rare earth metal-based sintered magnet and surface-modified rare earth metal-based sintered magnet Abstract An objective of the present invention is to provide a rare earth metal-based sintered magnet having imparted thereto sufficient corrosion resistance by an oxidative heat treatment, which is resistant even in an environment of fluctuating humidity, while suppressing the deterioration of the magnetic characteristics ascribed to the oxidative heat treatment, and to provide a method for producing the same. As a means of achieving the objective above, the surface-modified rare earth metal-based sintered magnet of the present invention is characterized in that the surface-modified part comprises a surface-modified layer comprising at least three layers formed in this order from the inner side of the magnet, a main layer containing R, Fe, B, and oxygen, an amorphous layer containing at least R, Fe, and oxygen, and an outermost layer containing iron oxide comprising mainly hematite as the

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			constituent, and the method for producing the same is characterized in that it comprises a step of applying a heat treatment to a bulk magnet body in the temperature range of from 200.degree. C. to 600.degree. C., under an atmosphere with oxygen partial pressure in a range of from 1.times.10.sup.2 Pa to 1.times.10.sup.5 Pa and water vapor partial pressure in a range of from 0.1 Pa to 1000 Pa (exclusive of 1000 Pa). The invention claimed is: 1. A method ***[presumptive process/method]*** for producing a surface-modified rare earth metal-based sintered magnet, the method comprising a step of: applying a heat treatment to a rare earth metal-based sintered magnet in the temperature range of from 200.degree. C. to 600.degree. C., under an atmosphere with oxygen partial pressure in a range of from 1.times.10.sup.2 Pa to 1.times.10.sup.5 Pa and water vapor partial pressure in a range of from 250 Pa to 700 Pa, wherein the surface-modified rare earth metal-based sintered magnet comprises a surface-modified part that comprises a surface-modified layer, said surface-modified layer comprising at least: a main layer containing R, Fe, B, and oxygen, and containing an R-enriched layer with a length in a range of from 0.5 .mu.m to 30 .mu.m and a thickness in a range of from 50 nm to 400 nm, an amorphous layer located outside of the main layer and containing at least R, Fe, and oxygen, and an outermost layer located outside of the amorphous layer and containing iron oxide, wherein the iron oxide is 75 mass % or more hematite. 3. A method for producing a surface-modified rare earth metal-based sintered magnet, the method comprising a step of: applying a heat treatment to a rare earth metal-based sintered magnet in the temperature range of from 200.degree. C. to 600.degree. C., under an atmosphere with oxygen partial pressure in a range of from 1.times.10.sup.2 Pa to 1.times.10.sup.5 Pa and

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			water vapor partial pressure in a range of from 0.1 Pa to 700 Pa wherein the surface-modified rare earth metal-based sintered magnet comprises a surface-modified part that comprises a surface-modified layer, said surface-modified layer comprising at least: a main layer containing R, Fe, B, and oxygen, and containing an R-enriched layer with a length in a range of from 0.5 .mu.m to 30 .mu.m and a thickness in a range of from 50 nm to 400 nm, an amorphous layer located outside of the main layer and containing at least R, Fe, and oxygen, and an outermost layer located outside of the amorphous layer and containing iron oxide, wherein the iron oxide is 75 mass % or more hematite, characterized in that an additional heat treatment is carried out prior to and/or after the heat treatment, in the temperature range of from 200.degree. C. to 600.degree. C. and under an atmosphere with oxygen partial pressure in a range of from 1.times.10.sup.-2 Pa to 50 Pa and water vapor partial pressure in a range of from 1.times.10.sup.-7 Pa to 1.times.10.sup.-2 Pa.
Filed: March 4, 2011 Issued: October 6, 2015 Expires: March 2031	9,154,004	Assignee: TDK CORP. (Tokyo, Japan)	***Rare earth*** sintered ***magnet*** and motor **Abstract** In the ***rare earth*** sintered ***magnet,*** the ratio of R2 to the sum of R1 and R2 that are contained in crystal grain boundaries surrounding the crystal grains in the ***rare earth*** sintered ***magnet*** body is higher than the ratio of R2 to the sum of R1 and R2 in the crystal grains, and the concentration of R2 increases from the central portion of the ***rare earth*** sintered ***magnet*** body toward the surface of the ***rare earth*** sintered ***magnet*** body. In addition, the degree of unevenness in residual magnetic flux density on the surface of the ***rare earth*** sintered ***magnet*** body is smaller than 3.0%. The invention claimed is: 1. A rare earth sintered magnet comprising **[presumptive composition of matter]**, a rare earth sintered magnet body including crystal grains of (R1, R2).sub.2T.sub.14B; wherein: R1 represents at least one rare earth element

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			except for Dy and Tb, R2 represents a rare earth element at least including one or both of Dy and Tb, T represents one or more transition metal elements including Fe or including Fe and Co, a ratio of R2 to a sum of R1 and R2 that is contained in crystal grain boundaries surrounding the crystal grains in the rare earth sintered magnet body is higher than a ratio of R2 to a sum of R1 and R2 in the crystal grains, a concentration of R2 increases from a central portion of the rare earth sintered magnet body toward a surface of the rare earth sintered magnet body; and a degree of unevenness in residual magnetic flux density among a plurality of areas on the surface of the rare earth sintered magnet body is smaller than 3.0%. 4. A rare earth sintered magnet obtained by **[presumptive process or method]** : rotating a rare earth sintered magnet body including crystal grains of (R1, R2).sub.2T.sub.14B, applying a slurry containing a compound of the rare earth element R2 to the rare earth sintered magnet body, drying the slurry while the rare earth sintered magnet body is rotated, and subjecting the rare earth sintered magnet body including the dried slurry to heat treatment, wherein: R1 represents at least one rare earth element except for Dy and Tb, R2 represents a rare earth element at least including one or both of Dy and Tb, T represents one or more transition metal elements including Fe or including Fe and Co, a ratio of R2 to a sum of R1 and R2 that is contained in crystal grain boundaries surrounding the crystal grains in the rare earth sintered magnet body is higher than a ratio of R2 to a sum of R1 and R2 in the crystal grains, a concentration of R2 increases from a central portion of the rare earth sintered magnet body toward a surface of the rare earth sintered magnet body; and a degree of unevenness in residual magnetic flux density among a plurality of areas on the surface of the rare earth sintered magnet body is smaller than 3.0%
Filed: Aug 13, 2012 Issued:	9,129,731	Assignee: Hitachi, Ltd. (Tokyo, Japan)	Sintered magnet **Abstract**

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September 8, 2015 Expires: August 2032			Disclosed is a sintered magnet which is a rare-earth magnet using a less amount of a rare-earth element but having a higher maximum energy product and a higher coercivity. The sintered magnet includes a NdFeB crystal; and an FeCo crystal adjacent to the NdFeB crystal through the medium of a grain boundary. The FeCo crystal includes a core and a periphery and has a cobalt concentration decreasing from the core to the periphery. The FeCo crystal has a difference in cobalt concentration of 2 atomic percent or more between the core and the periphery. In the NdFeB crystal, cobalt and a heavy rare-earth element are unevenly distributed and enriched in the vicinity of the grain boundary. What is claimed is: 1. A sintered magnet comprising **[presumptive composition of matter],** : a NdFeB crystal; an FeCo crystal; and a grain boundary region disposed between the NdFeB crystal and the FeCo crystal, wherein the FeCo crystal has a cobalt concentration decreasing from a center to an interface by 2 atomic percent or more, and wherein the NdFeB crystal contains cobalt and a heavy rare-earth element, and has concentrations of the cobalt and the heavy rare-earth element increasing from a center to an interface. 2. The sintered magnet according to claim 1, wherein the FeCo crystal includes a body-centered cubic structure or a body-centered tetragonal structure. 3. The sintered magnet according to claim 1, wherein the FeCo crystal has a saturation flux density higher than the saturation flux density of the NdFeB crystal. 4. The sintered magnet according to claim 1, wherein the grain boundary region has a width of 0.1 to 2 nm.

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			5. The sintered magnet according to claim 1, wherein the grain boundary region includes an acid fluoride. 8. The sintered magnet according to claim 1, being prepared through **[presumptive process/method]** quenching in a magnetic field at a cooling rate of 10.degree. C./second or more in a heat treatment process upon sintering.
Filed: May 14, 2015 Issued: Sept 8, 2015 Expires: May 2035	9,129,730	Assignee: SUMITOMO ELECTRIC INDUSTRIES, LTD. (Osaka, Japan)	Rare-earth-iron-based alloy material **Abstract** Provided are a powder for a magnet, which provides a rare-earth magnet having excellent magnet properties and which has excellent formability, a method for producing the powder for a magnet, a powder compact, a rare-earth-iron-based alloy material, and a rare-earth-iron-nitrogen-based alloy material which are used as materials for the magnet, and methods for producing the powder compact and these alloy materials. The invention claimed is: 1. A rare-earth-iron-based alloy material for a rare-earth magnet, the rare-earth-iron-based alloy material comprising **[presumptive composition of matter]**, a powder compact comprising: magnetic particles each containing a hydride of a rare-earth element in an amount of less than 40% by volume and the balance being Fe; a phase of the hydride of the rare-earth element is adjacent to a phase consisting of pure Fe, and an interval between adjacent phases of the hydride of the rare-earth element with the phase of Fe provided therebetween is 3 .mu.m or less, wherein: the phase of the hydride of the rare-earth element is granular, the granular hydride of the rare-earth element is dispersed in the phase of Fe, the rare-earth element is Sm, and the hydride of the rare-earth element consisting of Sm and hydrogen, an antioxidation layer is

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			provided on the surface of each of the magnetic particles, the antioxidation layer including a low-oxygen-permeability layer composed of a material having an oxygen permeability coefficient at 30.degree. C. of less than 1.0.times.10.sup.-11 m.sup.3m/(sm.sup.2Pa) and a low-moisture-permeability layer composed of a material having a moisture permeability coefficient at 30.degree. C. of less than 1000.times.10.sup.-13 kg/(msMPa), the low-oxygen-permeability layer is polyester or polyvinyl chloride, the powder compact has a relative density of 85% or more, and the rare-earth-iron-based alloy material is produced by **[presumptive process/method]** heat-treating the powder compact in an inert atmosphere or in a reduced atmosphere. 2. The rare-earth-iron-based alloy material according to claim 1, wherein a rate of volume change between the heat-treated powder compact before the heat treatment and the rare-earth-iron-based alloy material after the heat treatment is 5% or less. 3. The rare-earth-iron-based alloy material according to claim 1, wherein the inert atmosphere comprises a nitrogen element-containing atmosphere. 4. The rare-earth-iron-nitrogen-based alloy material according to claim 3, wherein the rare-earth-iron-nitrogen-based alloy material comprises an Sm--Fe--Ti--N alloy. 5. The rare-earth-iron-nitrogen-based alloy material according to claim 3, wherein a rate of volume change between the rare-earth-iron-based alloy material before the heat treatment and the rare-earth-iron-nitrogen-based alloy material after the heat treatment is 5% or less.
Filed: April 21, 2014	9,111,674	Assignee: TDK CORPORATION (Tokyo, Japan)	R-T-B based permanent magnet **Abstract**

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Issued: August 18, 2015 Expires: August 2034			The present invention provides a permanent magnet whose magnetic properties will not be significantly decreased and which is excellent in the temperature properties compared to the existing R-T-B based permanent magnet. In the R-T-B based structure, a stack structure of R1-T-B based crystallizing layer and (Y,Ce)-T-B based crystallizing layer can be formed by alternatively stacking R1-T-B and (Y,Ce)-T-B. In this way, a high magnetic anisotropy field of the R1-T-B based crystallizing layer can be maintained while an improved temperature coefficient of the (Y,Ce)-T-B based crystallizing layer can be obtained. Further, a high coercivity can be obtained by adding the Ce-T-B based crystallizing layer with a low lattice distortion to the Y-T-B based crystallizing layer. What is claimed is: 1. A R-T-B based permanent magnet, comprising **[presumptive composition of matter]:** a R-T-B based structure in which a R1-T-B based crystallizing layer and a (Y,Ce)-T-B based crystallizing layer are stacked, wherein: R1 is at least one rare earth element except Y and Ce, and T is at least one transition metal element including Fe or a combination of Fe and Co. 2. The R-T-B based permanent magnet according to claim 1, wherein an atomic ratio of R1 to (Y+Ce) is 0.1 or more and 10 or less. 3. The R-T-B based permanent magnet according to claim 1, wherein the R1-T-B based crystallizing layer has a thickness of 0.6 nm or more and 300 nm or less, and the (Y,Ce)-T-B based crystallizing layer has a thickness of 0.6 nm or more and 200 nm or less.
Filed: May 19, 2011	9,087,631	Assignee: KABUSHIKI KAISHA TOSHIBA	Permanent magnet and method of manufacturing the same, and motor and power generator using the same

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Issued: July 21, 2015 Expires: 2031		(Tokyo, Japan)	**Abstract** In an embodiment, a permanent magnet includes a composition represented by R(Fe.sub.p(Ti.sub.sM.sub.1-s).sub.qCu.sub.r(Co.sub.1-tA.sub.t).sub.1-p- -q-r).sub.z (R is at least one element selected from rare earth elements, M is at least one element selected from Zr and Hf, A is at least one element selected from Ni, V, Cr, Mn, Al, Ga, Nb, Ta and W, and p, q, r, s, t and z are numbers satisfying 0.3.ltoreq.p.ltoreq.0.6, 0.01.ltoreq.q.ltoreq.0.1, 0.01.ltoreq.r.ltoreq.0.15, 0.2.ltoreq.s.ltoreq.0.8, 0.ltoreq.t.ltoreq.0.2, 6.ltoreq.z.ltoreq.9 in an atomic ratio, respectively), and a structure composed mainly of a Th.sub.2Zn.sub.17 crystal phase and a CaCu.sub.5 crystal phase What is claimed is: 1. A permanent magnet, comprising **[presumptive composition of matter]**: a composition represented by a composition formula: R(Fe.sub.p(Ti.sub.sM.sub.1-s).sub.qCu.sub.r(Co.sub.1-tA.sub.t).sub.1-p-q--r).sub.z where, R is at least one element selected from rare earth elements, M is at least one element selected from Zr and Hf, A is at least one element selected from Ni, V, Cr, Mn, Al, Ga, Nb, Ta and W, p is a number (atomic ratio) satisfying 0.3.ltoreq.p.ltoreq.0.6, q is a number (atomic ratio) satisfying 0.01.ltoreq.q.ltoreq.0.1, r is a number (atomic ratio) satisfying 0.01.ltoreq.r.ltoreq.0.15, s is a number (atomic ratio) satisfying 0.2.ltoreq.s.ltoreq.0.5, t is a number (atomic ratio) satisfying 0.ltoreq.t.ltoreq.0.2, z is a number (atomic ratio) satisfying 6.ltoreq.z.ltoreq.9; and a structure composed mainly of a Th.sub.2Zn.sub.17 crystal phase and a CaCu.sub.5 crystal phase, wherein a ratio (c/a) of a lattice constant c in relation to a lattice constant a in a crystal structure of the permanent magnet is equal to or more than 0.839, where a crystal face perpendicular to a direction of an easy magnetization axis is a face a, one of crystal faces parallel to the direction of the easy magnetization axis is a face b, an x-ray main diffraction angle of the

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			face a is 2.theta..sub.1, an x-ray main diffraction angle of the face b is 2 .theta..sub.2, the lattice constant a is defined by 4/3.sup.1/2 .times.d1, the lattice constant c is defined by 2.times.d.sub.2, d.sub.1 [unit: angstrom] is .lamda./(2 sin(2.theta..sub.1/2), d2 [unit: angstrom] is .lamda./(2 sin(2.theta..sub.2/2), and .lamda. is 1.5418 angstrom. 2. The permanent magnet according to claim 1, wherein the element R is at least one selected from samarium (Sm), neodymium (Nd), and praseodymium (Pr). 3. The permanent magnet according to claim 2, wherein 50 atomic % or more of the element R is samarium (Sm). 4. The permanent magnet according to claim 3, wherein 80 atomic % or more of the element M is zirconium (Zr). 9. A method of manufacturing a permanent magnet, comprising: fabricating an alloy powder having a composition represented by a composition formula: R(Fe.sub.p(Ti.sub.sM .sub.1-s).sub.qCu.sub.r(Co.sub.1-tA.sub.t).sub.1-p-q-r).sub.z where, R is at least one element selected from rare earth elements, M is at least one element selected from Zr and Hf, A is at least one element selected from Ni, V, Cr, Mn, Al, Ga, Nb, Ta and W, p is a number (atomic ratio) satisfying 0.3.ltoreq.p.ltoreq.0.6, q is a number (atomic ratio) satisfying 0.01.ltoreq.q.ltoreq.0.1, r is a number (atomic ratio) satisfying 0.01.ltoreq.r.ltoreq.0.15, s is a number (atomic ratio) satisfying 0.2.ltoreq.s.ltoreq.0.5, t is a number (atomic ratio) satisfying 0.ltoreq.t.ltoreq.0.2, z is a number (atomic ratio) satisfying 6.ltoreq.z.ltoreq.9; fabricating a pressed powder body by forming the alloy powder in a magnetic field; fabricating a sintered body by sintering the pressed powder body; performing a solution heat treatment to the sintered body at a temperature of from 1130 to 1230.degree. C.; performing an aging heat treatment to the sintered body after the solution heat treatment at a temperature of from 700 to

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			900.degree. C. in a vacuum atmosphere; and cooling slowly the sintered body after the aging heat treatment at a cooling speed in a range of 0.5 to 5.degree. C./min, to obtain the permanent magnet including a structure composed mainly of a Th.sub.2Zn.sub.17 crystal phase and a CaCu.sub.5 crystal phase, wherein a ratio (c/a) of a lattice constant c in relation to a lattice constant a in a crystal structure of the permanent magnet is equal to or more than 0.839, where a crystal face perpendicular to a direction of an easy magnetization axis is a face a, one of crystal faces parallel to the direction of the easy magnetization axis is a face b, an x-ray main diffraction angle of the face a is 2.theta..sub.1, an x-ray main diffraction angle of the face b is 2.theta..sub.2, the lattice constant a is defined by 4/3.sup.1/2 .times.d1, the lattice constant c is defined by 2 .times.d.sub.2, d.sub.1 [unit: angstrom] is .lamda./(2sin(2.theta..sub.1/2), d2 [unit: angstrom] is .lamda./(2sin(2.theta..sub.2/2), and .lamda.is 1.5418 angstrom. 10. The manufacturing method **[presumptive process/method]** according to claim 9, wherein the fabricating the alloy powder comprises: fabricating a thin ribbon solidified to have a thickness of equal to or less than 1 mm continuously by injecting an alloy molten metal to a chill roll rotating at a peripheral speed of 0.1 to 20 m/sec; and grinding the thin ribbon.
Filed: Dec 1, 2008 Issued: July 14, 2015 Expires: Dec 2028	9,082,538	Assignee: ZHEJIANG UNIVERSITY (Hangzhou, China) ZHEJIANG INNUOVO MAGNETICS INDUSTRY CO., LTD (Dongyang, China)	Sintered Nd--Fe--B permanent magnet with high coercivity for high temperature applications **Abstract** A type of sintered Nd--Fe--B permanent magnet with high intrinsic coercivity of about 30KOe or more is produced by dual alloy method. The method comprises the following steps: preparing the powders of master phase alloy and intergranular phase alloy respectively, mixing the powders, compacting the powders in magnetic field, sintering the compacted body at 1050.about.1125.degree. C. and annealing at 890-1000.degree. C. and 500-

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			650.degree. C. successively. In the process of preparing the powder of intergranular phase alloy, the nano-powder additive selected from the group consisting of NiAl, TiC, SiC, AlN, TiN, ZrN and the combination thereof is used to modify the powder of intergranular phase alloy. We claim that: 1. A sintered Nd--Fe--B permanent magnet, comprising **[presumptive composition of matter]**: (A) 90.about.95 wt % of a master-phase alloy powder, by weight of the permanent magnet, wherein the master-phase alloy powder comprises 11.about.16% of Nd, 5.4.about.6.6% of B, 0.about.6% of M and a balance of Fe by atomic percent, wherein M is at least one selected from the group consisting of Dy, Tb, Nb, Co, Ga, Zr, and Al; and (B) 5.about.10 wt % of an intergranular-phase alloy powder, by weight of the permanent magnet, wherein the intergranular-phase alloy powder is modified by a nano-powder additive before being sintered to form the sintered Nd--Fe--B permanent magnet, the nano-powder additive is at least one selected from the group consisting of NiAl, TiC, SiC, AlN, TiN, and ZrN, the intergranular-phase alloy powder before being modified comprises 13.5.about.30% of Nd, 4.about.7% of B, 0.about.15% of R and a balance of Fe by atomic percent, where R is at least one selected from the group consisting of Dy, Tb, Nb, Co, Ga, Zr, Cu, Al, and Si, the sintered Nd--Fe--B permanent magnet is obtained by a two-alloy method, the intergranular-phase alloy powder is modified by an amount of the nano-powder additive sufficient so that the sintered Nd--Fe--B permanent magnet has an intrinsic coercivity of about 30KOe or more, and the amount of the nano-powder additive is 0.01.about.1% by weight of the intergranular-phase alloy powder. 2. The magnet of claim 1, wherein the nano-powder additive has an average particle size of 1.about.60 nm.

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			3. The magnet of claim 1, wherein the magnet is obtained by **[presumptive process/method**]: preparing the master-phase alloy powder with a particle size of 3-8 .mu.m; preparing the intergranular-phase alloy powder with a particle size of 1-4 .mu.m, and modifying with a predetermined amount of the nano-powder additive; mixing the master-phase alloy powder and the intergranular-phase alloy powder that is modified by the nano-powder additive to form a well-proportioned mixture; compacting said well-proportioned mixture in a magnetic field of 1.2-2.0 T to form a compacted body, sintering the compacted body at a temperature of 1050-1125.degree. C. in a high vacuum sintering furnace of 10.sup.-3-10.sup.-4 pa to form a sintered body; heating the sintered body at a temperature of 890-1000.degree. C. for 2-4 hours followed by slowly cooling at a cooling rate of 1-4.degree. C./min to room temperature; and heating the cooled sintered body at a temperature of 500-650.degree. C. for 2-4 hours followed by rapidly cooling at a cooling rate of 100-400.degree. C./min, to form the Nd--Fe--B permanent magnet. 4. The magnet of claim 1, wherein the magnet includes main phase grains that are substantially spherical with an average size of about 5 .mu.m to about 6 .mu.m.
Filed: April 25, 2014 Issued: July 14, 2015 Expires: April 2034	9,082,537	Assignee: TDK CORPORATION (Tokyo, Japan)	R-T-B based permanent magnet **Abstract** The present invention provides a permanent magnet which is excellent in the temperature properties and the magnetic properties of which will not be significantly decreased, compared to the conventional R-T-B based permanent magnet. In the R-T-B based structure, a stacked structure of R1-T-B based crystal layer and Y-T-B based crystal layer can be formed by alternatively stacking R1-T-B and Y-T-B. In this way, a high magnetic anisotropy field of the R1-T-B based crystal layer can be maintained while the temperature coefficient of the Y-T-B based crystal layer can be improved.

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			What is claimed is: 1. A R-T-B based permanent magnet, comprising **[presumptive composition of matter]** a R-T-B based structure in which a R1-T-B based crystal layer and a Y-T-B based crystal layer are stacked, wherein R1 represents at least one rare earth element except Y, and T represents at least one transition metal element comprising Fe or a combination of Fe and Co. 2. The R-T-B based permanent magnet according to claim 1, wherein an atomic ratio of R1 to Y is 0.1 or more and 10 or less. 4. The R-T-B based permanent magnet according to claim 2, wherein said R1-T-B based crystal layer has a thickness of 0.6 nm or more and 300 nm or less, and said Y-T-B based crystal layer has a thickness of 0.6 nm or more and 200 nm or less. 5. A R-T-B based film permanent magnet, comprising a R-T-B based structure in which a R1-T-B based crystal layer and Y-T-B based crystal layer are stacked, wherein R1 represents at least one rare earth element except Y, and T represents at least one transition metal element comprising Fe or a combination of Fe and Co. 6. The R-T-B based film permanent magnet according to claim 5, wherein an atomic ratio of R to Y is 0.1 or more and 10 or less. 9. A R-T-B based permanent magnet powder, comprising a R-T-B based structure in which a R1-T-B based crystal layer and a Y-T-B based crystal layer are stacked, wherein R1 represents at least one rare earth element except Y, and T represents at least one transition metal element comprising Fe or a combination of Fe and Co.
Filed: Dec	9,076,584	Assignee:	Powder for magnet

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2, 2010 Issued: July 7, 2015 Expires: Dec 2030		SUMITOMO ELECTRIC INDUSTRIES, LTD. (Osaka, Japan)	**Abstract** Provided are a powder for a magnet, which provides a rare-earth magnet having excellent magnet properties and which has excellent formability, a method for producing the powder for a magnet, a powder compact, a rare-earth-iron-based alloy material, and a rare-earth-iron-nitrogen-based alloy material which are used as materials for the magnet, and methods for producing the powder compact and these alloy materials. Magnetic particles 1 constituting the powder for a magnet each have a texture in which grains of a phase 3 of a hydride of a rare-earth element are dispersed in a phase 2 of an iron-containing material, such as Fe. The uniform presence of the phase 2 of the iron-containing material in each magnetic particle 1 results in the powder having excellent formability, thereby providing a powder compact 4 having a high relative density. The powder for a magnet is produced by heat-treating a rare-earth-iron-based alloy powder in a hydrogen atmosphere to separate the rare-earth element and the iron-containing material from each other and then forming a hydride of the rare-earth element. The powder for a magnet is subjected to compacting to form the powder compact 4. The powder compact 4 is subjected to heat treatment in vacuum to form a rare-earth-iron-based alloy material 5. The rare-earth-iron-based alloy material 5 is subjected to heat treatment in a nitrogen atmosphere to form a rare-earth-iron-nitrogen-based alloy material 6. The invention claimed is: 1. A powder compact used as a material for a rare-earth magnet comprising **[presumptive composition of matter]:** a powder comprising: magnetic particles each containing a hydride of a rare-earth element in an amount of less than 40% by volume and the balance being Fe; a phase of the hydride of the rare-earth element is adjacent to a phase consisting of pure Fe, and an interval

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			between adjacent phases of the hydride of the rare-earth element with the phase of Fe provided therebetween is 3 .mu.m or less, wherein: the phase of the hydride of the rare-earth element is granular, the granular hydride of the rare-earth element is dispersed in the phase of Fe, the rare-earth element is Sm, and the hydride of the rare-earth element consisting of Sm and hydrogen, an antioxidation layer is provided on the surface of each of the magnetic particles, the antioxidation layer including a low-oxygen-permeability layer composed of a material having an oxygen permeability coefficient at 30.degree. C. of less than 1.0.times.10.sup.-11 m.sup.3m/(sm.sup.2Pa) and a low-moisture-permeability layer composed of a material having a moisture permeability coefficient at 30.degree. C. of less than 1000.times.10.sup.-13 kg/(msMPa), the low-oxygen-permeability layer is polyester or polyvinyl chloride, and the powder compact has a relative density of 85% or more. 2. The powder compact used as a material for a rare-earth magnet according to claim 1, wherein the magnetic particles have an average particle size of 10 .mu.m to 500 .mu.m. 3. The powder compact used as a material for a rare-earth magnet according to claim 1, wherein the powder compact has a relative density of 90% or more. 4. The powder compact used as a material for a rare-earth magnet according to claim 1, wherein the low-moisture-permeability layer is polyethylene or polypropylene.
Filed: November 15, 2011 Issued: July 7, 2015	9,076,579	Assignee: The Board of Trustees of the University of Alabama for and on the behalf of the University of Alabama (Huntsville, AL, USA)	Magnetic exchange coupled core-shell nanomagnets **Abstract** A permanent magnet is fabricated such that it has a magnetically hard core surrounded by a thin magnetically soft shell. The magnetically hard core provides a relatively high intrinsic coercivity (H.sub.ci), and the magnetically soft shell provides a relatively high magnetic flux density (B). Due to magnetic

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Expires: Nov 2031			exchange coupling between the core and shell, a relatively high maximum energy product (BH).sub.max is achievable over a wide temperature range, including temperatures above 150.degree. C. Further, such effects can be achieved without using ***rare-earth*** metals or precious metals helping to keep the manufacturing costs of the magnet low. To allow sufficient exchange magnetic coupling between the core and shell, the width of the shell is less than about 40 nanometers, and the overall dimensions are controlled such that the width of the shell is less than two times the Bloch domain wall thickness of the core. Claims Now, therefore, the following is claimed: 1. A core-shell nanomagnetic particle, comprising ***[presumptive composition of matter]*** : a core of hard magnetic material; and a shell of soft magnetic material encasing the core, wherein a thickness of the shell is less than 40 nanometers and less than two times a Bloch domain thickness of the core, and wherein the core does not include rare-earth elements. 2. The core-shell nanomagnet particle of claim 1, wherein the shell has a uniform thickness around the core.
Filed: April 21, 2014 Issued: June 30, 2015 Expires:	9,070,500	Assignee: TDK CORPORATION (Tokyo, Japan)	R-T-B based permanent ***magnet*** **Abstract** The present invention provides a permanent ***magnet*** whose magnetic properties will not be significantly decreased and which is excellent in the temperature properties compared to the existing R-T-B based permanent ***magnet***. In the R-T-B based structure, a stacked structure of R1-T-B based crystallizing layer and (Y, La)-T-B based crystallizing layer can be formed by alternatively stacking R1-T-B and (Y, La)-T-B. In this way, a high magnetic

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April 2034			anisotropy field of the R1-T-B based crystallizing layer can be maintained while an improved temperature coefficient of the (Y, La)-T-B based crystallizing layer can be obtained. Further, the lattice distortion in the total stacked structure is moderated by setting the ***rare earth*** elements in the (Y, La)-T-B based crystallizing layer as both of Y and La, and a high residual flux density can be obtained accordingly. What is claimed is: 1. A R-T-B based permanent ***magnet,*** comprising ***[presumptive composition of matter],*** : a R-T-B based structure in which a R1-T-B based crystallizing layer and a (Y, La)-T-B based crystallizing layer are stacked, wherein R1 is at least one ***rare earth*** element except Y and La, and T is one or more transition metal element comprising Fe or the combination of Fe and Co. 2. The R-T-B based permanent ***magnet*** according to claim 1, wherein an atomic ratio of R1 to Y and La is 0.1 or more and 10 or less. 16. A bond magnet comprising the R-T-B based permanent magnet powder of claim 12. 17. A sintered magnet comprising the R-T-B based permanent magnet powder of claim 9.
Filed: March 28, 2011 Issued: June 9, 2015	9,053,846	Assignee: NITTO DENKO CORPORATION (Osaka, Japan)	Permanent ***magnet*** and manufacturing method thereof **Abstract** There are provided a permanent ***magnet*** and a manufacturing method thereof enabling carbon content contained in ***magnet*** particles to be reduced in advance before sintering even when wet milling is employed. Coarsely-milled ***magnet*** powder is further milled by a bead mill in a solvent together with an

Expires: March 2031			organometallic compound expressed with a structural formula of M-(OR).sub.x (M includes at least one of neodymium, praseodymium, dysprosium and terbium, each being a ***rare earth*** element, R represents a substituent group consisting of a straight-chain or branched-chain hydrocarbon, x represents an arbitrary integer) so as to uniformly adhere the organometallic compound to particle surfaces of the ***magnet*** powder. Thereafter, a compact body of compacted ***magnet*** powder is held for several hours in hydrogen atmosphere at 200 through 900 degrees Celsius to perform hydrogen calcination process. Thereafter, through sintering process, a permanent ***magnet*** 1 is manufactured. The invention claimed is: 1. A **manufacturing method** of a permanent magnet comprising steps of wet-milling magnet material in an organic solvent to obtain magnet powder; adding, to the organic solvent during the wet-milling, an organometallic compound expressed with a structural formula of M-(OR).sub.x, M including at least one of neodymium, praseodymium, dysprosium and terbium, each being a rare earth element, R representing a substituent group consisting of a straight-chain or branched-chain hydrocarbon, and x representing an arbitrary integer, to make the organometallic compound adhered to particle surfaces of the magnet powder in the organic solvent to obtain a slurry-state magnet powder; injecting the slurry-state magnet powder containing the organic solvent used in the wet-milling into a cavity without drying the slurry-state magnet powder, while applying an initial magnetic field to the cavity, and further applying a magnetic field stronger than the initial magnetic field to the cavity during or after the injection so as to perform wet molding and obtain a compact body in which the organometallic compound is adhered to the particle surfaces of the magnet powder; calcining the compact body in hydrogen atmosphere so as to obtain a calcined body of which carbon residue is reduced in comparison with before calcining the compact body, wherein the step of

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			calcining causes thermal decomposition of the organometallic compound and removes R so as to reduce carbon residue; and sintering the calcined body. 2. The manufacturing method of a permanent magnet according to claim 1, wherein R in the structural formula is an alkyl group. 3. The manufacturing method of a permanent magnet according to claim 2, wherein R in the structural formula is an alkyl group of which carbon number is any one of integer numbers 2 through 6.
Filed: July 14, 2012 Issued: June 2, 2015 Expires: July 2032	9,048,016	Assignee: DONGGUAN XUANYAO ELECTRONICS CO., LTD. (Dongguan, Guangdong Province, China)	Composite permanent magnetic material and preparation method thereof **Abstract** The invention relates to the field of permanent ***magnet*** materials, and discloses a composite permanent ***magnet*** material. The material is formed by splicing at least one permanent ***magnet*** material, with binding agent in between. The novel composite permanent ***magnet*** material that is formed by splicing different magnets greatly enriches the existing permanent ***magnet*** system and can completely replace the expensive rare metallic magnetic material. The composite permanent ***magnet*** material disclosed by the invention has high performances. The magnetic performance of the ***magnet*** can be regulated and controlled by adjusting the type and length of the magnets. In particular, the magnetic blank between the bonded NdFeB and the sintered NdFeB provides the designer and user of permanent magnetic motors with broader and flexible in material selection space and cost selection space What is claimed is:

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			1. A composite permanent magnetic material, characterized in that, the composite permanent magnetic material is made ***[presumptive process/method]*** by splicing at least two permanent magnets, with a binding agent in between, wherein the permanent magnets are one or more of: sintered NdFeB, isotropic bonded NdFeB, and anisotropic bonded NdFeB; wherein the binding agent is a polyurethanes binding agent or a two-component modified acrylic ester curing agent or an epoxy binding agent or an anaerobic binding agent; wherein the composite permanent magnetic material is made by arranging the permanent magnets as per requirements of the target ***magnet*** and splicing with the binding agent; wherein the permanent magnets are spaced according to odd numbers or even numbers; wherein according to odd numbers, the total amount of two magnets is M=2*N+1 (N.gtoreq.1) and two magnets of different materials are spaced into an integrated ***magnet***; and wherein according to even numbers, the total amount of two magnets is M=2*N (N.gtoreq.1) and magnets of the same material are arranged in one group while magnets of different materials are spaced
Filed: June 17, 2014 Issued: June 2, 2015 Expires: June 2034	9,044,834	Assignee: Urban Mining Technology Company (Perryville, MD, USA)	Magnet recycling to create Nd--Fe--B magnets with improved or restored magnetic performance **Abstract** Methods, systems, and apparatus, including computer programs encoded on computer storage media, for recycling magnetic material to restore or improve the magnetic performance. One of the methods includes demagnetizing magnetic material from a waste magnet assembly by cyclic heating and cooling of the magnetic material, fragmenting adhesives attached to the magnetic material, cracking coating layers of the magnetic material, and subjecting the magnetic material to at least one of: a) a mechanical treatment or b) a chemical treatment, to remove the coating layers and prepare the magnetic material

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			without impurities, fragmenting the demagnetized magnetic material to form a powder, and mixing the powder with a rare earth material R and an elemental additive A to produce a homogeneous powder, wherein the rare earth material R comprises at least one of: Nd or Pr, and the elemental additive A comprises at least one of: Nd, Pr, Dy, Co, Cu, and Fe. **What is claimed is:** 1. A method for manufacturing ***[presumptive process/method]:*** a recycled Nd--Fe--B permanent magnet comprising: demagnetizing magnetic material from a waste magnet assembly by cyclic heating and cooling of the magnetic material, fragmenting adhesives attached to the magnetic material, cracking coating layers of the magnetic material, and subjecting the magnetic material to at least one of: a) a mechanical treatment or b) a chemical treatment, to remove the coating layers and prepare the magnetic material without impurities; fragmenting the demagnetized magnetic material to form a powder; mixing the powder with a) a rare earth material R that comprises between 0.1 to 1 at. % of the total mixture and b) an elemental additive A to produce a homogeneous powder, wherein the rare earth material R comprises at least one of: i) Nd or ii) Pr with a ratio of 75 wt. % Nd to 25 wt. % Pr, and the elemental additive A comprises at least one of: i) Dy, ii) Co, iii) Cu, iv) Fe; and sintering and magnetizing the homogenous powder to form a recycled Nd--Fe--B magnetic product that comprises 1.98 at. % oxygen or less and has a remanence and a coercivity at least the same as a waste magnet part from the waste magnet assembly.
Filed: June 29, 2010 Issued: June 2,	9,044,810	Assignee: SHIN-ETSU CHEMICAL CO., LTD. (Tokyo, Japan)	***Rare earth magnet*** and its preparation **Abstract** A ***rare earth magnet*** is prepared by disposing a R.sup.1-T-B sintered body comprising a R.sup.1.sub.2T.sub.14B compound as a major phase in contact

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2015 Expires: June 2030			with an R.sup.2-M alloy powder and effecting heat treatment for causing R.sup.2 element to diffuse into the sintered body. The alloy powder is obtained by quenching a melt containing R.sup.2 and M. R.sup.1 and R.sup.2 are ***rare earth*** elements, T is Fe and/or Co, M is selected from B, C, P, Al, Si, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pt, Au, Pb, and Bi. The invention claimed is: 1. A method for preparing a ***rare earth magnet*** comprising: providing a R.sup.1-T-B sintered body comprising a R.sup.1.sub.2T.sub.14B compound as a major phase wherein R.sup.1 is one or more element selected from ***rare earth*** elements including Sc and Y and T is Fe and/or Co, providing an alloy powder consisting of R.sup.2 and M wherein R.sup.2 is one or more element selected from ***rare earth*** elements including Sc and Y and M is one or more element selected from the group consisting of B, C, P, Al, Si, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pt, Au, Pb, and Bi, wherein the alloy powder is a quenched alloy powder obtained by quenching a melt consisting of the R.sup.2 and the M, and the quenched alloy powder consisting of an amorphous structure, applying the alloy powder onto the surface of the sintered body, and then heating the sintered body and the alloy powder in vacuum or an inert gas atmosphere at a temperature equal to or lower than the sintering temperature of the sintered body for thereby causing R.sup.2 element to diffuse into the sintered body. 2. The method of claim 1, wherein a majority of the R.sup.2 is selected from the group consisting of Nd, Pr, Tb and Dy. 3. The method of claim 1, wherein the alloy powder has an average particle size of 0.1 to 100 .mu.m.

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			4. The method of claim 1, wherein the R.sup.2 and M is enriched near grain boundaries in the interior of the sintered body. 5. The method of claim 1, wherein the R.sup.2 and M is enriched near grain boundaries within the sintered body major phase grain.
Filed: December 27, 2012 Issued: May 12, 2015 Expires: December 2032	9,028,624	Assignee: Intermetallics Co., Ltd. (Nakatsugawa, Japan)	NdFeB system sintered magnet and method for producing the same Abstract Provided is a NdFeB sintered magnet which can be used in the grain boundary diffusion method as a base material in which R.sub.H can be easily diffused through the rare-earth rich phase and which itself has a high coercive force, a high maximum energy product and a high squareness ratio, as well as a method for producing such a magnet. A NdFeB system sintered has an average grain size of the main-phase grains magnet is equal to or smaller than 4.5 .mu.m, the carbon content of the entire NdFeB system sintered magnet is equal to or lower than 1000 ppm, and the percentage of the total volume of a carbon rich phase in a rare-earth rich phase at a grain-boundary triple point in the NdFeB system sintered magnet to the total volume of the rare-earth rich phase is equal to or lower than 50%. The invention claimed is: 1. A NdFeB system sintered magnet, ***[presumptive composition of matter]*** wherein: a) an average grain size of a main-phase grains in the NdFeB system sintered magnet is equal to or smaller than 4.5 .mu.m; b) a carbon content of the entire NdFeB system sintered magnet is greater than 0 ppm and equal to or

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			lower than 1000 ppm; and c) a percentage of a total volume of a carbon rich phase in a rare-earth rich phase at a grain-boundary triple point in the NdFeB system sintered magnet to a total volume of the rare-earth rich phase is greater than 0% and equal to or lower than 50%. 2. A method for producing ***[presumptive process/method]*** the NdFeB system sintered magnet according to claim 1, comprising: a) a hydrogen pulverization process for coarsely pulverizing a NdFeB system alloy by making the NdFeB system alloy occlude hydrogen; b) a fine pulverization process for finely pulverizing the coarsely pulverized NdFeB system alloy so that a grain size of the alloy will be equal to or smaller than 3.2 .mu.m in terms of a median D.sub.50 of a grain size distribution measured by a laser diffraction method; and c) a press-less magnet-production process including a step of putting fine powder of the NdFeB alloy into a filling container and a subsequent step of orienting and sintering the fine powder as held in the filling container, wherein: the fine pulverization process and the press-less magnet-production process are performed without thermal dehydrogenation for desorbing the hydrogen occluded in the hydrogen pulverization process; and the processes from the hydrogen pulverization process through the press-less magnet-production process are performed in an oxygen-free atmosphere.
Filed: March 28, 2005 Issued: April 14, 2015 Expires: March	9,005,780	Assignee: TDK Corporation (Tokyo, Japan)	Rare earth magnet, method for producing same and method for producing multilayer body Abstract The present invention aims to provide a rare earth magnet having sufficiently excellent anticorrosion property. The rare earth magnet 1 according to the present invention to solve the above problems includes a magnet body 10 containing rare earth elements, a substantial amorphous layer 20 formed on a surface of the magnet body 10, and a protecting layer 30 on a surface of the

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2025			amorphous layer 20, and the amorphous layer 20 contains material identical to main component elements of magnet material contained in the magnet body 10. The invention claimed is: 1. A rare earth magnet comprising ***[presumptive composition of matter]*** : a magnet body containing a rare earth element; an amorphous layer formed on a surface of the magnet body and containing amorphous substance; and a protecting layer formed on a surface of the amorphous layer, wherein the magnet body is polycrystalline and contains polycrystal substance, a boundary between the magnet body and the amorphous layer includes a region where the polycrystal substance of the magnet body and the amorphous substance of the amorphous layer are mixed, the amorphous layer has a film thickness from 0.3 to 10 .mu.m, the protecting layer consists of aluminum, the amorphous layer is amorphized from a surface of the magnet body and contains an element identical to a main component element of a magnet material contained in the magnet body, a roughness Ra of a boundary between the magnet body and the amorphous layer ranges from 1.27 to 1.45 .mu.m, a roughness Ra of a boundary between the amorphous layer and the protecting layer ranges from 0.68 to 0.85 .mu.m, and a coefficient of thermal expansion of the magnet body is substantially similar to a coefficient of thermal expansion of the amorphous layer.
Filed: March 31, 2011 Issued:	8,986,568	Assignee: TDK Corporation (Tokyo, Japan)	Sintered magnet and method for producing the sintered magnet Abstract The present invention aims to ensure strength of a thin-walled sintered magnet.

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March 24, 2015 Expires: March 2031			A sintered magnet is a ferrite sintered magnet made by sintering a magnetic material. A magnetic powder mixture obtained by mixing magnetic powder with a binder resin is injection-molded into a mold with a magnetic field applied thereto to produce a molded body, which is then sintered to produce the sintered magnet. The sintered magnet has a thickness of 3.5 mm or less in the position of center of gravity thereof. The sintered magnet has a surface roughness Rz of 0.1 .mu.m or more and 2.5 .mu.m or less. The surface roughness Rz is a 10 point average roughness. The invention claimed is: 1. A sintered magnet made by ***[presumptive process/method]:*** sintering a magnetic material, the sintered magnet having a thickness of 3.5 mm or less in the position of center of gravity thereof and a surface roughness Rz of 2.5 .mu.m or less, And the sintered magnet is a hard ferrite sintered magnet. 2. The sintered magnet according to claim 1, wherein the surface roughness Rz is 0.1 .mu.m or more ***[presumptive composition of matter].*** . BACKGROUND Sintered magnets are widely used for motors and the like mounted in household electric appliances, automobiles, and the like. In recent years, smaller and thinner-walled sintered magnets are sought after for requirements for space saving, fuel economy improvement, and the like. In order to improve strength of a ferrite sintered *magnet*, for example, Japanese Patent Application Laid-Open No. 2002-353021 discloses a technique described below. In this technique, powder to be molded is substantially composed of magnetic powder obtained by powderizing a ferrite sintered *magnet* containing Fe, an element A, **an element R** and an element M, or substantially composed of the magnetic

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			powder and raw material powder containing Fe, the element A, the element R and the element M. …… FIG. 5 is a flow chart illustrating a procedure of another method for producing a sintered *magnet* according to the present embodiment. The sintered *magnet* to be described below is a sintered metallic *magnet*, *and particularly a rare-earth* sintered *magnet* having a composition of R--Fe--B (where R is a *rare-earth* element). The sintered metallic *magnet* to which the method for producing a sintered *magnet* according to the present embodiment can be applied is not limited to this type. In the present embodiment, two or more types of alloys are combined so as to obtain a final composition, and then sintered to produce the sintered *magnet*. In the present embodiment, an alloy (low R alloy) mainly composed of R.sub.2Fe.sub.14B crystal grains is combined with an alloy containing a higher amount of R than the low R alloy (high R alloy). However, three or more types of alloys can be combined. Otherwise, the *rare-earth* sintered *magnet* can be produced from one type of alloy. When the sintered *magnet* is produced using the method for producing the sintered *magnet* according to the present embodiment, the low R alloy and the high R alloy are prepared (step S21). The low R alloy and the high R alloy are prepared, for example, using a strip casting method. The strip casting method is preferably used because it can improve magnetic characteristics by suppressing the crystal grains from growing in the low R alloy and the high R alloy. The method for preparing the low R alloy and the high R alloy is not limited to this method, but a casting method (such as a centrifugal casting method) can be used. Next, the low R alloy and the high R alloy are coarsely milled (step S22). In the present embodiment, hydrogen milling or mechanical milling (such as disk milling) is used for the coarse milling. However, the method for the coarse milling is not limited to these methods.

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			In the case of performing the hydrogen milling in the present embodiment, the low R alloy and the high R alloy are held in a hydrogen atmosphere for one hour to five hours at a temperature between about room temperature and 100.degree. C. to allow the low R alloy and the high R alloy to occlude hydrogen and to be milled. Thereafter, the low R alloy and the high R alloy are heated to a temperature of 500.degree. C. to 600.degree. C., and held at that temperature for about one hour to about ten hours so as to be dehydrogenated. After the coarse milling is finished, the coarsely milled powders of the low R alloy and the high R alloy are finely milled (step S23). In the present embodiment, jet milling using an inert gas (such as N.sub.2 gas) is used (but not limited thereto) for the fine milling. By the fine milling, low R alloy powder is obtained from the low R alloy, and high R alloy powder is obtained from the high R alloy. The low R alloy powder and the high R alloy powder after being prepared are mixed at a predetermined ratio (step S24). After the low R alloy powder and the high R alloy powder are mixed, the powder mixture of the low R alloy powder and the high R alloy powder is molded into a predetermined shape to be produced as a molded body (step S25). In the molding of the powder mixture, a predetermined molding pressure is applied to the powder mixture to mold it. In this case, the molding is preferably performed in a magnetic field of an intensity of 800 kA/m or more in order to orient the low R alloy powder and the high R alloy powder. The molding pressure is preferably from about 10 MPa to about 500 MPa. Thereafter, the molded body thus obtained is sintered (step S26). In the sintering, the molded body obtained in step S25 is sintered in vacuum (reduced pressure atmosphere) for a predetermined time at a predetermined temperature, and thus, a sintered body is obtained. For example, the sintering temperature is set in the range from 1000.degree. C. to 1100.degree. C., and the molded body is sintered for about one hour to about ten hours. A short sintering time

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			increases variability in density and magnetic characteristics of the obtained sintered body while a too long sintering time reduces the productivity of the sintered *magnet*. Therefore, the sintering time is determined by considering a balance between the variability and the productivity. After the sintering process is finished, an aging treatment is applied to the sintered body in air, or preferably, in an inert gas atmosphere (step S27). The aging treatment is a treatment of adjusting the magnetic characteristics of the sintered *magnet* to be obtained by holding the sintered body for a predetermined time at a temperature lower than the sintering temperature and thus by adjusting a structure of the sintered body. The aging treatment is applied under appropriate conditions so as to obtain high magnetic characteristics (such as a coercive force HcJ and a good squareness). The aging treatment can be applied in two stages. In this case, the aging temperature is kept at 700.degree. C. to 900.degree. C. at the first stage, and at 450.degree. C. to 600.degree. C. at the second stage, and the sintered body is held in each of the temperature ranges for one hour to ten hours. The sintered body after finishing the aging treatment is processed as necessary (step S28). The sintered *magnet* according to the present embodiment needs to be made to have a surface roughness Rz of 2.5 .mu.m or less before being subjected to a surface treatment. For this reason, the sintered body after finishing the aging treatment and necessary processing is ground on surfaces thereof as necessary so as to have the surface roughness Rz of 2.5 .mu.m or less, and thus is made to be a sintered *magnet*. This sintered *magnet* has the surface roughness Rz of 2.5 .mu.m or less, and thus is ensured to have a sufficient strength even if it is thin-walled. A surface treatment (such as plating or resin coating) for suppression of corrosion is applied to the sintered *magnet* having the surface roughness Rz of 2.5 .mu.m or less. The sintered *magnet* is then magnetized.

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			In the molding process (step S25), the molded body may be obtained by injection molding. In this case, the molded body is produced in the following manner. First, the low R alloy powder and the high R alloy powder prepared by the procedure up to step S24 are mixed at a predetermined ratio to obtain magnetic powder. The obtained magnetic powder is mixed with a binder resin, a wax, a lubricant, and a plasticizer, and then kneaded with a kneader for a predetermined time (about two hours) at a temperature of about 150.degree. C. to obtain a kneaded mixture. This kneading is the same as the kneading performed in step S16 described above. The obtained kneaded mixture is molded with a pelletizer (such as a twin taper single extruder). Thus, pellets (magnetic powder mixture) in which the magnetic powder is dispersed in the binder resin are obtained. The obtained pellets are injection-molded to obtain a magnetic powder molded body. The injection molding is the same as that performed in step S17 described above. As described above, by setting the surface roughness Rz to 2.5 .mu.m or less, the sintered *magnet* according to the present embodiment can be ensured to have a sufficient strength even if it is thin-walled. In the method for producing a sintered *magnet* according to the present embodiment, the magnetic powder mixture that is a mixture of the magnetic powder and the binder resin is injection-molded into the mold, and the mold has a surface roughness of 3.0 .mu.m or less on the surface thereof in contact with the magnetic powder mixture. The sintered *magnet* having the surface roughness Rz of 2.5 .mu.m or less can easily be produced by sintering a molded body obtained from such a mold. In the case of production of the ferrite sintered *magnet* among types of sintered *magnet*, Si and the like are sometimes added as an auxiliary agent in the middle of the process. However, after sintering, most of these elements gather at crystal grain boundaries of the sintered *magnet*, and hardly appear on the surface. The *rare-earth* sintered *magnet* is subjected to the aging treatment

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			after the sintering. However, the temperature of the aging treatment is lower than a temperature required for forming a heterogeneous phase in a glass state containing Si and the like. In addition, the ferrite sintered *magnet* is not generally subjected to a heat treatment after the sintering. Therefore, in the sintered *magnet*, the surface roughness Rz cannot be reduced by making the heterogeneous phase appear on the surface of the sintered *magnet*. Accordingly, in order to ensure the strength of the thin-walled sintered *magnet*, it is necessary to reduce the surface roughness Rz of the sintered *magnet* itself without making the heterogeneous phase appear on the surface thereof.
Filed: Dec 19, 2011 Issued: March 17, 2015 Expires: Dec. 2031	8,981,888	Assignee: TDK Corporation (Tokyo, Japan)	Magnetic body Abstract A magnetic body which can reversibly change its magnetic force with a small external magnetic field while having a high residual magnetic flux density is provided. The magnetic body of the present invention has a residual magnetic flux density Br of at least 11 kG and a coercive force HcJ of 5 kOe or less, while an external magnetic field required for the residual magnetic flux density Br to become 0 is 1.10 HcJ or less. The invention claimed is: 1. A magnetic body comprising: a residual magnetic flux density Br of at least 11 kG; and a coercive force HcJ of 5 kOe or less; wherein an external magnetic field required for the residual magnetic flux density Br to become 0 is 1.049 HcJ or less ***[presumptive composition of matter***. 2. A magnetic body according to claim 1, further comprising a rare-earth element R, a transition metal element T, and boron B ***[presumptive composition of matter]***.

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			3. A magnetic body comprising: a residual magnetic flux density Br of at least 11 kG; and a coercive force HcJ of 5 kOe or less; wherein an external magnetic field required for the residual magnetic flux density Br to become 0 is 1.10 HcJ or less, and wherein said magnetic body includes crystal particles having a rare-earth element R, a transition metal element T, and boron B, and the content of Cu in said particles is 0.5 to 0.6 atom % to the total atoms present within said crystal particles. 4. A magnetic body according to claim 1, wherein the content of Cu in said magnetic body to the total mass of said magnetic body is 1.0 to 1.25 mass %.
Filed: February 27, 2008 Issued: March 17, 2015 Expires: February 2028	8,980,116	Assignee: TDK Corporation (Tokyo, Japan)	Ferrite sintered *magnet* Abstract A sintered ferrite *magnet* having a ferrite phase with a hexagonal structure as the main phase, wherein the composition of the metal elements composing the main phase is represented by the following general formula (1): R.sub.xCa.sub.mA.sub.1-x-m(Fe.sub.12-yM.sub.y).sub.z: (1), x, m, y and z in formula (1) satisfying all of the conditions represented by the following formulas (2)-(6): 0.2.ltoreq.x.ltoreq.0.5: (2) 0.13.ltoreq.m.ltoreq.0.41: (3) 0.7x-m.ltoreq.0.15: (4) 0.18.ltoreq.yz.ltoreq.0.31: (5) 9.6.ltoreq.12z.ltoreq.11.8: (6), and wherein the density of the sintered ferrite *magnet* is at least 5.05 g/cm.sup.3, and the crystal grains of the sintered ferrite *magnet* satisfy all of the conditions represented by the following formulas (7) and (8), where L .mu.m is the average for the maximum value and S .mu.m is the average for the minimum value among the diameters passing through the center of gravity of each grains in the crystal cross-section parallel to the c-axis direction of hexagonal structures. L.ltoreq.0.95: (7) 1.8.ltoreq.L/S.ltoreq.2.5: (8).

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			The invention claimed is: 1. A sintered ferrite *magnet* having a ferrite phase with a hexagonal structure as the main phase, wherein the composition of the metal elements composing the main phase is represented by the following general formula ***[presumptive composition of matter],*** (1): R.sub.xCa.sub.mA.sub.1-x-m(Fe.sub.12-yM.sub.y).sub.z: (1) wherein R represents at least one element selected from the group consisting of La, Ce, Pr, Nd and Sm and including La as an essential component, A represents Sr and/or Ba, and M represents at least one element selected from the group consisting of Co, Zn, Ni, Mn, Al and Cr and including Co as an essential component, x, m, y and z in formula (1) satisfying all of the conditions represented by the following formulas (2), (3), (4), (5) and (6): 0.2.ltoreq.x.ltoreq.0.5: (2) 0.13.ltoreq.m.ltoreq.0.41: (3) 0.7x-m.ltoreq.0.15: (4) 0.18.ltoreq.yz.ltoreq.0.31: (5) 9.6.ltoreq.12z.ltoreq.11.8: (6), wherein the density of the sintered ferrite *magnet* is at least 5.05 g/cm.sup.3, and the crystal grains of the sintered ferrite *magnet* satisfy all of the conditions represented by the following formulas (7) and (8), where L .mu.m is the average for the maximum value and S .mu.m is the average for the minimum value among the diameters passing through the center of gravity of each grains in the crystal cross-section parallel to the c-axis direction of hexagonal structures, L.ltoreq.0.95: (7) 1.8.ltoreq.L/S.ltoreq.2.5: (8). 2. The sintered ferrite *magnet* according to claim 1, wherein the sintered ferrite *magnet* is formed from a finely milled material having a mean particle size of 0.1-0.3.mu.m. ***[presumptive composition of matter]*** BACKGROUND ART Hexagonal Ba ferrite and Sr ferrite are known in the prior art as magnetic materials for use in sintered ferrite magnets. In recent years, magnetoplumbite (M-type) Ba ferrite and Sr ferrite have become the most commonly used

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			ferrites. M-type ferrite is represented by the general formula AFe.sub.12O.sub.19, with Ba or Sr as the element represented by A. M-type ferrites, wherein the element represented by A is Sr with a portion thereof being replaced with a rare earth element and a portion of the Fe being replaced with Co, are known to exhibit excellent magnetic properties including residual flux density and coercive force (for example, see Patent documents 1 and 2). Such M-type ferrites must contain La as the rare earth element. This is because La is the rare earth element that has the highest solubility limit for hexagonal M-type ferrite. Patent documents 1 and 2 also teach that using La as a substitute element for the element represented by A can increase solubility of the Co which is substituting for a portion of the Fe, thus enhancing the magnetic properties as a result.
Filed: March 30, 2010 Issued: February 24, 2015 Expires: March 2030	8,961,868	Assignee: Hitachi Metals, Ltd. (Tokyo, Japan)	Nanocomposite bulk magnet and process for producing same Abstract In a nanocomposite bulk magnet according to the present invention, nanocomposite magnet powder particles, including an Nd.sub.2Fe.sub.14B crystalline phase and an .alpha.-Fe phase, are combined together. The composition of the magnet is represented by T.sub.100-x-y-z-n(B.sub.1-qC.sub.q).sub.xR.sub.yTi.sub.zM.sub.n, where T is at least one transition metal element selected from the group consisting of Fe, Co and Ni and always including Fe, R is at least one rare-earth element including substantially no La or Ce, M is an additive metallic element, and x, y, z, n and q satisfy 4 at %.ltoreq.x.ltoreq.10 at %, 6 at %.ltoreq.y.ltoreq.10 at %, 0.05 at %.ltoreq.z.ltoreq.5 at %, 0 at %.ltoreq.n.ltoreq.10 at %, and 0.ltoreq.q.ltoreq.0.5, respectively. The powder particles have a minor-axis size of less than 40 .mu.m. And powder particles, of which the major-axis size exceeds 53 .mu.m, account for at least 90 mass % of the entire magnet. And those powder particles are directly combined with each other. Consequently, a

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			full-dense magnet, of which the density is 96% or more of the true density of its material alloy, is realized. The invention claimed is: 1. A method for producing ***[presumptive process/method]*** a nanocomposite bulk magnet, the method comprising the steps of: providing a melt of an alloy having a composition represented by the compositional formula: T.sub.100-x-y-z-n(B.sub.1-qC.sub.q).sub.xR.sub.yTi.sub.zM.sub.n, where T is at least one transition metal element that is selected from the group consisting of Fe, Co and Ni and that always includes Fe, R is at least one rare-earth element including substantially no La or Ce, and M is at least one metallic element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, and the mole fractions x, y, z, n and q satisfy the inequalities of: 4 at %.ltoreq.x.ltoreq.10 at %, 6 at %.ltoreq.y.ltoreq.10 at %, 0.05 at %.ltoreq.z.ltoreq.5 at %, 0 at %.ltoreq.n.ltoreq.10 at %, and 0.ltoreq.q.ltoreq.0.5, respectively, quenching the melt to make a rapidly solidified alloy, at least 30 vol % of which is crystalline phases that include an R.sub.2T.sub.14B phase and an .alpha.-Fe phase and that have an average crystal grain size of 100 nm or less and the balance of which is amorphous phases and which has a thickness of less than 40 .mu.m; pulverizing the rapidly solidified alloy, thereby obtaining a powder, at least 90 mass % of which is accounted for by powder particles with a major-axis size of more than 53 .mu.m; and compacting the powder while heating and pressing the powder, thereby making a bulk body in which nanocomposite magnet powder particles including the R.sub.2T.sub.14B phase and the .alpha.-Fe phase are combined together and of which the density is 96% or more of the true density of the alloy. 2. The method of claim 1, ***[presumptive process/method]*** wherein the step of quenching the melt includes quenching the melt at a quenching rate of

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			5.times.10.sup.4.degree. C./s to 5.times.10.sup.7.degree. C./s. 3. The method of claim 1, wherein the step of quenching the melt includes controlling the standard deviation .sigma. of the thickness of the rapidly solidified alloy to 4 .mu.m or less. 4. The method of claim 1, wherein the step of compacting includes crystallizing the amorphous phases of the powder particles, thereby forming a nanocomposite magnet structure, 5 vol % to 60 vol % of which is accounted for by an .alpha.-Fe phase with an average crystal grain size of 1 nm to 50 nm and 40 vol % to 95 vol % of which is accounted for by an R.sub.2T.sub.14B phase with an average crystal grain size of 5 nm to 100 nm.
Filed: August 2, 2012 Issued: February 24, 2015 Expires: August 2032	8,961,712	Assignee: TDK Corporation (Tokyo, Japan)	Rare earth based sintered magnet Abstract The present invention provides a rare earth based sintered magnet. The magnet is a rare earth based permanent magnet with a R-T-B (R represents one or more elements selected from Y and rare earth elements, T represents one or more metal elements including Fe or the combination of Fe and Co, and B represents B or the combination of B and C) based composition. When a R-rich phase (R represents rare earth element(s)) with atomic ratio of (Fe+Co)/(LR+HR+Fe+Co).ltoreq.0.2 (LR represents Y and light rare earth element(s) selected from .sup.57La to .sup.63Eu, and HR represents heavy rare earth element(s) selected from .sup.64Gd to .sup.71Lu) is present in the grain boundary triple point, a region with HR/(LR+HR).gtoreq.0.01 (atomic ratio) is present in the R-rich phase, and the region with HR/(LR+HR).gtoreq.0.01 accounts for 10% to 90% of the area of the grain boundary triple point. What is claimed is:

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			1. A rare earth based sintered magnet, wherein, it is a rare earth based permanent magnet having a R-T-B based composition ***[presumptive composition of matter]*** , wherein, R represents one or more elements selected from Y and rare earth elements, T represents one or more metal elements containing Fe or the combination of Fe and Co, and B represents B or the combination of B and C, a R-rich phase with the atomic ratio of (Fe+Co)/(LR+HR+Fe+Co).ltoreq.0.2 is present in the grain boundary triple point, and a region with the atomic ratio of HR/(LR+HR).gtoreq.0.01 is present in the R-rich phase and accounts for 10% to 90% of the area of the grain boundary triple point, wherein, LR represents one or more elements selected from Y and the light rare earth elements from .sup.57La to .sup.63Eu, and HR represents one or more elements selected from the heavy rare earth elements from .sup.64Gd to .sup.71Lu, said LR at least contains Nd or Pr, and said HR at least contains Dy or Tb. 2. The rare earth based sintered magnet according to claim 1, wherein, when the magnet was observed via an electron probe microanalyzer (EPMA) in a visual field of 10-100 .mu.m.times.10-100 .mu.m, the CV value of the detection signal of HR in the visual filed excluding the 50 .mu.m part of the surface layer of the magnet ranges from 0.15 to 0.5, and the CV value is obtained by dividing the standard deviation of all analysis points by the arithmetic mean of all analysis points. 3. The rare earth based sintered magnet according to claim 1, wherein, the content of R is 25 mass % or more and 35 mass % or less, the content of B is 0.9 mass % or more and 1.1 mass % or less, and the balance is the composition substantially containing T. ***[presumptive composition of matter]*** 4. The rare earth based sintered magnet according to claim 2, wherein, the content of R is 25 mass % or more and 35 mass % or less, the content of B is 0.9 mass % or more and 1.1 mass % or less, and the balance is the composition

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			substantially containing T.
Filed: April 26, 2012 Issued: February 3, 2015 Expires: April 2032	8,945,318	Assignee: Hitachi Metals, Ltd. (Tokyo, Japan)	R-Fe-B type rare earth sintered magnet and process for production of the same Abstract In an R--Fe--B based rare-earth sintered magnet according to the present invention, at a depth of 20 .mu.m under the surface of its magnet body, crystal grains of an R.sub.2Fe.sub.14B type compound have an (RL.sub.1-xRH.sub.x).sub.2Fe.sub.14B (where 0.2.ltoreq.x.ltoreq.0.75) layer with a thickness of 1 nm to 2 .mu.m in their outer periphery. In this case, the light rare-earth element RL is at least one of Nd and Pr, and the heavy rare-earth element RH is at least one element selected from the group consisting of Dy, Ho and Tb. The invention claimed is: 1. An R--Fe--B based rare-earth sintered magnet comprising **[composition of matter]** an R--Fe--B based rare-earth sintered magnet body that includes, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound, including a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R, and a heavy rare-earth element RH, which is at least one element selected from the group consisting of Dy, Ho and Tb, wherein at a depth of 20 .mu.m under the surface of the R--Fe--B based rare-earth sintered magnet body, the crystal grains of the R.sub.2Fe.sub.14B type compound include an RH diffused layer at an outer periphery of the crystal grains, the RH diffused layer having an average thickness of 2 .mu.m or less and having a composition of (RL.sub.1-xRH.sub.x).sub.2Fe.sub.14B, where 0.2.ltoreq.x.ltoreq.0.75, wherein at a depth of 500 .mu.m under the surface of the R--Fe--B based rare-earth sintered magnet body, the crystal grains of the R.sub.2Fe.sub.14B type compound have an RH diffused layer with an average thickness of 0.5 .mu.m or less in their outer periphery, wherein the surface of

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			the R--Fe--B based rare-earth sintered magnet body is a machined surface that is not covered with a metal layer of the heavy rare-earth element RH and that is a surface of the R--Fe--B based rare-earth sintered magnet body, from which its surface portion has already been removed after the heavy rare-earth element RH has been introduced into the R--Fe--B based rare-earth sintered magnet body from outside of the R--Fe--B based rare-earth sintered magnet body, wherein the R--Fe--B based rare-earth sintered magnet body has a size of 1 mm to 4 mm as measured in a thickness direction, wherein a difference .DELTA.H.sub.cJ1 in coercivity is 150 kA/m or less between: the entire R--Fe--B based rare-earth sintered magnet body; and a portion of the R--Fe--B based rare-earth sintered magnet body below a distance of 200 .mu.m from the surface of the R--Fe--B based rare-earth sintered magnet body, and wherein the magnet has an RH-RL-O compound in at least one grain boundary triple junction, which is located at a depth of 100 .mu.m or less under the surface of the R--Fe--B based rare-earth sintered magnet body.
Filed: March 15, 2013 Issued: December 9, 2014 Expires: March 2033	8,907,755	Assignee: Toda Kogyo Corporation (Otake-shi, Hiroshima-ken, Japan)	R-T-B-based rare earth magnet particles, process for producing the R-T-B-based rare earth magnet particles, and bonded magnet Abstract R-T-B-based rare earth magnet particles are produced by an HDDR treatment which comprises a first stage HD step of heating particles of a raw material alloy having a composition of R, B and Co in an inert atmosphere or in a vacuum atmosphere and then replacing the atmosphere with a hydrogen-containing gas atmosphere in which the raw material alloy particles are held in the same temperature range and a second stage HD step of heating a material obtained in the first stage HD step in which the material is held in the hydrogen-containing gas atmosphere. What is claimed is: 1. A process for producing R-T-B-based rare earth magnet particles

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			[process/method] by HDDR treatment, comprising: a first stage HD step of heating particles of a raw material alloy to a temperature range of not lower than 770.degree. C. and not higher than 820.degree. C. in an inert atmosphere or in a vacuum atmosphere and then replacing the atmosphere with a hydrogen-containing gas atmosphere in which the raw material alloy particles are held in the same temperature range for not shorter than 30 min and not longer than 150 min, said raw material alloy comprising R (wherein R represents at least one rare earth element including Y), T (wherein T represents Fe, or Fe and Co) and B (wherein B represents boron), and having a composition comprising R in an amount of not less than 12.5 atom % and not more than 14.3 atom %, B in an amount of not less than 4.5 atom % and not more than 7.5 atom % and Co in an amount of not more than 10 atom %; and a second stage HD step of heating a material obtained in the first stage HD step again to a temperature range of not lower than 830.degree. C. and not higher than 870.degree. C. in which the material is held in the hydrogen-containing gas atmosphere for not shorter than 60 min and not longer than 240 min. 2. The process for producing R-T-B-based rare earth magnet particles according to claim 1, wherein the raw material alloy further comprises Ga and Zr, and has a composition comprising Ga in an amount of not less than 0.1 atom % and not more than 1.0 atom % and Zr in an amount of not less than 0.05 atom % and not more than 0.15 atom %. 3. R-T-B-based rare earth magnet particles comprising **[composition of matter]** R (wherein R represents at least one rare earth element including Y), T (wherein T represents Fe, or Fe and Co) and B (wherein B represents boron), and having a composition comprising R in an amount of not less than 12.5 atom % and not more than 14.3 atom %, B in an amount of not less than 4.5 atom % and not more than 7.5 atom % and Co in an amount of not more than 10.0 atom %, in which a squareness (H.sub.k/H.sub.cJ) of a demagnetization curve of the R-T-B-based rare earth magnet particles is not less than 0.5, and a

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			difference DB.sub.r between a residual magnetic flux density (B.sub.r106) of oversize particles obtained therefrom using a sieve of sieve opening 106 mm and a residual magnetic flux density (B.sub.r38) of undersize particles obtained therefrom using a sieve of sieve opening 38 mm is not more than 0.02T. 4. A bonded magnet comprising the R-T-B-based rare earth magnet particles as defined in claim 3
Filed: March 8, 2012 Issued: October 21, 2014 Expires: October 2032	8,866,574	Assignees: Kabushiki Kaisha Toyota Chuo Kenkyusho Toyota Jidosha Kabushiki Kaisha (Nagakute-shi, Japan)	Rare earth magnet and process for producing same Abstract A process for producing a rare earth magnet comprises: an adhesion step of causing a diffusion element capable of diffusing inwardly to adhere to the surface part of a magnet material comprising a compact or sintered body of rare earth alloy particles; and an evaporation step of heating the magnet material in vacuum to evaporate at least a portion of the diffusion element having been retained on or in the surface part of the magnet material. The invention claimed is: 1. A process for producing **[process/method]** a rare earth magnet, the process comprising: an adhesion step of causing a diffusion element capable of diffusing inwardly to adhere to a surface part of a magnet material comprising a compact or sintered body of rare earth alloy particles; and an evaporation step of heating the magnet material in vacuum to evaporate at least a portion of the diffusion element having been retained on or in the surface part of the magnet material, wherein: the adhesion step is a vapor deposition step that causes heated magnet material and heated diffusion material including the diffusion element to come close to each other in vacuum and exposes the magnet material to a vapor of the diffusion element evaporated from the diffusion material thereby to vapor deposit the diffusion element on the surface

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			of the magnet material; the evaporation step is a step that, subsequently to the vapor deposition step, heats the magnet material in vacuum without cooling the magnet material to room temperature region; and the adhesion step and the evaporation step are repeated in this order
Filed: Sept 13, 2011 Issued: Sep 30, 2014 Expires: Sept 2031	8846136	Assignee Toyota Jidosha Kabushiki Kaisha (Tokyo, Japan)	Production method of rare earth magnet ABSTRACT Provides a production method of an anisotropic rare earth magnet capable of being enhanced in coercivity without adding a large amount of a rare metal such as Dy and Tb. A production method of a rare earth magnet, comprising a step of bringing a compact obtained by applying hot working to impart anisotropy to a sintered body having a rare earth magnet composition into contact with a low-melting-point alloy melt containing a rare earth element. The invention claimed is: 1. A production method **[process/method]** of a rare earth magnet, comprising a step of bringing a compact obtained by applying hot working to impart anisotropy to a sintered body having a rare earth magnet composition into contact with a low-melting-point alloy melt containing a rare earth element, wherein said low-melting-point alloy melt containing a rare earth element is composed of an alloy having a melting point of less than 700° C. but not less than 480° C., and wherein the resulting rare earth magnet has a coercivity (Hc) of 17.5 kOe or greater at 300 k.
Filed: July 8, 2010 Issued: September 30, 2014	8,845,821	Assignee: Hitachi Metals, Ltd. (Tokyo, Japan)	Process for production of R-Fe-B-based rare earth sintered magnet, and steam control member Abstract A sintered R--Fe--B based rare-earth magnet body 1 including, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a

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Expires: September 2030			light rare-earth element RL, which is Nd and/or Pr, as a major rare-earth element R is provided. A bulk body 2 including a heavy rare-earth element RH, which is at least one of Dy, Ho and Tb is also provided. The sintered magnet body 1 and the bulk body 2 are arranged in a processing chamber 4 with a vapor control member 3 interposed between the sintered magnet body 1 and the bulk body 2. And the inside of the processing chamber 4 is heated to a temperature of 700.degree. C. to 1000.degree. C., thereby diffusing the heavy rare-earth element RH inside the sintered magnet body 1 while supplying the heavy rare-earth element RH from the bulk body 2 to the surface of the sintered magnet body 1 via the vapor control member 3. The invention claimed is: 1. A method for producing **[process/method]** a sintered R--Fe--B based rare-earth magnet, the method comprising the steps of: providing a sintered R--Fe--B based rare-earth magnet body including, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R; providing a bulk body including a heavy rare-earth element RH, which is at least one element selected from the group consisting of Dy, Ho and Tb; arranging the sintered R--Fe--B based rare-earth magnet body and the bulk body in a processing chamber with a vapor control member interposed between the sintered R--Fe--B based rare-earth magnet body and the bulk body; and heating the inside of the processing chamber to a temperature of 700.degree. C. to 1000.degree. C., thereby diffusing the heavy rare-earth element RH into the sintered R--Fe--B based rare-earth magnet body while supplying the heavy rare-earth element RH from the bulk body to the surface of the sintered R--Fe--B based rare-earth magnet body via the vapor control member, wherein the vapor control member includes: an upper surface and a lower surface; a plurality of openings, which communicate between the upper and lower surfaces; and a wall portion, which defines the openings, and wherein the wall

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			portion has a thickness of 0.5 mm or less, each said opening of the vapor control member has a depth of 1 mm to 10 mm, D/A is equal to or smaller than 8 mm.sup.-1, where each said opening of the vapor control member has an area of A [mm.sup.2] and a depth of D [mm], and in the step of heating, a gap between the sintered R--Fe--B based rare-earth magnet body and the vapor control member is set to be within a range of 0 mm to 10 mm, a gap between the vapor control member and the bulk body is set to be within a range of 0 mm to 10 mm, and a gap between the sintered R--Fe--B based rare-earth magnet body and the bulk body is set to be 10 mm or less.
Filed: March 28, 2011 Issued: September 2, 2014 Expires: September 2031	8,823,478	Assignee: TDK Corporation (Tokyo, JP)	Rare earth sintered magnet, method for producing same, motor and automobile Abstract A rare earth sintered magnet 10 including a magnet body that includes a rare earth compound, and a protective layer on the magnet body, having a first layer and a second layer in that order from the magnet body side, wherein the surface portion of the magnet body has a higher heavy rare earth element content than the interior of the magnet body that is surrounded by the surface portion, the first layer includes a rare earth oxide, the mass ratio of the heavy rare earth element being 1 or greater with respect to the light rare earth element, and the second layer includes an oxide containing iron and/or boron which is different from the rare earth oxide, the second layer having a lower rare earth oxide content than the first layer. The invention claimed is: 1. A rare earth sintered magnet comprising **[composition of matter]** : a magnet body that includes a rare earth compound; and a protective layer on the magnet body, the protective layer having a first layer and a second layer in that order from the magnet body, wherein a surface portion of the magnet body has a higher heavy rare earth element content than a heavy rare earth element

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			content of an interior portion of the magnet body, the interior portion surrounded by the surface portion, the first layer comprises a rare earth oxide having a heavy rare earth element and a light rare earth element, a mass ratio of the heavy rare earth element being 1 or greater as compared to the light rare earth element of the first layer, the second layer comprises an oxide containing at least one of iron boron which is different from the rare earth oxide, and the second layer has a lower rare earth oxide content than the first layer. 2. The rare earth sintered magnet according to claim 1, wherein the second layer contains essentially no rare earth oxide.
Filed: February 17, 2011 Issued: September 2, 2014 Expires: September 2031	8,821,649	Assignee: Hitachi, Ltd. (Tokyo, Japan)	Magnetic material and motor using the same Abstract Characteristics of a magnetic material are improved without using a heavy rare earth element as a scarce resource. By incorporating fluorine into a magnetic powder and controlling the crystal orientation in crystal grains, a magnetic material securing magnetic characteristics such as coercive force and residual flux density can be fabricated. As a result, the resource problem with heavy rare earth elements can be solved, and the magnetic material can be applied to magnetic circuits that require a high energy product, including various rotating machines and voice coil motors of hard discs. What is claimed is: 1. A magnetic material comprising **[composition of matter]** a main phase comprising fluorine and a magnetic powder, the magnetic powder comprising at least one crystal grain having a uniform crystal structure and an angular difference in crystal orientation of 45.degree. or less in average in the crystal structure, wherein the magnetic material is obtained by a fluorination reaction

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			of the magnetic powder at a temperature from 50.degree. to less than 500.degree. C. in an atmosphere of a fluorine-containing gas generated by decomposing a member selected from the group consisting of ammonium fluoride, xenon fluoride, ammonium hydrogen fluoride, ammonium acid fluoride, salts composed of an amine and hydrogen fluoride, and krypton fluoride, wherein the magnetic powder comprises at least two compositions of fluoride; fluorine atoms are disposed at interstitial positions of iron or at interstitial positions of a transition metal element excluding iron and a rare earth element; and the composition formula is represented by: RE.sub.x(Fe.sub.sM.sub.T).sub.YF.sub.Z+RE.sub.U(Fe.sub.SM.sub.T).sub.VF.s- ub.W wherein RE denotes a rare earth element, M denotes a transition metal element excluding iron and a rare earth element, F denotes fluorine, X, Y, Z, S, T, U, V and W are positive numbers, (Fe.sub.sM.sub.T).sub.YF.sub.Z represents a composition of a central portion of the magnetic powder, (Fe.sub.SM.sub.T)F.sub.W represents a composition of a surface of the magnetic powder, X<Y, Z<Y, S>T, U<V, W<V and Z<W, and wherein the compositions of fluoride satisfy X<Y/10, Z<3, Z<Y/4, T<0.4 and S>T; and a volume proportion of a phase other than the main phase comprising fluorides and oxy-fluorides exhibiting no ferromagnetism and having a body-centered tetragonal or hexagonal structure is 0.01 to 10% with respect to the main phase. 2. The magnetic material according to claim 1, wherein fluorine atoms are disposed at interstitial positions of a crystal lattice of the magnetic powder; and the magnetic powder has a higher fluorine concentration in a surface of the magnetic powder than in a central portion of the magnetic powder or has a larger crystal lattice in the surface than in the central portion. 3. The magnetic material according to claim 1, wherein the magnetic material comprises the main phase further comprising a transition metal element.

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			4. The magnetic material according to claim 3, wherein the transition metal element is at least one selected from the group consisting of Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zr, Nb and Mo. 5. The magnetic material according to claim 1, wherein the magnetic powder comprises at least two compositions of fluoride; fluorine atoms are disposed at interstitial positions of iron or at interstitial positions of a transition metal element excluding iron and a rare earth element; and the composition formula is represented by: (Fe.sub.SM.sub.T).sub.YF.sub.Z+(Fe.sub.UM.sub.V).sub.WF.sub.X wherein M denotes a transition metal element excluding iron and a rare earth element, F denotes fluorine, (Fe.sub.SM.sub.T).sub.YF.sub.Z represents a composition of a central portion of the magnetic powder, (Fe.sub.UM.sub.V).sub.WF.sub.X represents a composition a surface of the magnetic powder, Z<Y, X<W and Z<X. 6. The magnetic material according to claim 5, wherein the compositions of fluoride satisfy S>T and U>V. 7. The magnetic material according to claim 1, wherein the main phase further comprises Re.sub.1Fe.sub.mN.sub.n, wherein Re is a rare earth element, and l, m and n are positive integers; Re.sub.1Fe.sub.mC.sub.n, wherein Re is a rare earth element, and l, m and n are positive integers; Re.sub.1Fe.sub.mB.sub.n, wherein Re is a rare earth element, and l, m and n are positive integers; Re.sub.1Fe.sub.m, wherein Re is a rare earth element, and l and m are positive integers; or M.sub.lFe.sub.m, wherein M is at least one transition element excluding Fe, Fe is iron, and l and m are positive integers. 8. The magnetic material according to claim 7, wherein an oxy-fluoride comprising a rare earth element is present in a surface of the crystal grain or the powder of the main phase.

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Filed: April 21, 2008 Issued: August 12, 2014 Expires: April 2028	8,801,870	Assignee: Intermetallics Co., Ltd. (Kyoto, Japan)	Method for making NdFeB sintered magnet Abstract The objective of the present invention is to provide a method for making a NdFeB sintered magnet, capable of enhancing the effect of increasing the coercive force and preventing the instability of the effects, and in addition, being inexpensive. The method for making a NdFeB sintered magnet according to the present invention has processes of coating a NdFeB sintered magnet with a powder containing Dy and/or Tb, then heating the NdFeB sintered magnet, and thereby diffusing R.sup.h in the powder into the NdFeB sintered magnet through a grain boundary, and is characterized in that the powder contains 0.5 through 50 weight percent of Al in a metallic state; and the amount of oxygen contained in the NdFeB sintered magnet is equal to or less than 0.4 weight percent. The invention claimed is: 1. A method for making a NdFeB sintered magnet ***[process/method]:*** including processes of coating a NdFeB sintered magnet base material compact with a powder containing R.sup.h, ***[composition of matter],*** where R.sup.h represents Dy and/or Tb, then heating the NdFeB sintered magnet base material compact, and thereby diffusing R.sup.h in the powder into the NdFeB sintered magnet through a grain boundary, and obtaining a NdFeB sintered magnet that has a coercive force H.sub.c1, value within a range of from 19.0 to 26.9 kOe, wherein: the powder contains 0.5 through 50 weight percent of Al in a metallic state; at least a part of the Al is diffused by the heating through the grain boundary; and an amount of oxygen contained in the NdFeB sintered magnet base material compact is equal to or less than 0.4 weight percent. 2. The method for making a NdFeB sintered magnet ***[presumptive process/method]*** according to claim 1, wherein the amount of oxygen is equal

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			to or less than 0.3 weight percent ***[composition of matter].*** 3. The method for making ***[presumptive process/method]*** a NdFeB sintered magnet according to claim 1, wherein the powder contains a fluoride of R.sup.h***[composition of matter]*** . 4. The method for making ***[presumptive process/method]*** a NdFeB sintered magnet according to claim 1, wherein the powder contains ***[composition of matter]***a powder of an alloy of RR.sup.hT, where R represents one or plural kinds from among rare earth elements other than Dy and Tb, and T represents one or plural kinds from among Fe, Co, and Ni, and/or an alloy of RR.sup.hTB. 5. The method for making a NdFeB sintered magnet according to claim 2, wherein the powder contains a fluoride of R.sup.h ***[composition of matter]***. 6. The method for making ***[presumptive process/method]*** a NdFeB sintered magnet according to claim 2, wherein the powder contains a powder of an alloy of RR.sup.hT, where R represents one or plural kinds from among rare earth elements other than Dy and Tb, and T represents one or plural kinds from among Fe, Co, and Ni, and/or an alloy of RR.sup.hTB***[composition of matter]*** . 7. The method for making ***[presumptive process/method]*** a NdFeB sintered magnet according to claim 3, wherein the powder contains a powder of an alloy of RR.sup.hT, where R represents one or plural kinds from among rare earth elements other than Dy and Tb, and T represents one or plural kinds from among Fe, Co, and Ni, and/or an alloy of RR.sup.hTB ***[composition of matter]***. 8. The method for making ***[presumptive process/method]*** a NdFeB sintered

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			magnet according to claim 5, wherein the powder contains a powder of an alloy of RR.sup.hT, where R represents one or plural kinds from among rare earth elements other than Dy and Tb, and T represents one or plural kinds from among Fe, Co, and Ni, and/or an alloy of RR.sup.hTB ***[composition of matter]***. 9. The method for making ***[presumptive process/method]***a NdFeB sintered magnet according to claim 1, wherein the SQ value of the NdFeB sintered magnet is higher than 80 percent.
Filed: June 27, 2011 Issued: May 27, 2014 Expires: June 2031	8,734,714	Assignee: The University of Birmingham (Birmingham, Great Britian)	Magnet recycling Abstract The present invention discloses a method for recovering rare earth particulate material from an assembly comprising a rare earth magnet and comprises the steps of exposing the assembly to hydrogen gas to effect hydrogen decrepitation of the rare earth magnet to produce a rare earth particulate material, and separating the rare earth particulate material from the rest of the assembly. The invention also resides in an apparatus for separating rare earth particulate material from an assembly comprising a rare earth magnet. The apparatus comprises a reaction vessel having an opening which can be closed to form a gas-tight seal, a separation means for separating the rare earth particulate material from the assembly, and a collection means for collecting the rare earth particulate material. The reaction vessel is connected to a vacuum pump and a gas control system, and the gas control system controls the supply of hydrogen gas to the reaction vessel. What is claimed is: 1. Apparatus for producing and separating rare earth particulate material from an assembly comprising a rare earth magnet using hydrogen decrepitation, the

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			apparatus comprising: a reaction vessel having an opening which is capable of being closed to form a gas-tight seal; a separator configured to separate the rare earth particulate material from the assembly; and a collector configured to collect the rare earth particulate material; wherein the reaction vessel is connected to a vacuum pump and a gas control system; wherein the gas control system controls the supply of hydrogen gas to the reaction vessel; and wherein the separator comprises: a porous container located within the reaction vessel and having holes of appropriate size to allow the rare earth particulate material to pass through and to retain the assembly within the container; and a device capable of tumbling the assembly contained within the porous container to facilitate separation of the rare earth particulate material from the assembly and movement of the rare earth particulate material though the holes of the porous container 10. A method ***[process/method]*** for using the apparatus of claim 1 to produce and separate rare earth particulate material from the assembly, the method comprising the steps of: providing the assembly within the reaction vessel, using the gas control system, controlling the supply of hydrogen gas to the reaction vessel to expose the assembly to the hydrogen gas to effect hydrogen decrepitation of the rare earth magnet whereby the rare earth particulate material is produced, using the separator, separating the rare earth particulate material from the rest of the assembly, using the collector, collecting the rate earth particulate material and wherein the separating comprises tumbling the assembly. 11. The method according to claim 10, wherein the rare earth magnet is NdFeB or SmCo Note: gas mixture, temperature and pressure specifications are visible in other claims….

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Filed: Nov 27, 2009 Issued: April 15, 2014 Expires: Nov 2029	8,695,210	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, Japan)	Method of manufacturing an Nd based sintered magnet Abstract A method for preparing the magnet includes the steps of: (a) providing a sintered Nd base magnet block having surfaces and a magnetization direction, (b) coating the surfaces of the magnet block excluding the surface perpendicular to the magnetization direction with a Dy or Tb oxide powder, a Dy or Tb fluoride powder, or a Dy or Tb-containing alloy powder, (c) treating the coated block at a high temperature for causing Dy or Tb to diffuse into the block, and (d) cutting the block in a plane perpendicular to the magnetization direction into a magnet segment having a coercive force distribution on the cut section that the coercive force is high at the periphery and lower toward the inside and a constant coercive force distribution in the magnetization direction. The invention claimed is: 1. A method for preparing ***[process/method]*** a sintered Nd base magnet comprising in the recited order, the steps of: providing a sintered Nd base magnet block having surfaces perpendicular to a magnetization direction and extending to the magnetization direction; coating the surfaces of the magnet block excluding the surface perpendicular to the magnetization direction with a Dy or Tb oxide powder, a Dy or Tb fluoride powder, or a Dy or Tb-containing alloy powder, thereby obtaining a coated block; heating the coated block so that the Dy or Tb in the Dy or Tb oxide powder, the Dy or Tb fluoride powder, or the Dy or Tb-containing alloy powder, diffuses into the block; cutting the coated block in a plane perpendicular to the magnetization direction to form a cut section into a magnet segment having a coercive force distribution on the cut section so that the coercive force is high at a periphery of the cut section and lower toward an inside of the cut section and a constant coercive force distribution in the magnetization direction; and then machining the magnet segment on the surface perpendicular to the magnetization direction so as to

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			make a cross-section along the magnetization direction into a C or D shape. 2. A method for preparing ***[process/method]*** a sintered Nd base magnet according to claim 1, wherein the magnet block has a maximum dimension of up to 100 mm in a Dy or Tb-diffusing direction perpendicular to the magnetization direction and a maximum length of at least 30 mm in the magnetization direction.
Filed: September 10, 2007 Issued: March 18, 2014 Expires: Sept 2027	8,673,392	Assignee: ULVAC, Inc. (Kanagawa, Japan)	Permanent magnet and method of manufacturing same Abstract A permanent magnet is provided which has formed a Dy, Tb film on a surface of an iron-boron-rare earth sintered magnet of a predetermined shape, with diffusion thereof into grain boundary phases, having a higher coercive force. The method of manufacturing a permanent magnet includes a film-forming step of evaporating metal evaporating material containing at least one of Dy and Tb and adhering evaporated metal atoms to a surface of the iron-boron-rare earth sintered magnet, and a diffusing step of performing heat treatment to diffuse metal atoms adhered to the surface into grain boundary phases of the sintered magnet. The metal evaporating material contains at least one of Nd and Pr. What is claimed is: 1. A method of manufacturing [***process/method]*** a permanent magnet comprising: a film-forming step comprising: heating a total surface area of a metal evaporating material containing at least one of Dy and Tb in order to evaporate metal atoms of the metal evaporating material from the total surface area of the metal evaporating material; and adhering the evaporated metal atoms to a surface of an iron-boron-rare earth

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			sintered magnet; and a diffusing step of performing heat treatment to diffuse metal atoms adhered to the surface into grain boundary phases of the sinteredmagnet, wherein the metal evaporating material contains at least one of Nd and Pr, and a ratio of a the total surface area of the metal evaporating material to a total surface area of the sintered magnet is set to be in a range of 1.times.10.sup.-4 to 2.times.10.sup.3. 2. The method of manufacturing [***process/method]*** a permanent magnet according to claim 1, wherein the metal evaporating material further comprises at least one material of the group consisting of Ag, B, Ba, Be, C, Ca, Ce, Co, Cr, Cs, Er, Eu, Fe, Gd, Ge, Hf, Ho, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Ni, P, Pd, Ru, S, Sb, Si, Sm, Sn, Sr, Ta, Ti, Tm, V, W, Y, Yb, Zn, and Zr.
Filed: March 26, 2010 Issued: November 5, 2013 Expires: March 2020	8,574,380	Assignee: BYD Company Limited (People's Republic of China)	Composite magnetic material and method of preparing the same Abstract The present invention discloses a composite magnetic material. The composite magnetic material may, an Nd--Fe--B alloy and a Fe-based soft magnetic alloy having the general formula of Fe.sub.100-x-y-z-aA.sub.xR.sub.aSi.sub.yB.sub.z. A may be at least one element selected from Cu and Au. R may be at least one element selected from the group consisting of Ti, Zr, Hf, Mo, Nb, Ta, W and V. And the x, a, y, and z may satisfy: 0.ltoreq.x.ltoreq.3, 0.ltoreq.a.ltoreq.10, 0.ltoreq.y.ltoreq.20 and 2.ltoreq.z.ltoreq.25. The present invention further discloses a method of preparing the composite magnetic material as described above. According to the present invention, the composite magnetic material may have an enhanced magnetic energy product and residual magnetism respectively.

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			What is claimed is: 1. A composite magnetic material, comprising ***[composition of matter]*** : a Nd--Fe--B alloy powder; and a nano Fe-based soft magnetic alloy powder, which specified in atomic percentage is: Fe.sub.100-x-y-z-aA.sub.xR.sub.aSi.sub.yB.sub.z, wherein: A is at least one element selected from the group consisting of Cu and Au; R is at least one element selected from the group consisting of Ti, Zr, Hf, Mo, Nb, Ta, W and V; and wherein 0.ltoreq.x.ltoreq.3, 0.ltoreq.a.ltoreq.10, 0<y.ltoreq.20 and 2.ltoreq.z.ltoreq.25. … 4. A method of preparing a composite magnetic material ***[process/method]*** , the method comprising: the composite magnetic material comprising: a Nd--Fe--B alloy powder; and a nano Fe-based soft magnetic alloy powder which specified in atomic percentage is: Fe.sub.100-x-y-z-aA.sub.xR.sub.aSi.sub.yB.sub.z, wherein: A is at least one element selected from the group consisting of Cu and Au; R is at least one element selected from the group consisting of Ti, Zr, Hf, Mo, Nb, Ta, W and V; and wherein 0.ltoreq.x.ltoreq.3, 0.ltoreq.a.ltoreq.10, 0<y.ltoreq.20 and 2.ltoreq.z.ltoreq.25; mixing the Nd--Fe--B alloy powder and the nano Fe-based soft magnetic alloy powder to form a mixture; pressing the mixture in a magnetic field to form a blank; sintering the blank under a first temperature; and tempering the blank under a second temperature, wherein the sintering and/or tempering steps occur under a first atmosphere.
Filed: Filed: March 25, 2011 Issued:	8,568,539	Assignee: Kabushiki Kaisha Toshiba (Japan)	Permanent magnet and method for manufacturing the same, and motor and power generator using the same Abstract According to one embodiment, a permanent magnet is provided with a sintered body having a composition, represented by

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October 29, 2013 Expires: March 2031			R(Fe.sub.pM.sub.qCu.sub.rCo.sub.1-p-q-r).sub.zO.sub.w (where, R is at least one element selected from rare-earth elements, M is at least one element selected from Ti, Zr and Hf, and p, q, r, z and w are numbers satisfying 0.25.ltoreq.p.ltoreq.0.6, 0.005.ltoreq.q.ltoreq.0.1, 0.01.ltoreq.r.ltoreq.0.1, 4.ltoreq.z.ltoreq.9 and 0.005.ltoreq.w.ltoreq.0.6 in terms of atomic ratio). The sintered body has therein aggregates of oxides containing the element R dispersed substantially uniformly. What is claimed is: 1. A permanent magnet comprising a sintered body having a composition ***[composition of matter]*** represented by the following composition formula: R(Fe.sub.pM.sub.qCu.sub.rCo.sub.1-p-q-r).sub.zO.sub.w, wherein R is at least one element selected from the group consisting of rare-earth elements, M is at least one element selected from the group consisting of Ti, Zr and Hf, p is a number, which is an atomic ratio, satisfying 0.25.ltoreq.p.ltoreq.0.6, q is a number, which is an atomic ratio, satisfying 0.005.ltoreq.q.ltoreq.0.1, r is a number, which is an atomic ratio, satisfying 0.01.ltoreq.r.ltoreq.0.1, z is a number, which is an atomic ratio, satisfying 4.ltoreq.z.ltoreq.9, and w is a number, which is an atomic ratio, satisfying 0.005.ltoreq.w.ltoreq.0.6, wherein aggregates of oxides containing the element R are substantially uniformly dispersed in the sintered body. …. 8. A method for manufacturing ***[process/method]*** a permanent magnet, comprising: forming a magnetic powder having a composition represented by the following composition formula:…., press-forming the magnetic powder in a magnetic field, thereby forming a formed body; sintering the formed body in a vacuum atmosphere or an inert gas atmosphere, thereby forming a sintered body having a composition represented by the following composition formula: … performing a solution treatment on the sintered body; and performing an aging treatment on the sintered body after the solution treatment by holding the

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			sintered body at a temperature in a range of from 700.degree. C. to 900.degree. C., and cooling the sintered body to a temperature in a range of from 400.degree. C. to 650.degree. C. at a cooling rate of 1.3.degree. C./min or less, wherein 50 volume % or more of particles in the magnetic powder has a particle diameter of 3 .mu.m or more, and 50 volume % or more of the particles having the particle diameter of 3 .mu.m or more has a particle diameter of 10 .mu.m or less. … 9. A motor comprising the permanent magnet according to claim 1. 10. A power generator comprising the permanent magnet according to claim 1….
Filed: Jan 9, 2009 Issued: October 22, 2013 Expires: Jan 2029	8,562,756	Assignee: Intermetallics Co., Ltd. (Japan) (*a joint venture company of Daido Steel Co., Ltd., Mitsubishi Corporation and Molycorp, Inc.*)	NdFeB sintered magnet and method for producing the same Abstract The present invention is aimed at providing a method for producing an NdFeB sintered magnet having a higher coercivity and higher squareness of the magnetization curve than ever before. A method for producing an NdFeB sintered magnet according to the present invention includes the steps of forming a layer containing Dy and/or Tb on the surface of an NdFeB sintered magnet base material and then performing a grain boundary diffusion process for diffusing Dy and/or Tb from the aforementioned layer through the crystal grain boundaries of the magnet base material into the magnet base material by heating the magnet base material to a temperature equal to or lower than the sintering temperature thereof, and this method is characterized in that a) the content of a rare earth in a metallic state in the magnet base material is equal to or higher than 12.7 at %; b) the aforementioned layer is a powder layer formed by depositing a powder; and c) the powder layer contains Dy and/or Tb in a metallic state by an amount equal to or higher than 50 mass %. The invention claimed is:

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			1. A method for producing ***[process/method]*** an NdFeB sintered magnet, including steps of forming a layer containing Dy and/or Tb on a surface of an NdFeB sintered magnet base material and then performing a grain boundary diffusion process for diffusing Dy and/or Tb from the aforementioned layer through crystal grain boundaries of the magnet base material into the magnet base material by heating the magnet base material to a temperature equal to or lower than a sintering temperature of the magnet base material, wherein: a) a content of a rare earth in a metallic state in the magnet base material is equal to or higher than 12.7 at %; b) the aforementioned layer is a powder layer formed by depositing a powder; c) the powder layer contains 50 mass % or more Dy and/or Tb in a metallic state; and d) the powder layer contains 1 mass % or more Al.
Filed: Oct 27, 2010 Issued: October 15, 2013 Expires: October 2030	8,557,057	Assignee: Shin-Etsu Chemical Co., Ltd. (Japan)	Rare earth permanent magnet and its preparation Abstract A rare earth permanent magnet is prepared by disposing a powdered metal alloy containing at least 70 vol % of an intermetallic compound phase on a sintered body of R--Fe--B system, and heating the sintered body having the powder disposed on its surface below the sintering temperature of the sintered body in vacuum or in an inert gas for diffusion treatment. The advantages include efficient productivity, excellent magnetic performance, a minimal or zero amount of Tb or Dy used, an increased coercive force, and a minimized decline of remanence. The invention claimed is: 1. A rare earth permanent magnet, which is prepared by ***[process/method]*** disposing an alloy powder on a surface of an original sintered body of the composition R.sub.a-T.sup.1.sub.b-B.sub.c wherein R is at least one element

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			selected from rare earth elements inclusive of Y and Sc, T.sup.1 is at least one element selected from Fe and Co, B is boron, "a," "b" and "c" indicative of atomic percent are in the range: 12.ltoreq.a.ltoreq.20, 4.0.ltoreq.c.ltoreq.7.0, and the balance of b, said alloy powder having the composition R.sup.1.sub.1-M.sup.1.sub.j wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Y and Sc, M.sup.1 is at least one element selected from the group consisting of Al, Si, C, P, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pb, and Bi, "i" and "j" indicative of atomic percent are in the range: 63<j.ltoreq.89 and the balance of i, and containing at least 70% by volume of an intermetallic compound phase, and heat treating the sintered body having the alloy powder disposed on its surface at a temperature equal to or below the sintering temperature of the original sintered body in vacuum or in an inert gas, wherein at least one element of R.sup.1 and at least one element of M.sup.1 in the alloy powder is diffused to grain boundaries in the interior of the sintered body, near grain boundaries within sintered body primary phase grains or a combination thereof; and wherein the coercive force of the rare earth permanent magnet is increased over the magnetic properties of the original sintered body
Filed: December 27, 2007 Issued: October 8, 2013 Expires: Dec 2027	8,551,210	Assignee: Vacuumschmelze GmbH & Co. KG (Germany)	Composite article with magnetocalorically active material and method for its production **Abstract** A composite article (1; 10; 40) comprises a plurality of inclusions (5) of a magnetocalorically active material embedded in a matrix (4) of a magnetocalorically passive material. The inclusions (5) and the matrix (4) have a microstructure characteristic of a compacted powder. The invention claimed is: 1. A composite article, comprising ***[composition of matter]*** : (a) a solid

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			matrix comprising a magnetocalorically passive material and having a microstructure comprising a plurality of particles of magnetocalorically passive material that have lattice structure that exhibits strain, or fractures, or both, from compression, and that, at least in part, touch one or more immediately neighboring particles of magnetocalorically passive material; and (b) a plurality of solid inclusions comprising a magnetocalorically active material at least partially embedded in the solid matrix, wherein the inclusions either: (1) have a microstructure comprising a plurality of particles of magnetocalorically active material that have lattice structure that exhibits strain, or fractures, or both from compression, and that, at least in part, touch one or more immediately neighboring particles of magnetocalorically passive material, or (2) form a series of foils, flakes, or tapes embedded in the matrix. … 16. Composite article according to claim 1, wherein the magnetocalorically active material is ***[composition of matter]*** one or more of Gd, a La(Fe.sub.1-bSi.sub.b).sub.13-based phase, a Gd.sub.5(Si, Ge).sub.4-based phase, a Mn(As, Sb)-based phase, a MnFe(P, As) -based phase, a Tb--Gd-based phase, a (La, Ca, Pr, Nd, Sr)MnO.sub.3-based phase, a Co--Mn--(Si, Ge)-based phase, or a Pr.sub.2(Fe, Co).sub.17-based phase.
Filed: June 30, 2005 Issued: October 1, 2013 Expires: June 2025	8,545,641	Assignee: Intermetallics Co., Ltd. (Japan) *a joint venture company of Daido Steel Co., Ltd., Mitsubishi*	Method and system for manufacturing sintered rare-earth magnet having magnetic anisotropy Abstract A method for manufacturing a sintered rare-earth magnet having a magnetic anisotropy, in which a very active powder having a small grain size can be safely used in a low-oxidized state. A fine powder as a material of the sintered rare-earth magnet having a magnetic anisotropy is loaded into a mold until its density reaches a predetermined level. Then, in a magnetic orientation section, the fine powder is oriented by a pulsed magnetic field. Subsequently, the fine

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		Corporation and Molycorp, Inc	powder is not compressed but immediately sintered in a sintering furnace. A multi-cavity mold for manufacturing a sintered rare-earth magnet having an industrially important shape, such as a plate magnet or an arched plate magnet may be used. The invention claimed is: 1. A method for manufacturing ***[process/method]*** a sintered NdFeB magnet having a magnetic anisotropy, comprising: a) loading an NdFeB alloy powder into a container (called a mold hereinafter) having a cavity whose form corresponds to that of a product to be obtained with a loading density of the alloy powder being within a range from 47.4 to 55% of a real density, the alloy powder having an average grain size D.sub.50 of 0.5 to 5 .mu.m measured with a laser grain-size distribution measurement apparatus and containing a total of 6 weight percent or smaller of Dy and/or Tb; b) applying an orienting magnetic field that is 2 T or higher to the alloy powder in absence of a compression to orient the alloy powder; c) creating a sintered body by heating the alloy powder contained in the mold in an absence of a compression while allowing gas components released from the alloy powder to escape from the mold; and d) taking out the sintered body of the alloy powder from the mold, wherein the steps a) through c) are performed under vacuum or under an atmosphere of an inert gas.
Filed: November 22, 2010 Issued: September 24, 2013	8,540,929	Assignee: TDK Corporation (Japan)	Method for producing rare earth sintered magnet Abstract The present invention relates to a method for producing a rare earth sintered magnet including the steps of: molding a mixture of magnetic powder containing a rare earth compound and oil-extended rubber containing oil and rubber to produce a molded body; removing the oil-extended rubber from the molded body; and calcining the molded body from which the oil-extended

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Expires: Nov 2030			rubber is removed to produce a rare earth sintered magnet What is claimed is: 1. A method for producing ***[process/method]*** a rare earth sintered magnet, the method comprising the steps of: molding a mixture of magnetic powder containing a rare earth compound and oil-extended rubber containing oil and rubber to produce a molded body; removing the oil-extended rubber from the molded body; and calcining the molded body from which the oil-extended rubber is removed to produce a rare earth sintered magnet, wherein the rubber is at least one selected from a group consisting of polyisobutylene, ethylene-propylene rubber, styrene-butadiene rubber, butadiene rubber, isoprene rubber, butyl rubber and ethylene-propylene diene monomer rubber
Filed: September 30, 2009 Issued: August 27, 2013 Expires: Sept 2029	8,518,194	Assignee: Vacuumschmelze GmbH & Co. KG (Germany)	Magnetic article and method for producing a magnetic article Abstract A magnetic article comprises, in total, elements in amounts capable of providing at least one (La.sub.1-aM.sub.a)(Fe.sub.1-b-cT.sub.bY.sub.c).sub.13-dX.sub.e phase and less than 0.5 Vol % impurities, wherein 0.ltoreq.a.ltoreq.0.9, 0.ltoreq.b.ltoreq.0.2, 0.05.ltoreq.c.ltoreq.0.2, -1.ltoreq.d.ltoreq.+1, 0.ltoreq.e.ltoreq.3, M is one or more of the elements Ce, Pr and Nd, T is one or more of the elements Co, Ni, Mn and Cr, Y is one or more of the elements Si, Al, As, Ga, Ge, Sn and Sb and X is one or more of the elements H, B, C, N, Li and Be. The magnetic article comprises a permanent magnet. The invention claimed is: 1. Magnetic article comprising ***[composition of matter]*** , in total, elements in amounts capable of providing at least one (La.sub.1-aM.sub.a)(Fe.sub.1-b-

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			cT.sub.bY.sub.c).sub.13-dX.sub.e phase and less than 5 Vol % impurities, wherein 0.ltoreq.a.ltoreq.0.9, 0.ltoreq.b.ltoreq.0.2, 0.05.ltoreq.c.ltoreq.0.2, -1.ltoreq.d.ltoreq.+1, 0.ltoreq.e.ltoreq.3, M is one or more of the elements Ce, Pr and Nd, T is one or more of the elements Co, Ni, Mn and Cr, Y is one or more of the elements Si, Al, As, Ga, Ge, Sn and Sb and X is one or more of the elements H, B, C, N, Li and Be, wherein the magnetic article comprises a permanent magnet comprising: a non-magnetic matrix, and a plurality of permanently magnetic inclusions comprising at least one .alpha.-Fe-type phase distributed in the non-magnetic matrix ….. 10. Method of fabricating a magnetic article ***[process/method]*** comprising: providing a precursor article … and heat treating the precursor article to produce a permanent magnet comprising permanently magnetic .alpha.-Fe-type inclusions in a non-magnetic matrix.
Filed: Aug 17, 2011 Issued: Aug 20, 2013 Expires: Aug 2031	8,512,590	Assignee: Hitachi Metals, Ltd. (Japan)	Rotating machine, bonded magnet, magnet roll, and method for producing sintered ferrite magnet Abstract A method for producing a sintered ferrite magnet having an M-type ferrite structure and represented by: Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z, (by atomic ratio), where 0.3.ltoreq.1-x-y.ltoreq.0.65, 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.03.ltoreq.z.ltoreq.0.65, 4.ltoreq.n.ltoreq.7, and 1-x-y>y. The method includes mixing a Ca compound, an R element compound, a Ba compound, an iron compound and a Co compound as starting materials calcining the starting materials to obtain calcined bodies; pulverizing the calcined bodies to obtain a calcined powder; providing recycled materials having an M-type ferrite structure and being represented by the above formula; pulverizing the recycled materials to obtain a recycled material powder; mixing the recycled material powder with the calcined powder to form a moldable material; molding the moldable material

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			to obtain green bodies; and sintering the green bodies to obtain the sintered ferrite magnet. What is claimed is: 1. A method for producing ***[process/method]*** a sintered ferrite magnet having an M-type ferrite structure, comprising Ca, an R element that is at least one of rare earth elements and indispensably includes La, Ba, Fe and Co as indispensable metal elements, and having a composition represented by the following general formula: Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z, (by atomic ratio), wherein (1-x-y), x, y, z, and n represent the contents of Ca, the R element, Ba and Co, and a molar ratio, meeting 0.3.ltoreq.1-x-y.ltoreq.0.65, 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.03.ltoreq.z.ltoreq.0.65, 4.ltoreq.n.ltoreq.7, and 1-x-y>y, said method comprising the steps of mixing a Ca compound, an R element compound, a Ba compound, an iron compound and a Co compound as starting materials for the composition; calcining the starting materials to obtain calcined bodies; pulverizing the calcined bodies to obtain a calcined powder; providing recycled materials having an M-type ferrite structure, comprising Ca, an R element that is at least one of rare earth elements and indispensably includes La, Ba, Fe and Co as indispensable metal elements, and having the same metal composition as the one represented by the above-mentioned general formula; pulverizing the recycled materials to obtain a recycled material powder; mixing the recycled material powder with the calcined powder to form a moldable material; molding the moldable material to obtain green bodies; and sintering the green bodies to obtain the sintered ferrite magnet; wherein the mixing ratio of the recycled material powder to the calcined powder of the moldable material is 5 to 95 parts by mass to 95 to 5 parts by mass, and wherein the recycled materials comprise at least one of failed green bodies, failed sintered bodies and dust generated in the machining of the sintered bodies.

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Filed: March 9, 2011 Issued: August 13, 2013 Expires: March 2031	8,506,838	Assignee: Hitachi Metals, Ltd. (Japan)	Sintered ferrite magnet and its production method Abstract A sintered ferrite magne comprising a first granular ferrite compound phase containing Ca, La, Fe and Co and having a Curie temperature Tc1 between 415.degree. C. and 430.degree. C., and a second granular ferrite compound phase containing Sr, La, Fe and Co and having a Curie temperature Tc2 between 437.degree. C. and 455.degree. C., the volume ratio of the first ferrite compound phase being 50-90%, and the volume ratio of the second ferrite compound phase being 10-50%, with their total volume ratio being 95% or more. What is claimed is: 1. A sintered ferrite magnet comprising a first granular ferrite compound phase containing Ca, La, Fe and Co and having a Curie temperature between 415.degree. C. and 430.degree. C., and a second granular ferrite compound phase containing Sr, La, Fe and Co and having a Curie temperature between 437.degree. C. and 455.degree. C., the volume ratio of said first granular ferrite compound phase being 50-90%, and the volume ratio of said second granular ferrite compound phase being 10-50%, with their total volume ratio being 95% or more. ***[composition of matter]***… 11. A method for producing a sintered ferrite magnet comprising ***[process/method*** the steps of (1) mixing a first calcined ferrite in which the metal elements of Ca, La, (Ba+Sr), Fe and Co have a composition represented by the general formula: Ca.sub.1-x'-c'La.sub.x'A.sub.c'Fe.sub.2n'-y'Co.sub.y', wherein A represents (Ba+Sr), and x', c' and y' representing the atomic ratios of Ca, La, A, Fe and Co and n' representing a molar ratio are numbers meeting the conditions of 0.4.ltoreq.x'.ltoreq.0.6, 0.ltoreq.c'.ltoreq.0.2, 0.2<y'.ltoreq.0.5,

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			and 4.ltoreq.n'.ltoreq.6, with a second calcined ferrite in which the metal elements of Sr, La, Fe and Co have a composition represented by the general formula: Sr.sub.1-x"La.sub.x"Fe.sub.2n"-y"Co.sub.y", wherein x" and y" representing the atomic ratios of Sr, La, Fe and Co and n" representing a molar ratio are numbers meeting the conditions of 0.05.ltoreq.x".ltoreq.0.3, 0.05.ltoreq.y".ltoreq.0.3, and 5.ltoreq.n".ltoreq.6, at a mass ratio of 90/10 to 50/50, to obtain a calcined ferrite mixture; (2) pulverizing said calcined ferrite mixture to obtain powder; (3) molding said powder to obtain a green body; and (4) sintering said green body to obtain a sintered body.
Filed: Jan 28, 2011 Issued: July 9, 2013 Expires: Jan 2031	8,481,179	Assignee: Nissan Motor Co., Ltd. (Japan)	Rare earth magnet having high strength and high electrical resistance Abstract This rare earth magnet having high strength and high electrical resistance has a structure including an R--Fe--B-based rare earth magnet particles 18 which are enclosed with a high strength and high electrical resistance composite layer 12. The high strength and high electrical resistance composite layer 12 is constituted from a glass-based layer 16 that has a structure comprising a glass phase or R oxide particles 13 dispersed in glass phase, and R oxide particle-based mixture layers 17 that are formed on both sides of the glass-based layer 16 and contain an R-rich alloy phase 14 which contains 50 atomic % or more of R in the grain boundary of the R oxide particles. What is claimed is: 1. A rare earth magnet formed by stacking ***[composition of matter]*** a composite layer and an R--Fe--B-based rare earth magnet layer, wherein R represents one or more kind of rare earth element including Y, and the composite layer comprises a glass-based layer having a glass phase or a structure of R oxide particles dispersed in a glass phase, and R oxide particle-based mixture layers that are formed on both sides of the glass-based layer and

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			which contain an R-rich alloy phase which contains 50 atomic % or more of R in a grain boundary of the R oxide particles. … 3. The rare earth magnet according to claim 2, wherein R of the R oxide layer ***[composition of matter]*** contained in the composite layer is one or more selected from the group consisting of Y, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu. … 16. The rare earth magnet according to claim 9, wherein the rare earth magnet is formed ***[process/method]*** by forming a R--Fe--B-based rare earth magnet powder green compact layer using an R--Fe--B-based rare earth magnet powder in magnetic field; forming a sputtered layer of oxide of rare earth element on the upper surface of the R--Fe--B-based rare earth magnet powder green compact layer so as to make at least two stacked bodies constituted from the R--Fe--B-based rare earth magnet powder green compact layer and the R oxide layer; placing one of the stacked bodies on another one of the stacked bodies so as to provide the glass powder layer between the R oxide layers, thereby to form a stacked green compact constituted from the R--Fe--B-based rare earth magnet powder green compact layer, the R oxide layer, the glass powder layer, the R oxide layer, and the R--Fe--B-based rare earth magnet powder green compact layer in order; and conducting a hot pressing of the stacked green compact to obtain the rare earth magnet. …
Filed: Mar 28, 2011 Issued: July 9, 2013	8,480,818	Assignee: Nitto Denko Corporation (Japan)	Permanent magnet and manufacturing method thereof Abstract There are provided a permanent magnet and a manufacturing method thereof capable of preventing grain growth in a main phase and enabling rare-earth rich phase to be uniformly dispersed. To fine powder of milled neodymium magnet material is added an organometallic compound solution containing an organometallic compound expressed with a structural formula of M-

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Expires: March, 2031			(OR).sub.x (in the formula M represents Cu or Al, R represents a substituent group consisting of a straight-chain or branched-chain hydrocarbon, .sub.x represents an arbitrary integer) so as to uniformly adhere the organometallic compound to particle surfaces of the neodymium magnet powder. Thereafter, a compact body formed by compacting the above neodymium magnet powder is held for several hours in hydrogen atmosphere at 200 through 900 degrees Celsius. Thereafter, through a sintering process, a permanent magnet is manufactured. The invention claimed is: 1. A manufacturing method ***[process/method]*** of a Nd--Fe--B based permanent magnet comprising steps of milling magnet material into magnet powder; adding an organometallic compound expressed with a structural formula of M-(OR).sub.x M representing Cu or Al, R representing a substituent group consisting of a straight-chain or branched-chain hydrocarbon, and .sub.x representing an arbitrary integer, to the magnet powder obtained at the step of milling magnet material and getting the organometallic compound adhered to particle surfaces of the magnet powder; compacting the magnet powder of which particle surfaces have got adhesion of the organometallic compound so as to obtain a compact body; and sintering the compact body, wherein M contained in the organometallic compound is concentrated in grain boundaries of the permanent magnet after sintering, wherein the permanent magnet is Nd--Fe--B based.
Filed: Mar 14, 2011 Issued: May 28,	8,449,696	Assignee: TDK Corporation (JAPAN)	Rare-earth sintered magnet containing a nitride, rotator containing rare-earth sintered magnet, and reciprocating motor containing rare-earth sintered magnet Abstract The present invention relates to a rare-earth sintered magnet 100 containing an R-T-B-based alloy and a nitride of a transition element while the nitride is

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2013 Expires: March 2031			distributed preferentially to a surface part ***[process/method]***. (R, T, and B indicate a rare-earth element, at least one of iron and cobalt, and boron, respectively.) What is claimed is: 1. A rare-earth sintered magnet containing ***[composition of matter]***, an R-T-B-based alloy and a nitride of at least one element selected from the group consisting of iron and cobalt, wherein: R, T, and B indicate a rare-earth element, at least one transition element selected from the group consisting of iron and cobalt, and boron, respectively; the nitride is distributed preferentially to a surface part of the rare-earth sintered magnet; and the element contained in the nitride is the same as the transition element T. … 4. The rare-earth sintered magnet according to claim 1, wherein: the surface part is part extending by a depth of 2 .mu.m from a surface; and the surface part has a nitride content of 1 to 11 mass % in terms of nitrogen.
Filed: Jul 8, 2011 Issued: April 23, 2013 Expires: Jul 2031	8,425,695	Assignee: TDK Corporation (JAPAN)	Rare earth sintered magnet Abstract A rare earth sintered magnet includes a main phase that includes an R.sub.2T.sub.14B phase of crystal grain where R is one or more rare earth elements including Nd, T is one or more transition metal elements including Fe or Fe and Co, and B is B or B and C; a grain boundary phase in which a content of R is larger than a content of the R.sub.2T.sub.14B phase; and a grain boundary triple point that is surrounded by three or more main phases. The grain boundary triple point includes an R75 phase containing R of 60 at % to 90 at %, Co, and Cu. The relational expression 0.05.ltoreq.(Co+Cu)/R<0.5 is satisfied. An area where a Co-rich region overlaps with a Cu-rich region in a cross-sectional area of the grain boundary triple point is 60% or more.

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			What is claimed is: 1. A rare earth sintered magnet comprising ***[composition of matter]***. : a main phase that includes an R.sub.2T.sub.14B phase of crystal grain where R is one or more rare earth elements, T is Fe or Fe and Co, and B is B or B and C; a grain boundary phase in which a content of R is larger than a content of the R.sub.2T.sub.14B phase; and a grain boundary triple point that is surrounded by three or more main phases, wherein the grain boundary triple point includes an R-rich phase containing R of 90 at % or more, and an R75 phase containing R of 60 at % to 90 at %, Co, and Cu, 0.05.ltoreq.(Co+Cu)/R<0.45 is satisfied where (Co+Cu)/R is a composition ratio of R, Co, and Cu contained in the R75 phase in terms of atomic percentage, and an area where a Co-rich region overlaps with a Cu-rich region in a cross-sectional area of the grain boundary triple point on a cross section of the rare earth sintered magnet is 60% or more ***[composition of matter]***. 2. The rare earth sintered magnet according to claim 1, wherein a content of R in a magnet composition is of 25% by mass to 35% by mass. 3. The rare earth sintered magnet according to claim 1, wherein a content of Co in a magnet composition is of 0.6% by mass to 3.0% by mass. 4. The rare earth sintered magnet according to claim 1, wherein a content of Cu in a magnet composition is 0.05% by mass to 0.5% by mass.
Filed: March 25, 2008 Issued:	8,421,292	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Permanent magnet motor having composite magnets and manufacturing method thereof Abstract A permanent magnet motor includes: a rotor and a stator; and a plurality of

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April 16, 2013 Expires: March 2028			permanent magnets placed on either the rotor or the stator. Each permanent magnet is an R--Fe--B based rare-earth sintered magnet including a light rare-earth element RL (at least one of Nd and Pr) as a major rare-earth element R, and partially includes a high coercivity portion in which a heavy rare-earth element RH (at least one element selected from the group consisting of Dy, Ho and Tb) is diffused in a relatively higher concentration than in the other portion. The invention claimed is: 1. A permanent magnet motor comprising ***[composition of matte]*** : a rotor; a stator; and a plurality of permanent magnets located on either the rotor or the stator; wherein the permanent magnet is an R--Fe--B based rare-earth sintered magnet including light rare-earth element RL including at least one of Nd and Pr as a rare-earth element R, and partially includes a high coercivity portion in which a heavy rare-earth element RH including at least one element selected from the group consisting of Dy, Ho and Tb is diffused from a selected area of a surface of the permanent magnet in a relatively higher concentration than in other portions, the selected area of the surface of the permanent magnet defining a location of the high coercivity portion of the permanent magnet, the high coercivity portion and a portion other than the high coercivity portion being arranged at the surface of the permanent magnet; and an angle of the permanent magnet formed with respect to a rotation axis of the motor is A.degree., an angle of the high coercivity portion formed with respect to the rotation axis of the motor is B.degree., and B.degree./A.degree. is between more than 0% and not more than 40%. …. 8. A method for manufacturing ***[process/method]*** a permanent magnet motor, the method comprising the steps of: preparing a plurality of permanent magnets each of which is an R--Fe--B based rare-earth sintered magnet including a light rare-earth element RL including at least one of Nd and Pr as a

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			rare-earth element R, and partially including a high coercivity portion in which a heavy rare-earth element RH including at least one element selected from the group consisting of Dy, Ho and Tb is diffused in a relatively higher concentration than in the other portion, the high coercivity portion and a portion other than the high coercivity portion being arranged at a surface of the permanent magnet; and placing the plurality of permanent magnets on either a rotor or a stator; wherein the step of preparing a plurality of permanent magnets comprises the steps of: preparing an R--Fe--B based rare-earth sintered magnet including a light rare-earth element RL as a rare-earth element R; and forming a high coercivity portion by diffusing the heavy rare-earth element RH from a selected area of the surface of the R--Fe--B based rare-earth sintered magnet toward an inside of the magnet, the selected area of the surface of the permanent magnet defining a location of the high coercivity portion of the permanent magnet, the high coercivity portion and a portion other than the high coercivity portion being arranged at the surface of the permanent magnet; and the step of forming the high coercivity portion comprises: forming a mask layer having an opening that defines the selected area of the surface of the permanent magnet; and heating and vaporizing a bulk body including the heavy rare-earth element RH and diffusing the heavy rare-earth element into the selected area of the surface of the permanent magnet through the opening of the mask layer, the bulk body not being in contact with the surface of the permanent magnet. … 11. The method of claim 10, wherein the step of forming the high coercivity portion comprises: arranging the R--Fe--B based rare-earth sintered magnet and a bulk body including the heavy rare-earth element RH inside a processing chamber so as to face each other with a predetermined gap left between the R--Fe--B based rare-earth sintered magnet and the bulk body; and heating the processing chamber to vaporize the bulk body and diffuse the heavy rare-earth element into the selected area of the surface of the permanent magnet….

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Filed: Jul 23, 2007 Issued: April 16, 2013 Expires: Jul, 2027	8,420,160	Assignee: Intermetallics Co., Ltd. (JAPAN) (*a joint venture company of Daido Steel Co., Ltd., Mitsubishi Corporation and Molycorp, Inc.*)	Method for producing sintered NdFeB magnet Abstract The present invention provides a method for producing a sintered NdFeB magnethaving high coercivity and capable of being brought into applications without lowering its residual magnetic flux density or maximum energy product and without reprocessing. The method for producing a sintered NdFeB magnet according to the present invention includes applying a substance containing dysprosium (Dy) and/or terbium (Tb) to the surface of the sintered NdFeB magnet forming a base body and then heating the magnet to diffuse Dy and/or Tb through the grain boundary and thereby increase the coercivity of the magnet. This method is characterized in that: (1) the substance containing Dy or Tb to be applied to the surface of the sintered NdFeB magnet is substantially a metal powder; (2) the metal powder is composed of a rare-earth element R and an iron-group transition element T, or composed of R, T and another element X, the element X capable of forming an alloy or intermetallic compound with R and/or T; and (3) the oxygen content of the sintered NdFeB magnet forming the base body is 5000 ppm or lower. The element T may contain nickel (Ni) or cobalt (Co) to produce an anticorrosion effect. The invention claimed is: 1. A method for producing ***[process/method]*** a sintered NdFeB magnet, comprising: applying a substance to a surface of the sintered NdFeB magnet, the substance being substantially a metal powder comprising (i) a rare earth element component (R) that is dysprosium and/or terbium and optionally at least one other rare earth element and (ii) an iron group transition element component (T) that is at least one member selected from the group consisting of iron, cobalt, and nickel; and then heating the magnet to diffuse dysprosium and/or terbium through grain boundaries of the magnet in order to increase coercivity of the magnet, wherein an oxygen content of the sintered NdFeB magnet is 5000 ppm or lower.

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Filed: Mar 28, 2007 Issued: April 16, 2013 Expires: Mar, 2027	8,420,010	Shin-Etsu Chemical Co., Ltd. (JAPAN)	Method for preparing rare earth permanent magnet material Abstract A method for preparing a rare earth permanent magnet material is characterized by comprising the steps of disposing a powder mixture on a surface of a sintered magnet body of R.sup.1--Fe--B composition wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y, the powder mixture comprising a powder containing at least 0.5% by weight of M which is at least one element selected from Al, Cu, and Zn and having an average particle size equal to or less than 300 .mu.m and a powder containing at least 30% by weight of a fluoride of R.sup.2 which is at least one element selected from rare earth elements inclusive of Sc and Y and having an average particle size equal to or less than 100 .mu.m, and heat treating the magnet body having the powder disposed on its surface at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas, for causing at least one of M and R.sup.2 in the powder mixture to be absorbed in the magnet body. The invention provides an R--Fe--B sintered magnet with high performance and a minimized amount of Tb or Dy used. The invention claimed is: 1. A method for preparing ***[process/method]*** a rare earth permanent magnet material, comprising the steps of: disposing a powder mixture on a surface of a sintered magnet body of R.sup.1--Fe--B composition wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y, said powder mixture comprising a powder containing at least 0.5% by weight of M which is at least one element selected from Al, Cu, and Zn and having an average particle size equal to or less than 300 and a powder containing at least 30% by weight of a fluoride of R.sup.2 which is at least one element selected from rare earth elements inclusive of Sc and Y and having an average particle

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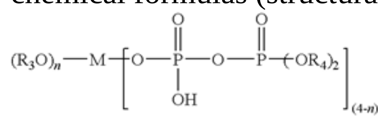
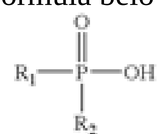
			size equal to or less than 100 .mu.m, and heat treating the magnet body having the powder disposed on its surface at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas, for absorption treatment for causing at least one of M and R.sup.2 in the powder mixture to be absorbed in the magnet body.
Filed: March 18, 2010 Issued: March 26, 2013 Expires: March 2030	8,404,141	Assignee: Minebea Co., Ltd. (Kitasaku-gun, JAPAN)	Rare earth bonded magnet Abstract A rare earth bonded magnet is provided which is produced such that a mixture which comprises: a rare earth magnet powder; a resin binder comprising a thermosetting resin; an organic phosphorus compound; and a coupling agent is compress-molded, heated and cured, wherein the organic phosphorus compound and the coupling agent are represented by the following respective chemical formulas (structural formulas): ##STR00001##  What is claimed is: 1. A rare earth bonded magnet produced such that ***[process/method]*** a mixture, which comprises: a rare earth magnet powder; a resin binder comprising a thermosetting resin; an organic phosphorus compound; and a coupling agent, is compress-molded, heated and cured, wherein the organic phosphorus compound is an organophosphate ester compound defined by a formula below: ##STR00009##  where: R.sub.1 and R.sub.2 are an organic group of at least one

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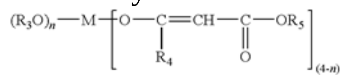
			kind including a hydrocarbon group; when R.sub.1 and R.sub.2 have two or more kinds of organic groups, the organic groups can be either identical to or different from one another; and the hydrocarbon group is one of an alkyl group and aryl group with a carbon number of 3 to 18 which can be either straight-chained, branched or cyclic in formation, and wherein the coupling agent is defined by a formula below: ##STR00010##  where: R.sub.3, R.sub.4 and R.sub.5 are an organic group of at least one kind including a hydrocarbon group; M is one element selected from Si, Ti and Zr; when R.sub.3, R.sub.4 and R.sub.5 have two or more kinds of organic groups, the organic groups can be either identical to or different from one another; n is an integer which corresponds to a number of coupling hands of M and which ranges from 1 to 3; and the hydrocarbon group is one of an alkyl group and aryl group with a carbon number of 3 to 18 which can be either straight-chained, branched or cyclic in formation. … 6. A rare earth bonded magnet produced ***[process/method]*** such that a mixture, which comprises: a rare earth magnet powder; a resin binder comprising a thermosetting resin; an organic phosphorus compound; and a coupling agent, is compress-molded, heated and cured, wherein the organic phosphorus compound is an organophosphate ester compound defined by a formula below: ##STR00011## where: R.sub.1 and R.sub.2 are an organic group of at least one kind including a hydrocarbon group; when R.sub.1 and R.sub.2 have two or more kinds of organic groups, the organic groups can be either identical to or different from one another; and the hydrocarbon group is one of an alkyl group and aryl group with a carbon number of 3 to 18 which can be either straight-chained, branched or cyclic in formation, and wherein the coupling agent is defined by a formula below: ##STR00012## where: R.sub.3 and R.sub.4 are an organic group of at least one kind including a hydrocarbon group; M is one element selected from Si, Ti and Zr; when R.sub.3 and R.sub.4 have two or more kinds of organic groups, the organic groups can be either

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			identical to or different from one another; n is an integer which corresponds to a number of coupling hands of M and which ranges from 1 to 3; and the hydrocarbon group is one of an alkyl group and aryl group with a carbon number of 3 to 18 which can be either straight-chained, branched or cyclic in formation. …
Filed: December 19, 2006 Issued: March 5, 2013 Expires; Dec 2026	8,388,769	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Powdered-iron magnet and rotating machine using the same Abstract To mold a high-resistance magnet at low temperature, including room temperature, the magnet includes magnetic powders, metallic powders having a lower hardness than the magnetic powders and a high-resistance layer, wherein the magnetic powders occupy a larger volume than the metallic powders. In particular, the high-resistance layer contains a fluorine compound and is placed between the magnetic powder and the metallic powders The invention claimed is: 1. A magnet comprising magnetic powders, metallic powders having a lower hardness than the magnetic powders and a high electrical resistance layer comprising a fluorine compound containing at least one rare earth metal and having a face-centered cubic crystal structure coated on at least one of the magnetic powders and the metallic powders, wherein the magnetic powders occupy a larger volume than the metallic powders ***[composition of matter]*** …. 9. A magnet produced by ***[process/method]*** molding a mixture of magnetic powders, metallic powders having a lower hardness than the magnetic powders and a high electrical resistance layer comprising a fluorine compound containing at least one rare earth metal and having a face-centered cubic crystal structure coated on at least one of the magnetic powders and the metallic powders. …

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Filed: Oct 24, 2011 Issued: March 5, 2013 Expires: Oct 2031	8,388,766	Assignee: Shin-Etsu Chemical Co., Ltd. (JAPAN)	Anisotropic rare earth sintered magnet and making method Abstract An anisotropic rare earth sintered magnet has a tetragonal R.sub.2Fe.sub.14B compound as a major magnetic phase, wherein R is Nd or a mixture of Nd with at least one rare earth element. Grains of the compound phase have two crystallographic axes, c and a-axes aligned. The biaxially aligned magnet exhibits a coercivity Hc of at least 1.6 MA/m. The invention claimed is: 1. An anisotropic rare earth sintered magnet comprising a tetragonal R.sub.2Fe.sub.14B compound as a major magnetic phase, wherein R is a rare earth element which is Nd or a combination of Nd with at least one member selected from the group consisting of Y, La, Ce, Pr, Sm, Eu, Gd, Ho, Er, Tm, Yb, and Lu ***[composition of matter]***, sintered grains of the tetragonal R.sub.2Fe.sub.14B phase having two crystallographic axes, and being biaxially aligned, in which the grains are aligned in c-axis direction and in which the grains are also separately aligned in the a-axis direction. 4. A method for preparing an anisotropic rare earth sintered magnet ***[process/method]*** comprising a tetragonal R.sub.2Fe.sub.14B compound as a major magnetic phase, wherein R a rare earth element which is Nd or a combination of Nd with at least one member selected from the group consisting of Y, La, Ce, Pr, Sm, Eu, Gd, Ho, Er, Tm, Yb, and Lu, the method comprising the steps of: providing a magnet powder comprising a tetragonal R.sub.2Fe.sub.14B compound as a major magnetic phase, grains of the tetragonal R.sub.2Fe.sub.14B phase powder having two crystallographic axes, c-axis as axis of easy magnetization and a-axis as axis of hard magnetization, compacting the powder while a first static magnetic field is applied across the

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			powder so as to align the c-axis in the magnetic field direction, and a second magnetic field substantially orthogonal to the first static magnetic field is overlappingly applied to align the a-axis, and sintering the resulting compact to form a sintered magnet in which the grains are aligned in c-axis direction and in which the grains are also separately aligned in the a-axis direction.
Filed: February 24, 2011 Issued: February 19, 2013 Expires: February 2031	8,377,233	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Preparation of rare earth permanent magnet material Abstract A method for preparing a rare earth permanent magnet material ***[process/method]*** comprises the steps of: disposing a powder comprising one or more members selected from an oxide of R.sup.2, a fluoride of R.sup.3, and an oxyfluoride of R.sup.4 wherein R.sup.2, R.sup.3 and R.sup.4 each are one or more elements selected from among rare earth elements inclusive of Y and Sc on a sintered magnet form of a R.sup.1--Fe--B composition wherein R.sup.1 is one or more elements selected from among rare earth elements inclusive of Y and Sc, and then heat treating the magnet form and the powder at a temperature equal to or below the sintering temperature of the magnet in vacuum or in an inert gas. The result high performance, compact or thin permanent magnet has a high remanence and coercivity at a high productivity.
Filed: June 19, 2007 Issued: February 12, 2013 Expires: June 2027	8,372,218	Assignee: Vacuumschmelze GmbH & Co. KG (Hanau, GERMANY)	Magnet core and method for its production Abstract Magnet cores pressed using a powder of nanocrystalline or amorphous particles and a pressing additive should be characterized by minimal iron losses. These particles have first surfaces represented by the original strip surfaces and second surfaces represented by surfaces produced in a pulverization process, the overwhelming majority of these second particle surfaces being smooth cut or fracture surfaces without any plastic deformation, the proportion T of areas of plastic deformation of the second particle surfaces

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			being 0.ltoreq.T.ltoreq.0.5. The invention claimed is: 1. A magnet core produced ***[process/method]*** from a composite of a powder of amorphous or nanocrystalline particles and from at least one pressing additive, wherein the particles comprise a first surface that formed a surface of the strip from which the particles were produced, and a second surface that did not form a surface of the strip, but was produced in a pulverisation process that formed the particles from the strip, wherein said pulverising occurs during a dwell time t in a pulverising chamber such that t<60 s, wherein these second particle surfaces include surfaces formed by fracture without any plastic deformation, such that the proportion T of areas of plastic deformation of the second particle surfaces is 0.ltoreq.T.ltoreq.0.5. … 5. The magnet core according to claim 1, wherein the particles have the alloy composition ***[composition of matter]*** (Fe.sub.1-aM.sub.a).sub.100-x-y-z-.alpha.-.beta.-.gamma.CU.sub.xSi-.sub.y-B.sub.zM'.sub.aM".sub..beta.X.sub..gamma., wherein M is Co and/or Ni, wherein M' is at least one element from the group consisting of Nb, W, Ta, Zr, Hf, Ti and Mo, wherein M' is at least one element from the group consisting of V, Cr, Mn, Al, elements of the platinum group, Sc, Y, rare earths, Au, Zn, Sn and Re, wherein X is at least one element from the group consisting of C, Ge, P, Ga, Sb, In, Be and As, and wherein a, x, y, z, .alpha., .beta. and .gamma. are specified in atomic percent and meet the following conditions: 0.ltoreq.a.ltoreq.0.5; 0.1.ltoreq.x.ltoreq.3; 0.ltoreq.y.ltoreq.30; 0.ltoreq.z.ltoreq.25; 0.ltoreq.y+.ltoreq.z.ltoreq.35; 0.1.ltoreq..alpha..ltoreq.30; 0.ltoreq..beta..ltoreq.10; and 0.ltoreq..gamma..ltoreq.10. … 16. A method for the production ***[process/method]*** of a magnet core, comprising: providing a strip or foil of an amorphous or nanocrystalline soft

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			magnetic alloy; pulverising the strip or foil in a pulverising chamber, wherein a sufficient degree of pulverising occurs by cutting and/or breaking of the amorphous or nanocrystalline magnetic alloy strip or foil to form powder particles that the number of powder particle surfaces that are formed during pulverizing and that are formed by fracture without any plastic deformation, are sufficient that the proportion T of areas of plastic deformation of these particle surfaces is 0.ltoreq.T.ltoreq.0.5, wherein said pulverising occurs during a dwell time t in the pulverising chamber such that t<60 s; removing the powder particles from the pulverising chamber on reaching their final particle size; mixing the powder particles with one or more pressing additives; pressing the resulting mixture to form a magnet core. …..
Filed: March 24, 2011 Issued: January 29, 2013 Expires: March 2031	8361242	Assignee: Vacuumschmeize GmbH & Co. KG (Hanau, GERMANY)	Powders for rare earth magnets, rare earth magnets and methods for manufacturing the same Abstract A powder consists essentially by weight, of 28.00.ltoreq.R.ltoreq.32.00%, where R is at least one rare earth element including Y and the sum of Dy+Tb>0.5, 0.50.ltoreq.B.ltoreq.2.00%, 0.50.ltoreq.Co.ltoreq.3.50%, 0.050.ltoreq.M.ltoreq.0.5%, where M is one or more of the elements Ga, Cu and Al, 0.25 wt %<O.ltoreq.0.5%, 0.15% or less of C, balance Fe. What is claimed: 1. A method ***[process/method]*** to produce powders for use in R--Fe--B--M type permanent magnets comprising: melting an alloy consisting of, by weight, 28.00.ltoreq.R.ltoreq.32.00%, where R is at least one rare earth element including Y and the sum of Dy+Tb>0.5, 0.50.ltoreq.B.ltoreq.2.00%, 0.50.ltoreq.Co.ltoreq.3.50%, 0.050.ltoreq.M.ltoreq.0.5%, where M is one or more of the elements Ga, Cu and Al, 0.25 wt %<O.ltoreq.0.5%, 0.15% or less of C, 0.15% or less of N, balance Fe, casting said alloy to form at least one

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			ingot, wherein the solidified ingot comprises finely dispersed .alpha.-Fe phase, and R.sub.2Fe.sub.14B and R-rich constituents; annealing said ingot at a temperature in the range of 800.degree. C. to 1200.degree. C. under an inert atmosphere of Ar or under vacuum to form an ingot which is free of said .alpha.-Fe phase; hydrogenating said ingots in hydrogen gas in order to hydrogenate the R-rich constituents; coarsely pulverising said ingot to form a coarsely pulverised powder; performing a fine pulverisation of said coarsely pulverised powder in an atmosphere comprising oxygen, thereby forming an oxidized, finely pulverised powder; wherein said finely pulverised powder comprises an oxygen content of 0.25 wt %<O.ltoreq.0.5 wt %. ……
Filed: April 23, 2012 Issued: January 8, 2013 Expires: April 2031	8,350,430	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rotating machine with sintered magnet and method for producing sintered magnet Abstract An R--Fe--B sintered magnet has a structure including main phase crystal grains and a grain boundary area surrounding the crystal grains. The sintered magnet includes fluorine and a specified metal element selected from elements belonging to Group 2 through Group 16 of periodic table excepting the rare earth element, carbon and boron. The fluorine has a higher concentration in a region closer to a magnet surface than in the center. The specified element also has a higher concentration in the region closer to the surface. The sintered magnet includes oxyfluoride containing carbon, Dy and the metal element in a grain boundary area region at a distance of 1 .mu.m or greater from the magnet surface, and the carbon has a higher concentration than the concentration of the metal element in a region at a distance of 1 .mu.m to 500 .mu.m from the magnet surface What is claimed is: 1. An R--Fe--B sintered magnet comprising ***[composition of matte]*** a rare

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			earth, iron and boron having a structure that includes main phase crystal grains and a grain boundary area surrounding the crystal grains, wherein: the sintered magnet includes fluorine and a specified metal element selected from elements belonging to Group 2 through Group 16 of periodic table excepting the rare earth element, carbon and boron, the fluorine has a concentration that is higher in a region closer to a surface of the magnet than in the center of the magnet, the specified metal element has a concentration which is higher in the region closer to the surface of the magnet than in the center of the magnet, the sintered magnet includes oxyfluoride containing carbon, Dy and the specified metal element in a region of the grain boundary area at a distance of equal to or greater than 1 .mu.m from the surface of the magnet, and the carbon has a concentration that is higher than the concentration of the specified metal element in a region at a distance of from 1 .mu.m to 500 .mu.m from the surface of the magnet 6. An R--Fe--B sintered magnet according to claim 1, wherein: the sintered magnet is a product obtained by ***[process/method]*** using a DyF-based solution in which an organic metal compound contains the specified metal element and heat treating the solution at a temperature in the range of from 400.degree. C. to 1,100.degree. C.
Filed: September 26, 2008 Issued: December 25, 2012 Expires: Sept 2038	8,337,714	Assignee: Dowa Electronics Materials Co., Ltd. (Tokyo, JAPAN) Dowa F-Tec Co., Ltd. (Okayama, JAPAN)	Ferrite powders for bonded magnet, process for the production of the powders, and bonded magnet made by using the same Abstract The present invention provides ferrite powders for bonded magnet capable of suppressing increase of SFD, while widening a particle size distribution for obtaining flowability and compressed density, and also capable of suppressing deterioration of orientation and magnetizability, and provides a process for a production magnetoplumbite-type ferrite powders containing an oxide of at least one or more kinds of transition metals selected from a group consisting of

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			Zr, Ti, Zn, Co, Mn, and Ni, having a mean particle size of 0.20 .mu.m or more and less than 5.00 .mu.m, being the ferrite powders for bonded magnet with the ratio of particles having particle size of 1 .mu.m or less being 20 mass % or more in the magnetoplumbite-type ferrite powder size distribution obtained by a laser diffraction type particle size distribution analyzer. What is claimed is: 1. Ferrite powders for bonded magnet, comprising ***[composition of matter]*** magneto-plumbite type ferrite fine powders having a mean particle size of 0.20 .mu.m or more and less than 1.00 .mu.m, wherein the magneto-plumbite type ferrite fine powders contain at least one oxide of a transition metal selected from the group consisting of Zr, Ti, Zn, Co, Mn, and Ni, and magneto-plumbite type ferrite coarse powders having a mean particle size of 1.00 .mu.m or more and less than 5.00 .mu.m, wherein a mixed amount of the magneto-plumbite type ferrite fine powders is 15 mass % or more and 40 mass % or less. …. 3. A process ***[process/method]*** for a production of ferrite powders for bonded magnet, comprising the steps of: preparing a magneto-plumbite type ferrit to obtain fine powders having a mean particle size of 0.20 .mu.m or more and less than 1.00 .mu.m, wherein the fine particles contain at least one oxide of a transition metal selected from the group consisting of Zr, Ti, Zn, Co, Mn, and Ni; preparing a magneto-plumbite type ferrite to obtain coarse powders having a mean particle size of 1.00 .mu.m or more and less than 5.00 .mu.m; and mixing the fine powders and the coarse powders, to produce ferrite powders with a mixing ratio of the fine powders and the coarse powders such that a mixed amount of fine powders is 15 mass % or more and 40 mass % or less.
Filed: August 10,	8,329,056	Assignee:	Anisotropic rare earth-iron based resin bonded magnet

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2010 Issued: December 11, 2012 Expires: Aug 2030		Minebea Co., Ltd. (Nagano, JAPAN)	Abstract Anisotropic rare earth-iron based resin bonded magnet comprises ***[composition of matter]*** : [1] a continuous phase including: (1) a spherical Sm.sub.2Fe.sub.17N.sub.3 based magnetic material covered with epoxy oligomer where its average particle size is 1 to 10 .mu.m, its average aspect ratio AR.sub.ave is 0.8 or more, and mechanical milling is not applied after Sm--Fe alloy is nitrided; (2) a linear polymer with active hydrogen group reacting to the oligomer; and (3) additive; and [2] a discontinuous phase being an Nd.sub.2Fe.sub.14B based magnetic material coated with the epoxy oligomer where its average particle size is 50 to 150 .mu.m, and its average aspect ratio AR.sub.ave is 0.65 or more, further satisfying: [3] the air-gap ratio of a granular compound on the phases is 5% or less; and [4] a composition where crosslinking agent with 10 .mu.m or less is adhered on the granular compound is formed at 50 MPa or less.
Filed: August 31, 2007 Issued: December 11, 2012 Expires: August 2027	8,327,524	Assignee: Vacuumscmelze GmbH & Co. KG (Hanau, GERMANY)	Inductive component and method for the production thereof Abstract Disclosed herein is an inductive component whose soft magnetic core is produced by ***[process/method]*** pouring a casting resin into a mold filled with a soft magnetic alloy powder and by subsequently hardening the casting resin with the alloy powder in order to form a solid soft magnetic core. This technique prevents the surface insulation of the alloy particles from becoming damaged, thereby largely preventing the formation of bulky eddy currents in the resulting soft magnetic cores. This enables a distinct reduction in the electric loss of the inductive component.
Filed: December 11, 2009	8,323,806	Assignee: Hitachi Metals, Ltd.	Rare earth magnet and method for producing same Abstract A rare-earth magnet includes a magnet body made of an R--Fe--B based rare-

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Issued: December 4, 2012 Expires: Dec 2029		(Tokyo, JAPAN)	earth magnet material (where R is at least one rare-earth element) and a metal film that has been deposited on the surface of the magnet body. The magnet further includes a plurality of reaction layers between the magnet body and the metal film. The reaction layers include: a first reaction layer, which contacts with at least some of R.sub.2Fe.sub.14B type crystals, included in the magnet body, to have received the rare-earth element that has been included in the R.sub.2Fe.sub.14B type crystals; and a second reaction layer, which is located between the first reaction layer and the metal film and which has a lower rare-earth element concentration than that of the first reaction layer. What is claimed is: 1. A method for producing a rare-earth sintered magnet ***[process/method]*** , the method comprising the steps of: providing a magnet body made of an R--Fe--B based rare-earth sintered magnet material, where R is at least one rare-earth element; depositing a metal film on the surface of the magnet body; and a heat treatment process step that is performed to form, between the magnet body and the metal film, a plurality of reaction layers including: a first reaction layer, which contacts with at least some of R.sub.2Fe.sub.14B type crystals included in the magnet body, to have received the rare-earth element that has been included in the R.sub.2Fe.sub.14B type crystals; and a second reaction layer, which is located between the first reaction layer and the metal film and which has a lower rare-earth element concentration than that of the first reaction layer; wherein the second reaction layer has received boron that has been included in the R.sub.2Fe.sub.14B type crystals and has a higher boron concentration than that of the first reaction layer.
Filed: March 30, 2009	8,317,941	Assignee: Hitachi Metals, Ltd.	R-T-B-type sintered magnet and method for production thereof Abstract An R-T-B based sintered magnet according to the present invention has a

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Issued: November 27, 2012 Expires: March 2029		(Tokyo, JAPAN)	composition including: 27.3 mass % to 29.5 mass % of R; 0.92 mass % to 1 mass % of B; 0.05 mass % to 0.3 mass % of Cu; 0.02 mass % to 0.5 mass % of M; and T as the balance, and has an oxygen content of 0.02 mass % to 0.2 mass %. The main phase of the sintered magnet is an R.sub.2T.sub.14B type compound. The crystal grain size of the main phase is represented by an equivalent circle diameter of 8 .mu.m or less. And crystal grains with equivalent circle diameters of 4 .mu.m or less account for at least 80% of the overall area of the main phase. The invention claimed is: 1. An R-T-B based sintered magnet having a composition comprising ***[composition of matter]*** : 27.3 mass % to 29.5 mass % of R, which is at least one of the rare-earth elements that include Y and of which at least 50 mass % is Pr and/or Nd; 0.92 mass % to 1 mass % of B; 0.05 mass % to 0.3 mass % of Cu; at most 0.5 mass % (including 0 mass %) of M, which is one, two, or more elements that are selected from the group consisting of Al, Ti, V, Cr, Mn, Ni, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Au, Pb and Bi; and T as the balance, which is Fe with or without Co and of which at least 50 mass % is Fe, and having an oxygen content of 0.02 mass % to 0.2 mass %, wherein the main phase of the sintered magnet is an R.sub.2T.sub.14B type compound, and wherein the crystal grain size of the main phase is represented by an equivalent circle diameter of 8 .mu.m or less and wherein crystal grains with equivalent circle diameters of 4 .mu.m or less account for at least 80% of the overall area of the main phase. 2. A method for producing ***[process/method]*** an R-T-B based sintered magnet having a composition comprising: 27.3 mass % to 29.5 mass % of R, which is at least one of the rare-earth elements that include Y and of which at least 50 mass % is Pr and/or Nd; 0.92 mass % to 1 mass % of B; 0.05 mass % to 0.3 mass % of Cu; at most 0.5 mass % (including 0 mass %) of M, which is one,

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			two, or more elements that are selected from the group consisting of Al, Ti, V, Cr, Mn, Ni, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Au, Pb and Bi; and T as the balance, which is Fe with or without Co and of which at least 50 mass % is Fe, and having an oxygen content of 0.02 mass % to 0.2 mass %, wherein the method comprises the steps of: providing, as a material alloy, a strip cast alloy that comprises R-rich phases in which an average interval between the R-rich phases is 4 .mu.m or less; exposing the material alloy to a hydrogen atmosphere, thereby getting the material alloy decrepitated and obtaining a coarse powder; obtaining a fine powder by finely pulverizing the coarse powder so that the fine powder has a particle size represented by a D50 of 3 .mu.m or less as measured by dry jet dispersion laser diffraction analysis and has an oxygen content of 0.2 mass % or less; obtaining a compact by performing a press compaction process on the fine powder under a magnetic field; and sintering the compact by keeping the compact heated to a temperature of 850.degree. C. to 1,000.degree. C. for 4 to 48 hours.
Filed: March 29, 2010 Issued: November 27, 2012 Expires: March 2030	8,317,937	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Alloy for sintered R-T-B-M magnet and method for producing same Abstract In order to make a sintered R-T-B-M magnet so that R.sub.2T.sub.14B phases that include a lot of Dy in the surface region of the main phase are distributed over the entire magnet, a region including a heavy rare-earth element RH at a high concentration is formed continuously beforehand at an interface between the crystals of an R.sub.2T.sub.14B compound that is the main phase of the sintered R-T-B-M magnet and the other phases. The invention claimed is: 1. A material alloy ***[composition of matter]*** used to produce a sintered R-T-B-M magnet having a composition that comprises: 12 at % to 17 at % of R, which represents rare-earth elements that include both a light rare-earth

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			element RL and a heavy rare-earth element RH and which includes either Nd or Pr as the light rare-earth element RL and at least one of Tb, Dy and Ho as the heavy rare-earth element RH; 5 at % to 8 at % of B, part of which is replaceable with C; 2 at % or less of an additive element M, which is at least one element selected from the group consisting of Al, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Pb and Bi; and T (which is a transition metal that includes Fe as a major component and that possibly includes Co) and inevitable impurities as the balance, wherein a continuous region where the heavy rare-earth element RH has a high concentration is present at an interface between crystals of an R.sub.2T.sub.14B compound that is a main phase and an R-rich phase so as to cover a length of at least 10 .mu.m along the major axis of the crystals of the R.sub.2T.sub.14B compound. 2. A method for producing a material alloy ***[process/method]*** used to produce a sintered R-T-B-M magnet, the method comprising the steps of: providing an R-T-B-M master alloy that includes: 12 at % to 17 at % of R, which represents rare-earth elements that include both a light rare-earth element RL and a heavy rare-earth element RH and which always includes either Nd or Pr as the light rare-earth element RL and at least one of Tb, Dy and Ho as the heavy rare-earth element RH; 5 at % to 8 at % of B, part of which is replaceable with C; 2 at % or less of an additive element M, which is at least one element selected from the group consisting of Al, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Pb and Bi; and T (which is a transition metal that includes Fe as a major component and that possibly includes Co) and inevitable impurities as the balance; providing a metal or alloy of the heavy rare-earth element RH that includes 20 at % or more of the heavy rare-earth element RH; and putting the R-T-B-M master alloy and the metal or alloy of the heavy rare-earth element RH in a processing space with a gap between the R-T-B-M master alloy and the metal or alloy of the heavy rare-earth element RH and subjecting the master alloy and the metal or alloy of the heavy rare-earth element RH to a heat treatment at a temperature of 600.degree. C. to

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			1,000.degree. C. within an atmosphere at a pressure of 10 Pa or less for at least 10 minutes and up to 48 hours. ….
Filed: Sept 15, 2009 Issued: November 20, 2012 Expires: Sept 2029	8,313,801	Assignee: Magnequench, Inc. (Republic of Singapore)	Coating formulation and application of organic passivation layer onto iron-based rare earth powders Abstract The present disclosure relates to coating formulations for neodymium-iron-boron type magnetic powders manufactured from rapid solidification processes for the purpose, inter alia, of corrosion and oxidation resistance when exposed to aggressive environments. The coating formulation preferably contains an epoxy binder, curing agent, an accelerating agent, and a lubricant. By incorporating coupling agents and optionally, other specialty additives with the magnetic powder and the organic epoxy components, additional oxidation and corrosion prevention, enhanced adhesion and dispersion between the filler and matrix phases can be achieved. This disclosure relates to all such rare earth-transition metal-boron (RE-TM-B) powders produced by rapid solidification and encompasses both the bonded magnet products that include combinations of the materials mentioned and the application processes. What is claimed is: 1. A process of making ***[process/method]*** a liquid-coated rapidly solidified rare earth-transition metal-boron magnet material, the process comprising: providing a homogeneous solution comprising a solvent, one or more of an organotitanate or organozirconate coupling agents, an epoxy resin, a hardener, an accelerator, and a lubricant; combining a rare earth-transition metal-boron magnet powder with said homogeneous solution to form a slurry mixture; stirring said slurry mixture periodically; and maintaining said slurry mixture at a temperature between 40-60.degree. C., such that said solvent evaporates and a coating is formed on the magnet powder; wherein the coupling agent has a

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			general form of (RO--).sub.n(Ti or Zr)(--OR'Y).sub.4-n where R is a neopentyl(diallyl), dioctyl, or (2,2-diallyloxymethyl)butyl group, Ti or Zr has a coordination number of 4, R' is a phosphito, pyrophosphato or cyclic pyrophosphato segment, and Y is a dioctyl or ditridecyl end group, with 1.ltoreq.n.ltoreq.4; and wherein the amount of the coupling agent in the coating that is formed is about 0.1 weight percent to about 1 weight percent of the coated magnet powder….. 12. A process of making ***[process/method]*** a liquid-coated rapidly solidified rare earth-transition metal-boron magnet material, the process comprising: providing a homogeneous solution comprising a solvent, one or more of an organotitanate or organozirconate coupling agents, an epoxy resin, a hardener, an accelerator, and a lubricant; combining a rare earth-transition metal-boron magnet powder with said homogeneous solution to form a slurry mixture; and evaporating the solvent to form a coating on the magnet powder; wherein the coupling agent has a general form of (RO--).sub.n(Ti or Zr)(--OR'Y).sub.4-n where R is a neopentyl(diallyl), dioctyl, or (2,2-diallyloxymethyl)butyl group, Ti or Zr has a coordination number of 4, R' is a phosphito, pyrophosphato or cyclic pyrophosphato segment, and Y is a dioctyl or ditridecyl end group, with 1.ltoreq.n.ltoreq.4; and wherein the amount of the coupling agent in the coating that is formed is about 0.1 weight percent to about 1 weight percent of the coated magnet powder. …
Filed: Feb 13, 2007 Issued: Nov 6, 2012 Expires:	8,303,837	Assignee: Hitachi Metals, Ltd. (Japan)	Rotating machine, bonded magnet, magnet roll, and method for producing sintered ferrite magnet Abstract A rotating machine comprising a sintered ferrite magnet having an M-type ferrite structure, comprising Ca, an R element that is at least one of rare earth elements and indispensably includes La, Ba, Fe and Co as indispensable elements, and having a composition represented by the formula: Ca.sub.1-x-

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Feb. 2027			yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z, wherein (1-x-y), x, y, z and n represent the contents of Ca, the R element, Ba and Co, and a molar ratio, meeting 0.3.ltoreq.1-x-y.ltoreq.0.65, 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.03.ltoreq.z.ltoreq.0.65, 4.ltoreq.n.ltoreq.7, and 1-x-y>y; a bonded magnet comprising ferrite powder having the above composition and a binder, and a magnet roll, at least one magnetic pole portion of which is made of the above bonded magnet. What is claimed is: 1. A magnet roll , at least one magnetic pole portion of which is made of a ***[composition of matter]*** bonded magnet comprising ferrite powder and a binder, said ferrite powder having an M-type ferrite structure, comprising Ca, an R element that is at least one of rare earth elements and indispensably includes La, Ba, Fe and Co as indispensable elements, and having a composition represented by the following general formula: Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z (by atomic ratio), wherein (1-x-y), x, y, z and n represent the contents of Ca, the R element, Ba and Co, and a molar ratio, meeting 0.3.ltoreq.1-x-y.ltoreq.0.65, 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.03.ltoreq.z.ltoreq.0.65, 4.ltoreq.n.ltoreq.7, and 1-x-y>y ….
Filed: Jan 29, 2010 Issued: November 6, 2012 Expires: Jan 2030	8,303,732	Assignee: Hitachi, Ltd. (Japan)	Rare earth magnet Abstract A rare earth magnet having a composition represented by RTB wherein R denotes a rare earth element, T a transition metal and B boron, the magnet being composed of magnet powder constituted by crystalline particles. The particles of the magnetic powder have a ratio of a short diameter being 10 .mu.m or more to a long diameter is 0.5 or less. An element Rm having a magnetic anisotropy higher than that of the rare earth element is contained in the surface and inside of the magnet constituted by the magnet powder in an

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			approximately constant concentration. An oxy-fluoride and carbon are present at boundaries of the particles of the magnet powder. What is claimed is: 1. A rare earth magnet having a composition ***[composition of matter]*** represented by RTB wherein R denotes a rare earth element, T a transition metal and B boron, the magnet being composed of particles of magnetic powder constituted by crystalline particles, wherein the particles of the magnetic powder have a flat form in which a ratio of a short diameter to a long diameter is 0.5 or less, wherein an element Rm having a magnetic anisotropy higher than that of the rare earth element is contained in the surface and inside of the magnet constituted by the magnet powder, a concentration of Rm in the surface of the crystalline particles being higher than that of the inside thereof, wherein a size of the crystalline particles in c-axis is 20 to 100 nm, and a size in a direction perpendicular to the c-axis is 100 to 400 nm, and wherein an oxy-fluoride and carbon are present at least at crystal grain boundaries of the particles of the magnet powder. … 6. A rare earth magnet having a composition represented by RTB ***[composition of matter]*** wherein R denotes a rare earth element, T a transition metal and B boron, wherein the magnet is composed of magnet powder constituted by crystalline particles, wherein the particles of the magnetic powder have a flat form, wherein an oxy-fluoride and carbon are present at least at crystal grain boundaries of the particles of the magnet powder, wherein an element Rm having a magnetic anisotropy higher than that of the rare earth element is contained in the surface and inside of the magnet constituted by the magnet powder, wherein a concentration of Rm in the surface of the magnet powder is higher than inside of the magnet powder, and wherein a size of the crystalline particles in c-axis is 20 to 100 nm, and a size in a direction perpendicular to the c-axis is 100 to 400 nm.

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Filed: Feb 7, 2012 Issued: Oct30, 2012 Expires: Feb 2032	8,298,469	Assignee: Siemens Aktiengesellschaft (Germany)	Method for manufacturing magnet poles Abstract A method for manufacturing sintered magnet poles is described. The mold is filled with a vitrifiable base material powder and closed with a plate. A magnetic field aligns the powder and a plate pressed onto the powder establishes a compact that holds the alignment in place. The compact is sintered to form a sintered magnet pole. The mold forms a protective cover of the sintered magnet pole and the plate forms a base plate of a magnet pole piece. Furthermore, a magnet pole piece is provided which has a magnet pole and a base plate which is fixed to a protective cover so that the base plate and the protective cover surround the magnet pole. The base plate and/or the protective cover of the magnet pole piece has at least one element that provides a geometrical locking of the magnet pole to the base plate and/or the protective cover. The invention claimed is: 1. A method for manufacturing ***[process/method]*** sintered magnet poles, comprising: providing a mould having a first opening; filling a vitrifiable randomly oriented base material powder into the mould through the first opening; closing the first opening with a plate; placing the mould with the randomly oriented powder into a magnetic field to align the randomly oriented powder into aligned powder; pressing the plate onto the aligned powder to establish a compact that holds the alignment of the aligned powder in place; sintering the compact while the compact is oriented over the plate inside the mould to form a sintered magnet pole that adheres to the plate as a result of the sintering process, wherein a gap is formed between the sintered magnet pole and the mould due to shrinkage of the compact during sintering; simultaneously pressing the mould inside a die during sintering, wherein the

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			mould is initially provided in a rough shape, and wherein the rough shape is converted to a final shape as a result of said pressing; quenching and then heat treating the sintered magnet pole; fixing the mould to the plate before or after quenching or heat treatment; introducing a filling material into the gap by vacuum injection after fixing the mould to the plate; and using the protective cover and base plate as part of the final product, wherein the mould ultimately forms a protective cover of the sintered magnet pole and the plate ultimately forms a base plate of a magnet pole piece.
Filed: July 23, 2008 Issued: October 30, 2012 Expires: July 2028	8,298,352	Assignee: Vacuumschmelze GmbH & Co. KG (Germany)	Method for the production of magnet cores, magnet core and inductive component with a magnet core Abstract A magnet core (1) made of a composite of platelet-shaped particles of a thickness D and a binder has a particularly linear relative permeability curve over a pre-magnetised constant field. For this purpose, the platelet-shaped particles (5) are provided with an amorphous volume matrix (8), wherein areas (9) with a crystalline structure having a thickness d of 0.04*D.ltoreq.d.ltoreq.0.25*D and covering a proportion x of x.gtoreq.0.1 of the surface (6, 7) of the particle (5) are embedded on the surface (6, 7) of the particle (5). The invention claimed is: 1. A magnet core comprising a ***[composition of matter]*** composite of: (a) platelet-shaped particles of a magnetic alloy, each comprising an amorphous volume matrix and two opposing main surfaces which are separated by a thickness D, wherein extending into the amorphous volume matrix from at least one of the surfaces are embedded areas having a crystalline structure, which embedded areas extend into the amorphous volume matrix a thickness d, such that 0.04*D.ltoreq.d.ltoreq.0.25*D and which embedded areas cover a

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			proportion x of the surface of the platelet-shaped particles such that x.gtoreq.0.1; and (b) a binder.
Filed: May 9, 2011 Issued: Oct 30, 2012 Expires: May 2031	8,298,351	Assignee: Shin-Etsu Chemical Co., Ltd. (Japan)	R-T-B rare earth sintered magnet Abstract A rare earth sintered magnet consists essentially of 26-36 wt % R, 0.5-1.5 wt % B, 0.1-2.0 wt % Ni, 0.1-3.0 wt % Si, 0.05-1.0 wt % Cu, 0.05-4.0 wt % M, and the balance of T and incidental impurities wherein R is a rare earth element, T is Fe or Fe and Co, M is selected from Ga, Zr, Nb, Hf, Ta, W, Mo, Al, V, Cr, Ti, Ag, Mn, Ge, Sn, Bi, Pb, and Zn. Simultaneous addition of Ni, Si, and Cu ensures magnetic properties and corrosion resistance. The invention claimed is: 1. A R-T-B rare earth sintered magnet in the form of a sintered body having a composition ***[composition of matter]*** consisting essentially of, in % by weight, 26 to 36% of R, 0.5 to 1.3% of B, 0.1 to 2.0% of Ni, 0.1 to 3.0% of Si, 0.05 to 1.0% of Cu, 0.05 to 4.0% of M, and the balance of T and incidental impurities, wherein R is one or more element selected from rare earth elements including Y and Sc, T is Fe or Fe and Co, M is one or more element selected from the group consisting of Ga, Zr, Nb, Hf, Ta, W, Mo, Al, V, Cr, Ti, Ag, Mn, Ge, Sn, Bi, Pb, and Zn, and a phase of compound containing R, Co, Si, Ni and Cu precipitates within the sintered body.
Filed: July 11, 2007 Issued: October	8,287,664	Assignee: Vacuumschmelze GmbH & Co. KG (Germany)	Method for the production of magnet cores, magnet core and inductive component with a magnet core Abstract A magnet core is required to be particularly dense, made of alloys produced in a rapid solidification process and have a minimal coercive field strength. To

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16, 2012 Expires: July 2027			achieve these aims, a coarse-grain powder fraction is first produced from an amorphous strip of a soft magnetic alloy. In addition, at least one fine-grain powder fraction is produced from a nanocrystalline strip of a soft magnetic alloy. The particle fractions are then mixed to produce a multi-modal powder, wherein the particles of the coarse-grain particle fraction have an amorphous structure and the particles of the fine-grain powder fraction have a nanocrystalline structure. The multi-modal powder is then pressed to produce a magnet core. The invention claimed is: 1. A method for the production of a magnet core ***[process/method]*** , comprising: producing from an amorphous soft magnetic strip at least one coarse-grain powder fraction having particle diameters between 70 and 200 .mu.m; producing from a nanocrystalline soft magnetic strip made of an alloy capable of nanocrystallisation at least one fine-grain powder fraction having particle diameters between 20 and 63 .mu.m; mixing of the coarse- and fine-grain powder fractions to produce a powder mixture with a multi-modal particle size distribution, wherein the particles of the coarse-grain particle fraction have an amorphous structure and the particles of the fine-grain powder fraction have a nanocrystalline structure; pressing of the multi-modal powder mixture to produce a magnet core.

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Filed: Jan 14, 2010 Issued: October 16, 2012 Expires: Jan 2030	8,287,661	Assignee: Hitachi Metals, Ltd. (Japan)	Method for producing R-T-B sintered magnet Abstract A method for producing a sintered R-T-B based magnet includes the steps of: providing R-T-B based alloy powders A and B so that the R-T-B based alloy powder B has a particle size D50 that is smaller by at least 1.0 .mu.m than that of the R-T-B based alloy powder A and that there is a difference .DELTA.RH of at least 4 mass % between the higher content of a heavy rare-earth element RH in the R-T-B based alloy powder B and the lower content of the heavy rare-earth element RH in the R-T-B based alloy powder A; mixing these two R-T-B based alloy powders A and B together; compacting the mixed R-T-B based alloy powder to obtain a compact with a predetermined shape; and sintering the compact. The invention claimed is: 1. A method for producing ***[process/method]*** a sintered R-T-B based magnet, the method comprising the steps of: providing R-T-B based alloy powders A and B, wherein the powder A includes 27.3 mass % to 31.2 mass % of R (which is at least one of the rare-earth elements), 0.92 mass % to 1.15 mass % of B, and T as the balance (where T is either Fe alone or Fe and Co and where Co accounts for at most 20 mass % of T if T includes Fe and Co) and wherein the powder B includes 27.3 mass % to 36.0 mass % of R (which is at least one of the rare-earth elements), 0.92 mass % to 1.15 mass % of B, and T as the balance (where T is either Fe alone or Fe and Co and where Co accounts for at most 20 mass % of T if T includes Fe and Co); mixing these two R-T-B based alloy powders A and B together; compacting the mixed R-T-B based alloy powder to obtain a compact with a predetermined shape; and sintering the compact, wherein R included in the R-T-B based alloy powder B includes 4 mass % to 36 mass % of heavy rare-earth element RH, which is at least one of Dy and Tb, and wherein the content of the heavy rare-earth element RH in the

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			R-T-B based alloy powder B is larger by at least 4 mass % than the content of the heavy rare-earth element RH in the R-T-B based alloy powder A, and wherein the particle size D50 of the R-T-B based alloy powder B is smaller by at least 1.0 .mu.m than the particle size D50 of the R-T-B based alloy powder A.
Filed: Oct 27, 2010 Issued: October 2, 2012 Expires: Oct 2030	8,277,578	Assignee: Shin-Etsu Chemical Co., Ltd. (Japan)	Rare earth permanent magnet and its preparation Abstract A rare earth permanent magnet is prepared by disposing a powdered metal alloy containing at least 70 vol % of an intermetallic compound phase on a sintered body of R--Fe--B system and heating the sintered body having the powder disposed on its surface below the sintering temperature of the sintered body in vacuum or in an inert gas for diffusion treatment. The advantages include efficient productivity, excellent magnetic performance, a minimal or zero amount of Tb or Dy used, an increased coercive force, and a minimized decline of remanence.

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			The invention claimed is: 1. A rare earth permanent magnet, which is prepared by ***[process/method]*** disposing an alloy powder on a surface of an original sintered body of the composition R.sub.a-T.sup.1.sub.b-B.sub.cwherein R is at least one element selected from rare earth elements inclusive of Y and Sc, T.sup.1 is at least one element selected from Fe and Co, B is boron, "a," "b" and "c" indicative of atomic percent are in the range: 12.ltoreq.a.ltoreq.20, 4.0.ltoreq.c7.0, and the balance of b, said alloy powder having the composition M.sup.1.sub.d-M.sup.2.sub.ewherein each of M.sup.1 and M.sup.2is at least one element selected from the group consisting of Al, Si, C, P, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pb, and Bi, M.sup.1 is different from M.sup.2, "d" and "e" indicative of atomic percent are in the range: 0.1.ltoreq.e.ltoreq.99.9 and the balance of d, and containing at least 70% by volume of an intermetallic compound phase, and heat treating the sintered body having the alloy powder disposed on its surface at a temperature equal to or below the sintering temperature of the original sintered body in vacuum or in an inert gas, wherein at least one element of M.sup.1 and at least one element of M.sup.2 in the alloy powder is diffused to grain boundaries in the interior of the sintered body and/or near grain boundaries within sintered body primary phase grains, and not into the interior of primary phase grains, so that the coercive force of the magnet is increased over the magnet properties of the original sintered body. 2. The rare earth permanent magnet according to claim 1, wherein ***[composition of matter]*** the at least one element of M.sup.1 and the at least one element of M.sup.2 in the alloy powder is diffused to grain boundaries in the interior of the sintered body and near grain boundaries within sintered body primary phase grains so that the coercive force of the magnet is increased over the magnet properties of the original sintered body.

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Filed: May 18, 2007 Issued: September 18, 2012 Expires: May 2027	8,268,093	Assignee: Hitachi Metals, Ltd. (Japan)	R-Fe-B porous magnet and method for producing the same Abstract An R--Fe--B based porous magnet according to the present invention has an aggregate structure of Nd.sub.2Fe.sub.14B type crystalline phases with an average grain size of 0.1 .mu.m to 1 .mu.m. At least a portion of the magnet is porous and has micropores with a major axis of 1 .mu.m to 20 .mu.m. The invention claimed is: 1. A method ***[process/method]*** for producing an R--Fe--B based porous magnet, the method comprising the steps of: providing an R--Fe--B based rare-earth alloy powder with a mean particle size that is less than 10 .mu.m; making a powder compact by compacting the R--Fe--B based rare-earth alloy powder; producing hydrogenation and disproportionation reactions by heat-treating the powder compact at a temperature of 650.degree. C. to less than 900.degree. C. within a hydrogen gas; producing desorption and recombination reactions by heat-treating the powder compact at a temperature of 650.degree. C. to less than about 900.degree. C. within either a vacuum or an inert atmosphere, which forms an R--Fe--B based porous magnet that has a density of 3.5 g/cm.sup.3 to 7.0 g/cm.sup.3 and that has micropores with a major axis of 1 .mu.m to 20 .mu.m; and decreasing a temperature of the R--Fe--B based porous magnet to room temperature, which forms the R--Fe--B based porous magnet that has a density of 3.5 g/cm.sup.3 to 7.0 g/cm.sup.3 at room temperature. .. 4. The method of claim 1, wherein the R--Fe--B based rare-earth alloy powder is obtained by pulverizing a rapidly solidified alloy. … 8. A method of making an R--Fe--B based magnet powder, the method

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			comprising the steps of: making a powder compact by compacting an R--Fe--B based rare-earth alloy powder with a mean particle size that is less than 10 .mu.m; producing hydrogenation and disproportionation reactions by heat-treating the powder compact at a temperature of 650.degree. C. to less than 900.degree. C. within a hydrogen gas; producing desorption and recombination reactions and forming an R--Fe--B based porous magnet by heat-treating the powder compact at a temperature of 650.degree. C. to less than about 900.degree. C. within either a vacuum or an inert atmosphere, which forms an R--Fe--B based porous magnet that has a density of 3.5 g/cm.sup.3 to 7.0 g/cm.sup.3 and that has micropores with a major axis of 1 .mu.m to 20 .mu.m; and pulverizing the R--Fe--B based porous magnet …
Filed: Dec 19, 2007 Issued: Sept 11, 2012 Expires: Dec 2027	8,262,808	Assignee: ULVAC, Inc. (Japan)	Permanent magnet and method of manufacturing same Abstract There is provided a method of manufacturing a permanent magnet which has an extremely high coercive force and high magnetic properties is manufactured at high productivity. There are executed: a first step of causing at least one of Dy and Tb to adhere to at least part of a surface of iron-boron-rare-earth based sintered magnet; and a second step of diffusing, through heat-treatment at a predetermined temperature, at least one of Dy and Tb adhered to the surface of the sintered magnet into grain boundary phase of the sintered magnet. As the sintered magnet, there is used one which is manufactured by: mixing each powder of principal phase alloy (constituted primarily by R.sub.2T.sub.14B phase, where R is at least one rare earth element primarily including Nd and where T is a transition metal primarily including Fe), and a liquid phase alloy (having a higher content of R than R.sub.2T.sub.14B phase and primarily constituted by R-rich phase) in a predetermined mixing ratio; press-forming in magnetic field a mixed powder thus obtained; and sintering a press-formed body in vacuum or inert gas atmosphere

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			What is claimed is: 1. A method of manufacturing ***[process/method]*** a permanent magnet comprising: manufacturing an iron-boron-rare-earth based sintered magnet by: mixing a first powder and a second powder in a predetermined mixing ratio into a mixed powder, the first powder comprising a principal phase alloy including an R.sub.2T.sub.14B phase, where R is at least one rare earth element including Nd and where T is a transition metal including Fe, and the second powder comprising a liquid phase alloy including a higher content of R than the R.sub.2T.sub.14B phase of the first powder and a R-rich phase; press-forming the mixed powder oriented in a magnetic field into a press-formed body; and sintering the press-formed body in one of vacuum and inert gas atmosphere providing the manufactured sintered magnet and an evaporating material disposed at a distance from each other; providing, through a vapor atmosphere, the evaporating material comprising at least one of Dy and Tb to at least part of a surface of the sintered magnet; and diffusing, through heat-treatment at a first predetermined temperature, the at least one of Dy and Tb adhered to at least part of the surface of the sintered magnet into a grain boundary phase of the sintered magnet, before a thin film made of the evaporating material is formed on the at least part of the surface of the sintered magnet.
Filed: Oct 27, 2010 Issued: Aug 28, 2012 Expires: Oct 2030	8,252,123	Assignee: Shin-Etsu Chemical Co., Ltd. (Japan)	Rare earth permanent magnet and its preparation Abstract A rare earth permanent magnet is prepared by disposing a powdered metal alloy containing at least 70 vol % of an intermetallic compound phase on a sintered body of R--Fe--B system, and heating the sintered body having the powder disposed on its surface below the sintering temperature of the sintered body in vacuum or in an inert gas for diffusion treatment. The advantages include efficient productivity, excellent magnetic performance, a minimal or zero amount of Tb or Dy used, an increased coercive force, and a minimized

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			decline of remanence. The invention claimed is: 1. A method for preparing ***[process/method]*** a rare earth permanent magnet, comprising the steps of: disposing an alloy powder having an average particle size of up to 500 .mu.m on a surface of an original sintered body of the composition R.sub.a-T.sup.1.sub.b-B.sub.c wherein R is at least one element selected from rare earth elements inclusive of Y and Sc, T.sup.1 is at least one element selected from Fe and Co, B is boron, "a," "b" and "c" indicative of atomic percent are in the range: 12.ltoreq.a.ltoreq.20, 4.0.ltoreq.c.ltoreq.7.0, and the balance of b, said alloy powder having the composition R.sup.1.sub.xT.sup.2.sub.yM.sup.1.sub.z wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Y and Sc, T.sup.2 is at least one element selected from Fe and Co, M.sup.1 is at least one element selected from the group consisting of Al, Si, C, P, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pb, and Bi, x, y and z indicative of atomic percent are in the range: 5.ltoreq.x.ltoreq.85, 15<z.ltoreq.95, and the balance is y being greater than 0, and containing at least 70% by volume of an intermetallic compound phase, and heat treating the sintered body having the alloy powder disposed on its surface at a temperature equal to or below the sintering temperature of the original sintered body in vacuum or in an inert gas, for causing at least one element of R.sup.1 and at least one element of M.sup.1 in the powder to diffuse to grain boundaries in the interior of the sintered body and/or near grain boundaries within sintered body primary phase grains, said disposing step includes grinding an alloy having the composition R.sup.1.sub.xT.sup.2.sub.yM.sup.1.sub.z wherein R.sup.1, T.sup.2, M.sup.1, x, y and z are as defined above and containing at least 70% by volume of an intermetallic compound phase into a powder having an average particle size of up to 500 .mu.m, dispersing the powder in an organic solvent or water, applying the resulting slurry to the surface of the

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			sintered body, and drying.
Filed: April 12, 2007 Issued: July 31, 2012 Expires: Ap 2027	8,231,740	Assignee: Shin-Etsu Chemical Co., Ltd. (Japan)	Method for preparing rare earth permanent magnet material Abstract A rare earth permanent magnet material is prepared by covering a sintered magnet body of R.sup.1--Fe--B composition wherein R.sup.1 is a rare earth element, with a powder comprising at least 30% by weight of an alloy of R.sup.2.sub.aT.sub.bM.sub.cA.sub.dH.sub.e wherein R.sup.2 is a rare earth element, T is Fe and/or Co, and M is Al, Cu or the like, and having an average particle size up to 100 .mu.m, and heat treating the powder-covered magnet body at a suitable temperature, for causing R.sup.2, T, M and A in the powder to be absorbed in the magnet body. The invention claimed is: 1. A method ***[process/method]*** for preparing a rare earth permanent magnet material, comprising the steps of: disposing a powder on a surface of a sintered magnet body of R.sup.1--Fe--B composition wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y, said powder comprising at least 30% by weight of an alloy of R.sup.2.sub.aT.sub.bM.sub.cA.sub.dH.sub.e wherein R.sup.2 is at least one element selected from rare earth elements inclusive of Sc and Y, T is iron or iron and cobalt wherein the content of iron is 30 to 70 atom % based on T, M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, A is boron and/or carbon, H is hydrogen, and "a" to "e" is representative of atomic percentages based on the alloy and the range of "a", "c", "d" and "e" is 15.ltoreq.a.ltoreq.70, 0.1.ltoreq.c.ltoreq.10, 0.ltoreq.d.ltoreq.12, e=0, and the balance is b, and said powder having an average particle size equal to or less than 100 .mu.m, heat treating the magnet body having the powder disposed on

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			its surface at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas, for absorption treatment for causing R.sup.2 and at least one of T, M and A in the powder to be absorbed in the magnet body, and effecting an aging treatment at a lower temperature after the absorption treatment.
Filed: March 22, 2005 Issued: July 3, 2012 Expires: March 2025	8,211,327	Assignee: Shin-Etsu Chemical Co., Ltd. (Japan)	Preparation of rare earth permanent magnet material Abstract A method for preparing a rare earth permanent magnet material comprising the steps of ***[process/method]***: disposing a powder comprising one or more members selected from an oxide of R.sup.2, a fluoride of R.sup.3, and an oxyfluoride of R.sup.4 wherein R.sup.2, R.sup.3 and R.sup.4 each are one or more elements selected from among rare earth elements inclusive of Y and Sc on a sintered magnet form of a R.sup.1--Fe--B composition wherein R.sup.1 is one or more elements selected from among rare earth elements inclusive of Y and Sc, and heat treating the magnet form and the powder at a temperature equal to or below the sintering temperature of the magnet in vacuum or in an inert gas. The invention offers a high performance, compact or thin permanent magnet having a high remanence and coercivity at a high productivity.
Filed: June 25, 2008 Issued: June 26, 2012 Expires: June 2038	8,206,606	Assignee: Hitachi Metals, Ltd. (Japan)	Oxide magnetic material Abstract An oxide magnetic material [***composition of matter]*** includes a ferrite with a hexagonal structure as its main phase. Metallic elements included in the oxide magnetic material are represented by the formula: Ca.sub.1-x-x'La.sub.xSr.sub.x'Fe.sub.2n-yCo.sub.y, where atomic ratios x, x' and y and a molar ratio n satisfy 0.4.ltoreq.x.ltoreq.0.6, 0.01.ltoreq.x'.ltoreq.0.3, 0.2.ltoreq.y.ltoreq.0.45 and 5.2.ltoreq.n.ltoreq.5.8, respectively.

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			What is claimed is: 1. An oxide magnetic material ***[composition of matter]*** comprising a ferrite with a hexagonal structure as its main phase, wherein metallic elements included in the oxide magnetic material are represented by the formula: Ca.sub.1-x-x'La.sub.xSr.sub.x'Fe.sub.2n-yCo.sub.y, where atomic ratios x, x' and y and a molar ratio n satisfy: 0.4.ltoreq.x.ltoreq.0.55; 0.01.ltoreq.x'.ltoreq.0.2; 0.2.ltoreq.y.ltoreq.0.4; x/y.gtoreq.1.3; 1-x-x'.gtoreq.x'; and 5.2.ltoreq.n.ltoreq.5.8; respectively. … 11. An sintered magnet comprising ***[composition of matter]***a ferrite with a hexagonal structure as its main phase, wherein metallic elements included in the sintered magnet are represented by the formula: Ca.sub.1-x-x'La.sub.xSr.sub.x'Fe.sub.2n-yCo.sub.y, where atomic ratios x, x' and y and a molar ratio n satisfy: 0.4.ltoreq.x.ltoreq.0.55; 0.01.ltoreq.x'.ltoreq.0.2; 0.2.ltoreq.y.ltoreq.0.4; x/y.gtoreq.1.3; 1-x-x'.gtoreq.x'; and 4.3.ltoreq.n.ltoreq.5.8; respectively; and the sintered magnet is made by adding at least one of 1.8 mass % of less of CaCO.sub.3, 0.5 mass % or less of SrCO.sub.3, and 1.0 mass % of less of SiO.sub.2 to a calcined body of an oxide magnetic material and then sintering the mixture.
Filed: March 1, 2007 Issued: June 26, 2012 Expires: March 2027	8,206,516	Assignee: Hitachi Metals, Ltd. (Japan)	R--Fe--B rare earth sintered magnet and method for producing same Abstract In a method for producing an R--Fe--B based rare-earth sintered magnet according to the present invention, first, provided is an R--Fe--B based rare-earth sintered magnet body including, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R. Thereafter, the sintered magnet body is heated while a heavy rare-earth element RH, which is at least one element selected from the group consisting of Dy, Ho and Tb, is supplied to the surface of the sintered magnet body, thereby diffusing the

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			heavy rare-earth element RH into the rare-earth sintered magnet body. The invention claimed is: 1. A method for producing ***[process/method]*** an R--Fe--B based rare-earth sintered magnet, the method comprising the steps of: (a) providing an R--Fe--B based rare-earth sintered magnet body including, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R; (b) arranging a bulk body including a heavy rare-earth element RH, which is at least one element selected from the group consisting of Dy, Ho and Tb, along with the R--Fe--B based rare-earth sintered magnet body in a container; and (c) heating the container, by a heat treatment furnace in which the container is loaded, so that the bulk body and the R--Fe--B based rare-earth sintered magnet body arranged in the container are heated to a temperature of 700.degree. C. to 1,000.degree. C. to vaporize the heavy rare-earth element RH from the bulk body, thereby diffusing the heavy rare-earth element RH into the R--Fe--B based rare-earth sintered magnet body while supplying the heavy rare-earth element RH from the bulk body to the surface of the R--Fe--B based rare-earth sintered magnet body so that substantially no thin film made of the heavy rare-earth element RH is formed on the R--Fe--B based rare-earth sintered magnet body, wherein the step (c) includes arranging the bulk body and the R--Fe--B based rare-earth sintered magnet body out of contact with each other in the container and setting an average gap between the two bodies within the range of 0.1 mm to 300 mm, and wherein the step (c) includes setting a difference in temperature between the R--Fe--B based rare-earth sintered magnet body and the bulk body within 20.degree. C.
Filed: July 1, 2008	8,187,392	Assignee: Hitachi Metals, Ltd.	R-Fe-B type rare earth sintered magnet and process for production of the same Abstract

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Issued: May 29, 2012 Expires: July 2028		(Japan)	In an R--Fe--B based rare-earth sintered magnet according to the present invention, at a depth of 20 .mu.m under the surface of its magnet body, crystal grains of an R.sub.2Fe.sub.14B type compound have an (RL.sub.1-xRH.sub.x).sub.2Fe.sub.14B (where 0.2.ltoreq.x.ltoreq.0.75) layer with a thickness of 1 nm to 2 .mu.m in their outer periphery. In this case, the light rare-earth element RL is at least one of Nd and Pr, and the heavy rare-earth element RH is at least one element selected from the group consisting of Dy, Ho and Tb. The invention claimed is: 1. A method ***[process/method]*** for producing an R--Fe--B based rare-earth sintered magnet, the method comprising the steps of: (a) providing an R--Fe--B based rare-earth sintered magnet body, which includes, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound including a light rare-earth element RL (which is at least one of Nd and Pr) as a major rare-earth element R; (b) diffusing a heavy rare-earth element RH (which is at least one element selected from the group consisting of Dy, Ho and Tb) inside the R--Fe--B based rare-earth sintered magnet body; and (c) removing a surface portion of the R--Fe--B based rare-earth sintered magnet body, in which the heavy rare-earth element RH has been diffused, to a depth of 5 .mu.m to 500 .mu.m, wherein the step (b) includes the steps of: (b1) arranging a bulk body including the heavy rare-earth element RH (which is at least one element selected from the group consisting of Dy, Ho and Tb), along with the R--Fe--B based rare-earth sintered magnet body, in a processing chamber and arranging the bulk body and the R--Fe--B based rare-earth sintered magnet body out of contact with each other in the processing chamber and leaving an average gap of 0.1 mm to 300 mm between them; and (b2) heating the bulk body and the R--Fe--B based rare-earth sintered magnet body together to a temperature of 700.degree. C. to 1,000.degree. C., thereby diffusing the heavy rare-earth element RH inside the R--Fe--B based rare-earth sintered magnet body while

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			simultaneously supplying the heavy rare-earth element RH from the bulk body onto the surface of the R--Fe--B based rare-earth sintered magnet body ***[composition of matter]*** .
Filed: Oct 20, 2011 Issued: May 22, 2012 Expires: Oct 2031	8,183,732	Assignee: Panasonic Corporation (Japan)	Radial anisotropic magnet manufacturing method, permanent magnet motor using radial anisotropic magnet, and iron core-equipped permanent magnet motor Abstract To improve tranquility and controllability of an iron core-equipped permanent magnet motor with an improved maximum energy product (BH).sub.max by improving shape compatibility of a radial anisotropic magnet, there is provided a radial anisotropic magnet manufacturing method of fixing magnet powder in a net shape so as to maintain a magnetic anisotropic (C-axis) angle of a magnet with respect to a tangential line and for performing a deformation with a flow so as to have a predetermined circular arc shape or a predetermined annular shape. Particularly, by performing a deformation with a viscous flow or an extension flow, a deformability of the magnet is improved, and thus shape compatibility with respect to a thickness is. improved. A C-axis angle .theta. with respect to a tangential direction is controlled at an arbitrary position and an arbitrary angle so as to reduce cogging torque without separating a magnetic pole into segments. The invention claimed is: 1. An iron core-equipped permanent magnet motor comprising ***[composition of matter]*** an even number of radial anisotropic magnets: wherein the radial anisotropic magnets maintain a magnetic anisotropic angle of a magnet with respect to a tangential line by fixing magnet powder in a net shape, and have a predetermined circular arc shape or a predetermined annular shape by performing a deformation with a flow; wherein the pre-deformation magnet is

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			a resin composite of which a microstructure includes a magnet powder stationary phase A and a flow phase B, wherein a part of the phase B is chemically coupled to the phase A so as to fix the stationary phase A group in a net shape; wherein the magnet is deformed by a shear flow action and an extension flow action of the phase B; wherein the radial anisotropic magnets are manufactured by (i) manufacturing a deformed magnet including a perpendicular anisotropic part .alpha..sub.0 having a magnetic anisotropic angle of 90 degree with respect to a tangential line, a non-perpendicular anisotropic part .beta..sub.0 having a magnetic anisotropic angle .theta. in a range of 0 to 90 degree with respect to the tangential line, and a non-perpendicular anisotropic part .beta.'.sub.0 having .theta. in a range of 90 to 180 degree; and (ii) deforming the magnet into an annular shape or a circular arc shape so as to form a radial anisotropic part .alpha..sub.1 corresponding to the perpendicular anisotropic part .alpha..sub.0, a curved surface .beta..sub.1 corresponding to the non-perpendicular anisotropic part .beta..sub.0, and a curved surface .beta.'.sub.1 corresponding to the non-perpendicular anisotropic part .beta.'.sub.0; and wherein in the post-deformation radial anisotropic part .alpha..sub.1 corresponding to the pre-deformation perpendicular anisotropic part .alpha..sub.0, the post-deformation curved surface .beta..sub.1 corresponding to the pre-deformation non-perpendicular anisotropic part .beta..sub.0, and the post-deformation curved surface .beta.'.sub.1 corresponding to the pre-deformation non-perpendicular anisotropic part .beta.'.sub.0, the magnetic anisotropic angles with respect to the tangential line are the same before and after the deformation.
Filed: July 5, 2011 Issued: May 22,	8,182,619	Assignee: Hitachi Metals, Ltd. (Japan)	R-F e-B rare-earth sintered magnet and process for producing the same Abstract First, an R--Fe--B based rare-earth sintered magnet body including, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-

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2012 Expires: July 2031			earth element R is provided. Next, an M layer, including a metallic element M that is at least one element selected from the group consisting of Al, Ga, In, Sn, Pb, Bi, Zn and Ag, is deposited on the surface of the sintered magnet body and then an RH layer, including a heavy rare-earth element RH that is at least one element selected from the group consisting of Dy, Ho and Tb, is deposited on the M layer. Thereafter, the sintered magnet body is heated, thereby diffusing the metallic element M and the heavy rare-earth element RH from the surface of the magnet body deeper inside the magnet. What is claimed is: 1. An R--Fe--B based rare-earth sintered magnet comprising ***[composition of matter]*** , as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R, wherein the magnet further includes a metallic element M and a heavy rare-earth element RH, both of which have been introduced from a surface of the magnet by grain boundary diffusion into an interior of the magnet, the metallic element M being at least one element that is selected from the group consisting of Al, Ga, In, Sn, Pb, Bi, Zn and Ag, the heavy rare-earth element RH being at least one element that is selected from the group consisting of Dy, Ho and Tb, wherein the heavy rare-earth element RH is diffused to a depth of about 0.5 mm or more as measured from a surface of the magnet, and wherein each crystal grain of the R.sub.2Fe.sub.14B type compound has an outer periphery layer in which the heavy rare-earth element RH is more concentrated than in the interior of the crystal grain. ….
Filed: November 30, 2006	8,182,618	Assignee: Hitachi Metals, Ltd.	Rare earth sintered magnet and method for producing same Abstract A sintered rare-earth magnet includes an Nd.sub.2Fe.sub.14B type crystalline

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Issued: May 22, 2012 Expires: Nov. 2026		(Tokyo, JAPAN)	phase as its main phase and Al as an additive. The magnet includes at least one light rare-earth element LR selected from the group consisting of yttrium and the rare-earth elements other than Dy, Ho and Tb, and at least one heavy rare-earth element HR selected from the group consisting of Dy, Ho and Tb. The mole fractions .alpha.1, .alpha.2 and .beta. of the light and heavy rare-earth elements LR and HR and Al satisfy the inequalities 25.ltoreq..alpha.1+.alpha.2.ltoreq.40 mass %, 0<.alpha.2.ltoreq.40 mass %, .beta.>0.20 mass %, and 0.04.ltoreq..beta./.alpha.2.ltoreq.0.12. The invention claimed is: 1. A sintered rare-earth magnet comprising ***[composition of matter]*** an Nd.sub.2Fe.sub.14B type crystalline phase as its main phase and Al as an additive; wherein the rare-earth magnet includes at least one light rare-earth element LR selected from the group consisting of yttrium and the rare-earth elements other than Dy, Ho and Tb, and at least one heavy rare-earth element HR selected from the group consisting of Dy, Ho and Tb; and .alpha.1, .alpha.2 and .beta. of the light and heavy rare-earth elements LR and HR and Al satisfy the inequalities 25.ltoreq..alpha.1+.alpha.2.ltoreq.40 mass %, 4.0.ltoreq..alpha.2.ltoreq.40 mass %, .beta..gtoreq.0.35 mass %, and 0.04.ltoreq..beta./.alpha.2.ltoreq.0.12; and the rare-earth magnet further includes 0.01 to 0.2 mass % of at least one additive element M that is selected from the group consisting of Si, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Pb and Bi. 2. The sintered rare-earth magnet of claim 1, wherein the magnet is made of a sintered powder of a rapidly solidified alloy that has been obtained by a strip casting process. 3. A method for producing ***[process/method]*** a sintered rare-earth magnet, the method comprising the steps of: providing a rapidly solidified alloy that

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			includes at least one light rare-earth element LR, at least one heavy rare-earth element HR and Al as an additive, the at least one light rare-earth element LR being selected from the group consisting of yttrium and the rare-earth elements other than Dy, Ho and Tb, the at least one heavy rare-earth element HR being selected from the group consisting of Dy, Ho and Tb, .alpha.1, .alpha.2 and .beta. of the light and heavy rare-earth elements LR and HR and Al satisfying the inequalities 25.ltoreq..alpha.1+.alpha.2.ltoreq.40 mass %, 4.0.ltoreq..alpha.2.ltoreq.40 mass %, .beta..gtoreq.0.35 mass %, and 0 04.ltoreq..beta./.alpha.2.ltoreq.0.12; pulverizing the rapidly solidified alloy to make a powder; compacting the powder under a magnetic field to make a compact; and sintering the compact, thereby obtaining a sintered rare-earth magnet including an Nd.sub.2Fe.sub.14B type crystalline phase as its main phase; wherein the rapidly solidified alloy includes 0.01 to 0.2 mass % of at least one additive element M that is selected from the group consisting of Si, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Pb and Bi.
Filed: Sept 2, 2008 Issued: May 15, 2012 Expires: Sept. 2028	8,177,922	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-Fe-B anisotropic sintered magnet Abstract An R--Fe--B based anisotropic sintered magnet according to the present invention has, as a main phase, an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL (which is at least one of Nd and Pr) as a major rare-earth element R, and also has a heavy rare-earth element RH (which is at least one element selected from the group consisting of Dy and Tb). In the crystal lattice of the main phase, the c-axis is oriented in a predetermined direction. The magnet includes a portion in which at least two peaks of diffraction are observed within a 2.theta. range of 60.5 degrees to 61.5 degrees when an X-ray diffraction measurement is carried out using a CuK .alpha. ray on a plane that is located at a depth of 500 .mu.m or less under a pole face of the magnet and that is parallel to the pole face. The invention claimed is:

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			1. An R--Fe--B based anisotropic sintered magnet (where R is at least one of the rare-earth elements that include Y) comprising, ***[composition of matter]*** as a main phase, an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL (which is at least one of Nd and Pr) as a major rare-earth element R, and also comprising a heavy rare-earth element RH (which is at least one element selected from the group consisting of Dy and Tb), wherein the magnet includes a portion in which at least two peaks of diffraction are observed within a 2.theta. range of 60.5 degrees to 61.5 degrees when an X-ray diffraction measurement is carried out using a CuK.alpha. ray on a plane that is located at a depth of 500 .mu.m or less under a pole face of the magnet and that is parallel to the pole face.
Filed: July 25, 2008 Issued: May 15, 2012 Expires: July 2028	8,177,921	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-Fe-B rare earth sintered magnet Abstract An R--Fe--B based rare-earth sintered magnet according to the present invention includes, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes Nd, which is a light rare-earth element, as a major rare-earth element R. The magnet includes a heavy rare-earth element RH (which is at least one of Dy and Tb) that has been introduced through the surface of the sintered magnet by diffusion. The magnet has a region in which the concentration of the heavy rare-earth element RH in a grain boundary R-rich phase is lower than at the surface of the crystal grains of the R.sub.2Fe.sub.14B type compound but higher than at the core of the crystal grains of the R.sub.2Fe.sub.14B type compound. The invention claimed is: 1. An R--Fe--B based rare-earth sintered magnet comprising, ***[composition of matter]*** as a main phase, crystal grains of an R.sub.2Fe.sub.14B type

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			compound that includes Nd, which is a light rare-earth element, as a major rare-earth element R, wherein the magnet includes a heavy rare-earth element RH (which is at least one of Dy and Tb) that has been introduced through the surface of the sintered magnet by diffusion, and wherein the magnet has a region in which the concentration of the heavy rare-earth element RH in a grain boundary R-rich phase is lower than at the surface of the crystal grains of the R.sub.2Fe.sub.14B type compound but higher than at the core of the crystal grains of the R.sub.2Fe.sub.14B type compound.
Filed: December 23, 2009 Issued: April 17, 2012 Expires: Dec 2029	8,157,927	Assignee: DK Corporation (Tokyo, JAPAN)	Raw material alloy for R-T-B system sintered magnet, R-T-B system sintered magnet and production method thereof Abstract It is an object of the present invention to obtain a highly coercive R-T-B system sintered magnet by making the crystal microstructure of a raw material alloy prepared by strip casting more uniform, thereby making the crushed powder obtained from such raw material alloy more fine and making the size distribution more narrow. The present invention provides a raw material alloy for an R-T-B system sintered magnet containing grains of an R.sub.2T.sub.14B compound, wherein a P and/or S content is between 100 and 950 ppm. This raw material alloy preferably has a composition comprising 25 to 35% by weight of R, 0.5 to 4% by weight of B, 0.02 to 0.6% of one or both of Al and Cu, 5% by weight or less of Co, and the balance of Fe. What is claimed is: 1. A method ***[process/method]*** for producing an R-T-B sintered magnet, comprising a sintered body having grains comprising an R.sub.2T.sub.14B compound as a main phase, and comprising steps of: strip casting a raw material metal to prepare a raw material alloy having a total of P and S content between 100 and 950 ppm; milling the raw material alloy into a powder having a prescribed particle size; compacting the powder in a magnetic field to

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			fabricate a compacted body; and sintering the compacted body to obtain the sintered body having a total of P and S content between 10 and 220 ppm, wherein R represents one or more elements selected from rare earth elements, and T represents one or more elements selected from transition metal elements and comprises Fe, or Fe and Co.
Filed: Dec 19, 2007 Issued: April 17, 2012 Expires: Dec 2027	8,157,926	Assignee: Ulvac, Inc. (Kanagawa, JAPAN)	Permanent magnet and method of manufacturing same Abstract There is provided a method of manufacturing a permanent magnet in which Dy and/or Tb adhered to the surface of a sintered magnet containing a lubricant can be efficiently diffused and in which the permanent magnet having high magnetic properties can be manufactured at good productivity. The permanent magnet is manufactured by executing a first step of adhering at least one of Dy and Tb to at least a part of a surface of a sintered magnet made by sintering iron-boron-rare earth based alloy raw meal powder containing a lubricant; and a second step of heat-treating the sintered magnet at a predetermined temperature to thereby disperse at least one of Dy and Tb adhered to the surface of the sintered magnet into grain boundary phase of the sintered magnet. At this time, as the sintered magnet, there is used one manufactured in an average grain size within a range of 4 .mu.m.about.8 .mu.m. What is claimed is: 1. A method of manufacturing ***[process/method]*** a permanent magnet comprising; a first step of adhering at least one of Dy and Tb to at least a part of a surface of a sintered magnet made by sintering iron-boron-rare earth based alloy raw metal powder containing a lubricant; a second step of heat-treating the sintered magnet at a first predetermined temperature to thereby disperse the at least one of Dy and Tb adhered to the surface of the sintered magnet into grain boundary phase of the sintered magnet; wherein the sintered magnet

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			employed is manufactured to have an average grain size within a range of 4 .mu.m.about.8 .mu.m.
Filed: June 27, 2008 Issued: April 10, 2012 Expires: June 2028	8,152,936	Assignee: TDK Corporation (Tokyo, JAPAN)	Rare earth magnet Abstract There is provided a rare earth magnet with excellent Br and HcJ values. The rare earth magnet according to a preferred embodiment of the invention is characterized by being composed mainly of R (where R is at least one element selected from among rare earth elements including Y), B, Al, Cu, Zr, Co, O, C and Fe, wherein the content of each element is R: 25-34 wt %, B: 0.85-0.98 wt %, Al: 0.03-0.3 wt %, Cu: 0.01-0.15 wt %, Zr: 0.03-0.25 wt %, Co: .ltoreq.3 wt % (but not 0 wt %), O: .ltoreq.0.2 wt %, C: 0.03-0.15 wt % and Fe: remainder. The invention claimed is: 1. A rare earth (*magnet?)* ***[composition of matter]*** including a main phase magnet characterized by being composed mainly of R (where R is at least one element selected from among rare earth elements including Y, and R includes Nd and Dy as an essential element), B, Al, Cu, Zr, Co, O, C and Fe, wherein the content of each element is as follows: R: 25-34 wt % (where Dy content is 0.1-8 wt %) B: 0.85-0.98 wt % Al: 0.03-0.3 wt % Cu: 0.03-0.11 wt % Zr: 0.03-0.25 wt % Co: .ltoreq.3 wt % (but not 0 wt %) O: 0.03-0.1 wt % C: 0.03-0.15 wt % Fe: remainder.
Filed: April 11, 2008 Issued: March 27, 2012	8,142,573	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-T-B sintered magnet and method for producing the same Abstract An R-T-B based sintered magnet includes both a light rare-earth element R.sub.L (which is at least one of Nd and Pr) and a heavy rare-earth element R.sub.H (which is at least one of Dy and Tb) and Nd.sub.2Fe.sub.14B type

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Expires: April 2028			crystals as a main phase. The magnet has a first region, which includes either the heavy rare-earth element R.sub.H in a relatively low concentration or no heavy rare-earth elements R.sub.H at all, and a second region, which includes the heavy rare-earth element R.sub.H in a relatively high concentration. The first and second regions are combined together by going through a sintering process. The invention claimed is: 1. An R-T-B based sintered magnet comprising ***[composition of matter]*** : a light rare-earth element R.sub.L, which is at least one of Nd and Pr, a heavy rare-earth element R.sub.H, which is at least one of Dy and Tb, and Nd.sub.2Fe.sub.14B type crystals as a main phase; wherein a first region, which includes the heavy rare-earth element R.sub.H in a first concentration of zero or more heavy rare-earth elements R.sub.H, and a second region, which includes the heavy rare-earth element R.sub.H in a second concentration that is higher than the first concentration, are stacked in layers such that the layers extend across an entire length or width of the R-T-B based sintered magnet; and the first and second regions are sintered and combined together. …. 10. A method for producing ***[process/method]***an R-T-B based sintered magnet including both a light rare-earth element R.sub.L, which is at least one of Nd and Pr, and a heavy rare-earth element R.sub.H, which is at least one of Dy and Tb, and Nd.sub.2Fe.sub.14B type crystals as a main phase, the method comprising the steps of: providing a first material alloy powder, which includes either the heavy rare-earth element R.sub.H in a relatively low concentration or no heavy rare-earth elements R.sub.H at all, and a second material alloy powder, which includes the heavy rare-earth element R.sub.H in a relatively high concentration; forming a composite compact including a first compact portion made of the first material alloy powder that extends across an entire length or width of the composite compact and a second compact portion

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			made of the second material alloy powder that extends across the entire length or width of the composite compact; and sintering the composite compact, thereby making a sintered magnet in which the first and second compact portions have been combined together.
Filed: Dec 19, 2007 Issued: March 6, 2012 Expires: Dec 2027	8,128,760	Assignee: Ulvac, Inc. (Kanagawa, JAPAN)	Permanent magnet and method of manufacturing same Abstract By eliminating the necessity of a prior step for cleaning a sintered magnet before adhering Dy and/or Tb to the surface of the sintered magnet S, the productivity of a permanent magnet having diffused Dy and/or Tb into grain boundary phase is improved. Iron-boron-rare earth based sintered magnet (S) disposed in a processing chamber (20) is heated to a predetermined temperature. An evaporating material (V) which is made of a hydride containing at least one of Dy and Tb is disposed in the same or in another processing chamber and is evaporated to cause the evaporated evaporating material to the surface of the sintered magnet. Metal atoms of Dy and/or Tb are diffused into grain boundary phase of the sintered magnet. What is claimed is: 1. A method of manufacturing ***[process/method]*** a permanent magnet comprising: heating an iron-boron-rare earth based sintered magnet disposed in a processing chamber to a first predetermined temperature which is from 800.degree. C. to 1050.degree. C.; evaporating an evaporating material disposed in the processing chamber or another processing chamber, the evaporating material comprising a hydride containing at least one of Dy and Tb; causing the evaporated evaporating material to be adhered to a surface of the sintered magnet; and diffusing metal atoms of the at least one of Dy and Tb of the adhered evaporating material into a grain boundary phase of the sintered magnet, before a thin film made of the evaporated material is formed on the

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			surface of the sintered magnet, wherein the evaporating and the diffusing are executed substantially simultaneously.
Filed: Dec 19, 2007 Issued: March 6, 2012 Expires: Dec 2027	8,128,759	Assignee: Ulvac, Inc. (Kanagawa, JAPAN)	Permanent magnet and method of manufacturing same Abstract By causing at least one of Dy and Tb to be adhered to the surface of an iron-boron-rare earth based sintered magnet of a predetermined shape, and is then to be diffused into grain boundary phase, a permanent magnet can be manufactured at high workability and low cost. An iron-boron-rare earth based sintered magnet is disposed in a processing chamber and is heated to a predetermined temperature. Also, an evaporating material made up of a fluoride containing at least one of Dy and Tb disposed in the same or another processing chamber is evaporated, and the evaporated evaporating material is caused to be adhered to the surface of the sintered magnet. The Dy and/or Tb metal atoms of the adhered evaporating material are diffused into the grain particle phase of the sintered magnet before a thin film made of the evaporated material is formed on the surface of the sintered magnet. What is claimed is: 1. A method of manufacturing ***[process/method]*** a permanent magnet, comprising: heating to a predetermined temperature an iron-boron-rare earth based sintered magnet disposed in a processing chamber; evaporating an evaporating material comprising a fluoride including at least one of Dy and Tb, disposed in the processing chamber or another processing chamber; adhering, through a vapor atmosphere, the evaporated evaporating material to a surface of the sintered magnet; and diffusing metal atoms of the at least one of Dy and Tb of the adhered evaporating material into a grain boundary phase of the sintered magnet.

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			2. The method of manufacturing a permanent magnet according to claim 1, wherein the evaporating material further comprises a fluoride including at least one of Nd and Pr. 3. The method of manufacturing a permanent magnet according to claim 1, wherein the evaporating material further comprises ***[composition of matter]*** at least one material of the group consisting of Al, Ag, B, Ba, Be, C, Ca, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pd, Pr, Ru, S, Sb, Si, Sm, Sn, Sr, Ta, Tb, Tm, Ti, V, W, Y, Yb, Zn, and Zr.
Filed: Oct 21, 2008 Issued: March 6, 2012 Expires: Oct 2028	8,128,758	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-Fe-B microcrystalline high-density magnet and process for production thereof Abstract An R--Fe--B based rare-earth alloy powder with a mean particle size of less than about 20 .mu.m is provided and compacted to make a powder compact. Next, the powder compact is subjected to a heat treatment at a temperature of about 550.degree. C. to less than about 1,000.degree. C. within hydrogen gas, thereby producing hydrogenation and disproportionation reactions (HD processes). Then, the powder compact is subjected to another heat treatment at a temperature of about 550.degree. C. to less than about 1,000.degree. C. within either a vacuum or an inert atmosphere, thereby producing desorption and recombination reactions and obtaining a porous material including fine crystal grains, of which the density is about 60% to about 90% of their true density and which have an average crystal grain size of about 0.01 .mu.m to about 2 .mu.m (DR processes). Thereafter, the porous material is subjected to yet another heat treatment at a temperature of about 750.degree. C. to less than about 1,000.degree. C. within either the vacuum or the inert atmosphere, thereby further increasing its density to about 93% or more of their true density and making an R--Fe--B based microcrystalline high-density magnet.

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			What is claimed is: 1. A method for producing ***[process/method]*** an R--Fe--B based microcrystalline high-density magnet, the method comprising the steps of: (A) providing an R--Fe--B based rare-earth alloy powder, where R is at least one element selected from the group consisting of the rare-earth elements including Y and Sc, with a mean particle size of less than about 20 .mu.m; (B) compacting the R--Fe--B based rare-earth alloy powder to make a powder compact; (C) subjecting the powder compact to a heat treatment at a temperature of about 550.degree. C. to less than 900.degree. C. within hydrogen gas, thereby producing hydrogenation and disproportionation reactions; (D) subjecting the powder compact to another heat treatment at a temperature of about 550.degree. C. to less than 900.degree. C. within either a vacuum or an inert atmosphere, thereby producing desorption and recombination reactions and obtaining a porous material including fine crystal grains, of which a density is about 50% to about 90% of a true density thereof and which have an average crystal grain size of about 0.01 .mu.m to about 2 .mu.m; and (E) subjecting the porous material to yet another heat treatment at a temperature of about 750.degree. C. to less than 900.degree. C. within either the vacuum or the inert atmosphere so that rare-earth-rich phases with areas of 1 .mu.m.sup.2 to 10 .mu.m.sup.2 are formed at a number density of at least 1.6.times.10.sup.4 phases per square millimeter on a cross section that passes through a center portion of the R--Fe--B based microcrystalline high-density magnet, thereby further increasing the density thereof to about 93% or more of the true density thereof without performing any hot pressing process.
Filed: March 8, 2006	8,123,832	Assignee: TDK Corporation	R-T-B system sintered magnet Abstract An R-T-B system sintered magnet is provided which achieves both a high

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Issued: Feb 28, 2012 Expires: March 2026		(Tokyo, JAPAN)	residual magnetic flux density and a high coercive force. The R-T-B system sintered magnet comprises main-phase grains 1 each having a core-shell structure comprising an inner shell part 2 and an outer shell part 3 surrounding the inner shell part 2, wherein the concentration of the heavy rare earth element in the inner shell part 2 is lower by 10% or more than the concentration of the heavy rare earth element in the periphery of the outer shell part 3, and (L/r).sub.ave falls within a range from 0.03 to 0.40 in the main-phase grains 1 each comprising the inner shell part 2 and the outer shell part 3, wherein L represents the shortest distance from the periphery of the main phase grain 1 to the inner shell part 2, r represents the equivalent diameter of the main phase grain 1, and (L/r).sub.ave represents the average value of L/r for the main-phase grains 1 present in the sintered body and having the core-shell structure The invention claimed is: 1. An R-T-B system sintered magnet comprising ***[composition of matter]*** a sintered body comprising, as a main phase of the sintered body, grains mainly comprising an R.sub.2T.sub.14B compound and comprising at least one of Dy and Tb as a heavy rare earth element and at least one of Nd and Pr as a light rare earth element, the R-T-B system sintered magnet being characterized in that: the sintered body has a composition comprising R: 25 to 37 wt %, B: 0.5 to 2.0 wt %, Co: 3.0 wt % or less, Al: 0.03 to 0.30 wt %, Cu: 0.01 to 0.15 wt %, and the balance: Fe and inevitable impurities, wherein R represents the heavy rare earth elements in an amount of 0.1 to 10 wt %; the sintered body comprises the grains each having a core-shell structure consisting of a single inner shell part and a single outer shell part surrounding the inner shell part; the concentration of the heavy rare earth element in the inner shell part is 20 to 95% of the concentration of the heavy rare earth element in the periphery of the outer shell part; in the grains each comprising the inner shell part and the outer shell part, (L/r).sub.ave falls within a range from 0.10 to 0.25; and in a section thereof, the proportion of the number of the grains each having the

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			core-shell structure to the total number of the grains forming the sintered body is 20% or more; wherein: R represents one or more rare earth elements inclusive of Y; T represents one or more transition metal elements wherein Fe or Fe and Co are essential; L represents the shortest distance from the periphery of the grain to the inner shell part; r represents the equivalent diameter of the grain; and (L/r).sub.ave represents the average value of L/r for the grains, present in the sintered body, having the core-shell structure.
Filed: July 27, 2005 Issued: February 21, 2012 Expires: July 2025	8,119,260	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rare-earth magnet Abstract In a ferromagnetic material containing at least one kind of rare-earth element, a layer containing at least one kind of alkaline earth element or rare-earth element and fluorine is formed at the grain boundary or near the powder surface of the ferromagnetic material. A further layer containing at least one kind of rare-earth element, having a fluorine concentration lower than that of the layer described first and having a rare-earth element concentration higher than that of the host phase of the ferromagnetic material, or an oxide layer containing a rare-earth element is formed in adjacent with a portion of the layer described first. What is claimed is: 1. A rare-earth sintered magnet comprising ***[composition of matter]*** : a host phase of a NdFeB series ferromagnetic material containing Nd as at least one kind of rare-earth element, a primary coating being formed on a surface of the host phase substantially along an outer periphery of the host phase, the primary coating being constituted by a rare-earth element containing layer having rare-earth element concentration higher than that of the host phase, and a fluorine-containing layer containing rare-earth element and fluorine having a fluorine concentration higher than that of the host phase and containing 10 atom % or

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			more of fluorine, the fluorine-containing layer being formed on the primary coating in a continuous layer, wherein the average thickness of the fluorine-containing layer is thicker than that of the primary coating, and which is 1 nm to 10000 nm.
Filed: February 17, 2010 Issued: February 7, 2012 Expires: Feb 2030	8,110,049	Assignee: Showa Denko K.K. (Tokyo, JAPAN)	Alloy containing rare earth element, production method thereof, magnetostrictive device, and magnetic refrigerant material Abstract An RE-containing alloy, which is represented by a compositional formula of R.sub.rT.sub.tA.sub.a (wherein R represents at least one rare earth element selected from among La, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Tm, Yb, Gd, and Lu; T collectively represents transition metal elements containing at least Fe atoms, a portion of the Fe atoms being optionally substituted by at least one species selected from among Co, Ni, Mn, Pt, and Pd; A represents at least one element selected from among Al, As, Si, Ga, Ge, Mn, Sn, and Sb; and r, t, and a have the following relationships: 5.0 at. %.ltoreq.r.ltoreq.6.8 at. %, 73.8 at. %.ltoreq.t.ltoreq.88.7 at. %, and 4.6 at. %.ltoreq.a.ltoreq.19.4 at. %) and having an alloy microstructure containing an NaZn.sub.13-type crystal structure in an amount of at least 85 mass % and .alpha.-Fe in an amount of 5-15 mass % inclusive. What is claimed is: 1. An RE-containing alloy ***[composition of matter]*** , which is represented by a compositional formula of R.sub.rT.sub.tA.sub.a (wherein R represents at least one rare earth element selected from among La, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Tm, Yb, Gd, and Lu; T collectively represents transition metal elements containing at least Fe atoms, a portion of the Fe atoms being optionally substituted by at least one species selected from among Co, Ni, Mn, Pt, and Pd; A represents at least one element selected from among Al, As, Si, Ga, Ge, Mn,

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			Sn, and Sb; and r, t, and a have the following relationships: 5.0 at. %.ltoreq.r.ltoreq.6.8 at. %, 73.8 at. %.ltoreq.t.ltoreq.88.7 at. %, and 4.6 at. %.ltoreq.a.ltoreq.19.4 at. %) and having an alloy microstructure containing an NaZn.sub.13-type crystal structure in an amount of at least 85 mass% and .alpha.-Fe in an amount of 5-15 mass% inclusive. 2. A method for producing ***[process/method]*** an RE-containing alloy powder, comprising pulverizing, by mechanical means, the RE-containing alloy according to claim 1 to a powder having a mean particle size of 0.1 .mu.m to 1.0 mm. …
Filed: July 27, 2005 Issued: January 31, 2012 Expires: July 2025	8,105,466	Assignee: SpringWorks, LLC (Minnetonka, MN, USA)	Biased pulse DC reactive sputtering of oxide films Abstract A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present invention. We claim: 1. A method of depositing a film on a substrate ***[process/method]***, comprising: providing a process gas between a target and a substrate; providing an RF bias at a bias frequency to the substrate; providing pulsed DC power to the target so that a target voltage alternates between positive and negative voltages; and filtering the pulsed DC power through a narrow band-rejection filter that rejects power in a narrow band around the bias frequency and passes power at

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			frequencies above and below the bias frequency; and wherein a material related to the target is deposited on the substrate by exposure of the substrate to the plasma; wherein the RF biased power is a 2 MHz power supply and the bias frequency is 2 MHz; and further wherein the narrow band is 100 kHz and the narrow band-rejection filter is a filter that rejects power at 2 MHz and has a 100 kHz bandwidth. The target can be a metallic target made of a material to be deposited on the substrate. In some embodiments, the metallic target is formed from Al, Si and various rare-earth ions. A target with an erbium concentration, for example, can be utilized to deposit a film that can be formed into a waveguide optical amplifier….. 9. The method of claim 6 wherein the alloyed target includes one or more elements taken from a set consisting of Si, Al, Er, Yb, Zn, Ga, Ge, P, As, Sn, Sb, Pb, Ag, Au, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Th, Dy Ho, Tm, and Lu.
Filed: April 8, 2010 Issued: Jan 31, 2012 Expires: Ap 2030	8,105,446	Assignee: Santoku Corporation (Hyogo, JAPAN)	Process for producing alloy slab for rare-earth sintered magnet, alloy slab for rare-earth sintered magnet and rare-earth sintered magnet Abstract Disclosed are a method for producing alloy flakes for rare earth sintered magnets, which makes uniform the intervals, size, orientation, and shape of the R-rich region and the dendrites of the 2-14-1 phase, and alloy flakes for a rare earth sintered magnet obtained by the method. A rare earth sintered magnet employing the alloy flakes is also disclosed What is claimed is: 1. Alloy flakes for a rare earth sintered magnet, said alloy flakes having a composition consisting of ***[composition of matter]*** 27.0 to 33.0 mass % of at

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			least one element R selected from the group consisting of rare earth metal elements including yttrium, 0.94 to 1.30 mass % of boron, and the balance of at least one element M selected from the group consisting of transition metals, silicon, carbon, and mixtures thereof, with iron being essential, and an alloy structure comprising R-rich regions and dendrites of an R.sub.2Fe.sub.14B phase, wherein an average interval r between said R-rich regions is 1 to 10 .mu.m, and an average size of crystal grains in the alloy structure is larger than (6r+2.74x-65) .mu.m and not smaller than 40 .mu.m, wherein r stands for an average interval between said R-rich regions, and x stands for a content of R in mass %.
Filed: May 30, 2007 Issued: January 31, 2012 Expires: May 2027	8,105,444	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Process for producing highly anticorrosive rare earth permanent magnet and method of using the same Abstract A process for producing a highly anticorrosive rare earth permanent magnet, characterized by sequentially subjecting an R--Fe--B sintered magnet to surface finishing involving cutting and/or polishing, plating pretreatment, nickel electroplating to a given plating thickness, immersion in an aqueous solution containing a phosphoric salt, washing with water and heat treatment at 150.degree. to 400.degree. C. for 1 to 24 hr in an atmosphere of 1.3.times.10.sup.3 Pa or higher oxygen partial pressure so as to form a thin nickel oxide layer at the surface layer portion. The invention claimed is: 1. A method for preparing ***[process/method]*** a highly corrosion resistant rare earth permanent magnet, comprising the sequential steps of: casting an alloy, said alloy containing R which is a rare earth element or a combination of two or more rare earth elements, T which is Fe or Fe and Co, and B as main components, and specifically consisting essentially of 26.8 to 33.5% by weight

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			of R, 0.78 to 1.25% by weight of B, 0.05 to 3.5% by weight in total of at least one element selected from the group consisting of Ni, Ga, Zr, Nb, Hf, Ta, Mn, Sn, Mo, Zn, Pb, Sb, Al, Si, V, Cr, Ti, Cu, Ca, and Mg, and the balance of T and incidental impurities; pulverizing the alloy in an oxygen-free atmosphere of argon, nitrogen or vacuum; finely pulverizing, compacting in a magnetic field, sintering, and aging the finely pulverized, compacted and sintered alloy, thereby producing a sintered magnet, the magnet having an oxygen concentration of up to 0.6% by weight and magnetic properties, Br of 12.0 kG to 14.8 kG and iHc of 11 kOe to 35 kOe; machining and/or grinding the magnet for surface finishing; pretreating the magnet, which is machined and/or ground, with mineral acid, nickel electroplating the magnet, which is pretreated, to form a plating of a predetermined thickness; immersing the magnet, which is nickel electroplated, in a phosphate-containing aqueous solution, washing with water; and further heat treating the magnet in an atmosphere having an oxygen partial pressure of at least 1.3.times.10.sup.3 Pa (10 Torr) at 150 to 400.degree. C. for 1 to 24 hours for thereby forming a thin nickel oxide layer in a surface region of the plating.
Filed: April 25, 2007 Issued: January 31, 2012 Expires: April 2027	8,105,443	Assignee: Vacuumschmelze GmbH & Co. (Hanau, GERMANY)	Non-ageing permanent magnet from an alloy powder and method for the production thereof Abstract A method for the production of pressed permanent magnets comprises the following steps: A mixture of at least one magnetic powder and a thermosetting binder is provided and pressed to produce a moulded body. In order to obtain a permanent and particularly reliable protection against oxidation and corrosion, the moulded body is impregnated with an acid and solvent mixture in an impregnating bath before the cure of the thermosetting binder, whereby the entire surface of the permanent magnet is coated with a reaction layer.

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			The invention claimed is: 1. A method for the production of a permanent magnet ***[process/method]*** , comprising: providing a mixture of at least one magnetic powder and a thermosetting binder; pressing the mixture to produce a porous moulded body; impregnating the porous moulded body in an impregnating bath with a solution containing an acid to produce an impregnated moulded body; curing the thermosetting binder to produce a cured impregnated moulded body permanent magnet after said impregnating.… 8. The method according to claim 7, wherein the magnetic powder comprises an alloy powder of neodymium, iron and boron containing the hard magnetic phase Nd.sub.2Fe.sub.14B.
Filed: June 11, 2009 Issued: Jan 10, 2012 Expires: June 2029	8,092,619	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-T-Cu-Mn-B type sintered magnet Abstract An R-T-Cu--Mn--B based sintered magnet includes: 12.0 at % to 15.0 at % of R, which is at least one of the rare-earth elements that include Y and of which at least 50 at % is Pr and/or Nd; 5.5 at % to 6.5 at % of B; 0.08 at % to 0.35 at % of Cu; 0.04 at % to less than 0.2 at % of Mn; at most 2 at % (including 0 at %) of M, which is one, two, or more elements that are selected from the group consisting of Al, Ti, V, Cr, Ni, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Au, Pb and Bi; and T as the balance, which is either Fe alone or Fe and Co and of which at most 20 at % is Co if T includes both Fe and Co. The invention claimed is: 1. An R-T-Cu--Mn--B based sintered magnet comprising ***[composition of matter]*** : 12.0 at % to 15.0 at % of R, which is at least one of the rare-earth elements that include Y and of which at least 50 at % is Pr and/or Nd; 5.5 at %

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			to 6.5 at % of B; 0.08 at % to 0.35 at % of Cu; 0.04 at % to less than 0.15 at % of Mn; at most 2 at % (including 0 at %) of M, which is one, two, or more elements that are selected from the group consisting of Al, Ti, V, Cr, Ni, Zn, Ga, Zr, Nb, Mo, Ag, In, Sn, Hf, Ta, W, Au, Pb and Bi; and T as the balance, which is either Fe alone or Fe and Co and of which at most 20 at % is Co if T includes both Fe and Co.
Filed: January 22, 2009 Issued: January 10, 2012 Expires: Jan 2029	8,092,615	Assignee: Hoganas AB (Hoganas, SWEDEN)	Composition for producing soft magnetic composites by powder metallurgy Abstract The invention concerns powder compositions consisting of electrically insulated particles of a soft magnetic material of an iron or iron-based powder and 0.1-2% by weight of a lubricant selected from the group consisting of fatty acid amides having 14-22 C atoms. Optionally a thermoplastic binder such as polyphenylene sulphide may be included in the composition. The invention also concerns a method for the preparation of soft magnetic composite components. The invention claimed is: 1. A method for making soft magnetic components comprising the steps of ***[process/method]***: (a) mixing a soft magnetic substantially pure water-atomized iron or sponge iron powder, wherein the particles are surrounded by an electrically insulating layer, and 0.05-2% by weight of a lubricant selected from the group consisting of primary amides of saturated or unsaturated, straight fatty acid having 12-24 C atoms, (b) uniaxially compacting the resulting mixture, and (c) optionally subjecting the obtained component to heat treatment. 2. A method according to claim 1 wherein the compaction is performed at an elevated temperature above ambient temperature. ….

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Filed: Dec 9, 2010 Issued: Dec 27, 2011 Expires: Dec 2030	8,084,128	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rare-earth magnet and manufacturing method thereof and magnet motor Abstract The object of the present invention is to provide a rare earth magnet which enables to achieve a good balance between high coercive force and high residual magnetic flux density, and its manufacturing method. The present invention provides a rare earth magnet in which a layered grain boundary phase is formed on a surface or a portion of a grain boundary of Nd.sub.2Fe.sub.14B which is a main phase of an R--Fe--B (R is a rare-earth element) based magnet, and wherein the grain boundary phase contains a fluoride compound, and wherein a thickness of the fluoride compound is 10 .mu.m or less, or a thickness of the fluoride compound is from 0.1 .mu.m to 10 .mu.m, and wherein the coverage of the fluoride compound over a main phase particle is 50% or more on average. Moreover, after layering fluoride compound powder, which is formed in plate-like shape, in the grain boundary phase, the rare earth magnet is manufactured by quenching the layered compound after melting it at a vacuum atmosphere at a predetermined temperature, or by heating and pressing the main phase and the fluoride compound to make the fluoride compound into a layered fluoride compound along the grain boundary phase.
Filed: Feb 23, 2010 Issued: Dec 13, 2011 Expires: Feb 2030	8,075,954	Assignee: Ulvac, Inc. (Kanagawa, JAPAN)	Coating method and apparatus, a permanent magnet, and manufacturing method thereof Abstract The object of the present invention is to improve the productivity of a permanent magnet and to manufacture it at a low cost by effectively coating Dy and Tb on a surface of the magnet of Fe--B-rare earth elements having a predetermined configuration. The permanent magnet of the present invention is manufactured by a coating step for coating Dy on the surface of the magnet of

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			Fe--B-rare earth elements having a predetermined configuration and a diffusing step for diffusing Dy coated on the surface of the magnet into crystal grain boundary phases of the magnet with being heat treated at a predetermined temperature. In this case, the coating step comprises a first step for heating a process chamber used for carrying out the coating step and generating metallic vapor atmosphere within the process chamber by vaporizing vaporizable metallic material previously arranged within the process chamber, and a second step for introducing into the process chamber the magnet held at a temperature lower than that within the process chamber and then selectively depositing the vaporizable metallic material on a surface of the magnet by an effect of temperature difference between the temperature within the process chamber and that of the magnet by the magnet reaches a predetermined temperature. What is claimed is: 1. A method for manufacturing ***[process/method]*** a permanent magnet, the method comprising the steps of: coating a vaporizable metallic material including at least one of Dy and Tb onto a surface of a magnet of Fe--B-rare earth elements having a predetermined configuration; and diffusing the vaporizable metallic material coated onto the surface of the magnet into crystal grain boundary phases of the magnet by heat treating the vaporizable metallic material at a first predetermined temperature, wherein the coating step comprises: a first step for heating a process chamber to the first predetermined temperature used for carrying out the coating step and generating metallic vapor atmosphere within the process chamber by vaporizing the vaporizable metallic material previously arranged within the process chamber; and a second step for introducing into the process chamber the magnet held at a second predetermined temperature that is lower than the first predetermined temperature within the process chamber and selectively depositing the vaporizable metallic material onto the surface of the magnet by an effect of a

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			temperature difference between the first predetermined temperature within the process chamber and the second predetermined temperature of the magnet until the magnet heats up and reaches a third predetermined temperature.
Filed: March 28, 2007 Issued: Dec 13, 2011 Expires: March 2027	8,075,707	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Method for preparing rare earth permanent magnet material Abstract A method for preparing a rare earth permanent magnet material comprises the steps of disposing a powder on a surface of a sintered magnet body of R.sup.1.sub.aT.sub.bA.sub.cM.sub.d composition wherein R.sup.1 is a rare earth element inclusive of Sc and Y, T is Fe and/or Co, A is boron (B) and/or carbon (C), M is Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, or W, said powder comprising an oxide of R.sup.2, a fluoride of R.sup.3 or an oxyfluoride of R.sup.4 wherein R.sup.2, R.sup.3, and R.sup.4 are rare earth elements inclusive of Sc and Y and having an average particle size equal to or less than 100 .mu.m, heat treating the magnet body and the powder at a temperature equal to or below the sintering temperature of the magnet body for absorption treatment for causing R.sup.2, R.sup.3, and R.sup.4 in the powder to be absorbed in the magnet body, and repeating the absorption treatment at least two times. According to the invention, a rare earth permanent magnet material can be prepared as an R--Fe--B sintered magnet with high performance and a minimized amount of Tb or Dy used. The invention claimed is: 1. A method for preparing ***[process/method]*** a rare earth permanent magnet material, comprising a disposing step of disposing a powder on a surface of a sintered magnet body of R.sup.1.sub.aT.sub.bA.sub.cM.sub.d composition wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y, T is Fe and/or Co, A is boron (B) and/or carbon (C), M

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			is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, and a to d indicative of atom percent based on the alloy are in the range: 10.ltoreq.a.ltoreq.15, 3.ltoreq.c.ltoreq.15, 0.01.ltoreq.d.ltoreq.11, and the balance of b, said powder comprising at least one compound selected from among an oxide of R.sup.2, a fluoride of R.sup.3, and an oxyfluoride of R.sup.4 wherein each of R.sup.2, R.sup.3, and R.sup.4 is at least one element selected from rare earth elements inclusive of Sc and Y and having an average particle size equal to or less than 100 .mu.m, and then a heat treating step of heat treating the sintered magnet body and the powder at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas for absorption treatment for causing at least one of R.sup.2, R.sup.3, and R.sup.4 in said powder to be absorbed in said magnet body, a cooling step of cooling the magnet body after the heat treating step; followed by repeating the disposing step, the heat treating step and the cooling step, in the recited order, at least two times.
Filed: August 13, 2009 Issued: December 6, 2011 Expires: August 2029	8,069,552	Assignee: Minebea Co., Ltd. (Kitasaku-Gun, JAPAN)	Method of manufacturing rotor magnet for micro rotary electric machine Abstract A method of manufacturing a rotor magnet for a micro rotary electric machine is provided which includes steps of: a process in which a plurality of thick films, each of which is made of nanocomposite texture composed of .alpha.Fe and R-TM-B where R is either 10 to 20 atomic % Nd or 10 to 20 atomic % Pr, B is 5 to 20 atomic % and TM is either Fe or partly Co-substituted Fe with 0 to 16 atomic %, are formed into a laminated magnet including isotropic nano-crystalline texture which contains .alpha.Fe and R.sub.2TM.sub.14B and which has a remanence, Mr, of 0.95 T or more; and a process where the laminated magnet is multi-polar magnetized in-plane of the thick films. What is claimed is:

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			1. A method of manufacturing ***[process/method]*** a rotor magnet with at least two pole-pairs for a cylindrical radial gap micro rotary electric machine, the method comprising steps of: 1) a process to form a laminated film magnet comprising isotropic nano-crystalline texture which contains an .alpha.Fe phase and an R.sub.2TM.sub.14B phase, where R is one of 10 to 20 atomic % Nd and 10 to 20 atomic % Pr, B is 5 to 20 atomic % and TM is one of Fe and partly Co-substituted Fe with 0 to 16 atomic %, and which has a remanence, Mr, of 0.95 T or more, the laminated film magnet being composed of a predetermined number of a plurality of thick films; 2) a process in which the laminated film magnet is cylindrically formed; and 3) a process in which the laminated film magnet is multi-polar magnetized in a radial direction of the thick films.
Filed: Jan 12, 2007 Issued: October 18, 2011 Expires: Jan 2027	8,038,807	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-Fe-B rare-earth sintered magnet and process for producing the same Abstract First, an R--Fe--B based rare-earth sintered magnet body including, as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R is provided. Next, an M layer, including a metallic element M that is at least one element selected from the group consisting of Al, Ga, In, Sn, Pb, Bi, Zn and Ag, is deposited on the surface of the sintered magnet body and then an RH layer, including a heavy rare-earth element RH that is at least one element selected from the group consisting of Dy, Ho and Tb, is deposited on the M layer. Thereafter, the sintered magnet body is heated, thereby diffusing the metallic element M and the heavy rare-earth element RH from the surface of the magnet body deeper inside the magnet. The invention claimed is: 1. A method for producing ***[process/method]*** an R--Fe--B based rare-earth

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			sintered magnet, the method comprising the steps of: providing an R--Fe--B based rare-earth sintered magnet body including ***[composition of matter]*** , as a main phase, crystal grains of an R.sub.2Fe.sub.14B type compound that includes a light rare-earth element RL, which is at least one of Nd and Pr, as a major rare-earth element R; depositing an M layer, including a metallic element M that is at least one element selected from the group consisting of Al, Ga, In, Sn, Pb, Bi, Zn and Ag, on a surface of the R--Fe--B based rare-earth sintered magnet body; depositing an RH layer, including a heavy rare-earth element RH that is at least one element selected from the group consisting of Dy, Ho and Tb, on the M layer; and heating the R--Fe--B based rare-earth sintered magnet body, thereby diffusing the metallic element M and the heavy rare-earth element RH from the surface of the R--Fe--B based rare-earth sintered magnet body deeper inside the magnet.
Filed: March 27, 2009 Issued: October 11, 2011 Expires: March 2029	8,033,314	Assignee: TDK Corporation (Tokyo, JAPAN)	Method for producing sintered magnet Abstract A method for producing a sintered magnet ***[process/method]*** comprising steps of; wet-pulverizing a magnetic powder under the presence of a surface active agent, drying said wet-pulverized magnetic powder 20 for obtaining magnetic powder to which said surface active agent is adhered, heating and kneading said dried magnetic powder 20 with binder resin to form pellet, melting said pellet and injecting said pellet in a mold to which magnetic field is applied, to form a preform body, and firing said preform body.
Filed: March 17, 2008 Issued: September 27, 2011	8,025,744	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare earth permanent magnet and its preparation Abstract A rare earth permanent magnet is prepared by disposing a powdered metal alloy containing at least 70 vol % of an intermetallic compound phase on a sintered body of R--Fe--B system, and heating the sintered body having the powder disposed on its surface below the sintering temperature of the sintered

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Expires: March 2028			body in vacuum or in an inert gas for diffusion treatment. The advantages include efficient productivity, excellent magnetic performance, a minimal or zero amount of Tb or Dy used, an increased coercive force, and a minimized decline of remanence. The invention claimed is: 1. A method for preparing ***[process/method]*** a rare earth permanent magnet, comprising the steps of: disposing an alloy powder having ***[composition of matter]*** an average particle size of up to 500 .mu.m on a surface of a sintered body of the composition R.sub.a-T.sup.1.sub.b-B.sub.c wherein R is at least one element selected from rare earth elements inclusive of Y and Sc, T.sup.1 is at least one element selected from Fe and Co, B is boron, "a," "b" and "c" indicative of atomic percent are in the range: 12.ltoreq.a.ltoreq.20, 4.0.ltoreq.c.ltoreq.7.0, and the balance of b, said alloy powder having the composition R.sup.1.sub.i-M.sup.1.sub.j wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Y and Sc, M.sup.1 is at least one element selected from the group consisting of Al, Si, C, P, Ti, V, Cr, Mn, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pb, and Bi, "i" and "j" indicative of atomic percent are in the range: 15<j.ltoreq.99 and the balance of i, and containing at least 70% by volume of an intermetallic compound phase, and heat treating the sintered body having the powder disposed on its surface at a temperature equal to or below the sintering temperature of the sintered body in vacuum or in an inert gas, for causing at least one element of R.sup.1and M.sup.1 in the powder to diffuse to grain boundaries in the interior of the sintered body and/or near grain boundaries within sintered body primary phase grains, said disposing step including grinding an alloy having the composition and R.sup.1.sub.i-M.sup.1.sub.j and containing at least 70% by volume of an intermetallic compound phase into a powder having an average particle size of up to 500 .mu.m, dispersing the powder in an organic solvent or water, applying the resulting slurry to the

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			surface of the sintered body, and drying.
Filed: October 12, 2010 Issued: September 20, 2011 Expires: Oct 2030	8,021,567	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Oxide-type, magnetic material and it's production method, and sintered ferrite magnet and it's production method Abstract A sintered ferrite magnet having an M-type ferrite structure and comprising Ca, an R element which is at least one rare earth element indispensably including La, Ba, Fe and Co as indispensable elements, which is represented by Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z, wherein (1-x-y), x, y, z and n are numbers representing the amounts of Ca, the R element, Ba and Co and a molar ratio, meeting 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.03.ltoreq.z.ltoreq.0.65, and 4.ltoreq.n.ltoreq.7. What is claimed is: 1. An oxide-type, magnetic material ***[composition of matter]*** based on ferrite having a hexagonal structure, comprising Ca, an R element which is at least one rare earth element indispensably including La, Ba, Sr, Fe and Co as indispensable elements, the composition ratios of Ca, R, Ba, Sr, Fe and Co being represented by the following general formula: Ca.sub.1-x-yR.sub.x(Ba.sub.1-aSr.sub.a).sub.yFe.sub.2n-zCo.sub.z (by atomic ratio), wherein (1-x-y), x, y, a, z and n are numbers representing the amounts of Ca, the R element, Ba, Sr and Co and a molar ratio, respectively, meeting the following conditions: 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.3.ltoreq.1-x-y.ltoreq.0.6, 0<a.ltoreq.0.5, 0.03.ltoreq.z.ltoreq.0.65, and 4.ltoreq.n.ltoreq.7, wherein it contains 0.05 to 0.2% by mass (calculated as B.sub.2O.sub.3) of B. 2. A method for producing ***[process/method]*** an oxide-type, magnetic material based on ferrite having a hexagonal structure and comprising Ca, an R element which is at least one rare earth element indispensably including La, Ba, Sr, Fe

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			and Co as indispensable elements, the composition ratios of Ca, R, Ba, Sr, Fe and Co being represented by the following general formula: Ca.sub.1-x-yR.sub.x(Ba.sub.1-aSr.sub.a).sub.yFe.sub.2n-zCo.sub.z (by atomic ratio), wherein (1-x-y), x, y, a, z and n are numbers representing the amounts of Ca, the R element, Ba, Sr and Co and a molar ratio, respectively, meeting the following conditions: 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.3.ltoreq.1-x-y.ltoreq.0.6, 0<a.ltoreq.0.5, 0.03.ltoreq.z.ltoreq.0.65, and 4.ltoreq.n.ltoreq.7, wherein it contains 0.05 to 0.2% by mass (calculated as B.sub.2O.sub.3) of B, said method comprising the steps of mixing a Ca compound, an R compound, a Ba compound, a Sr compound, an iron compound and a Co compound, 0.05 to 0.2% by mass of a boron compound per 100 parts by mass of the resultant mixture is added, and calcining the resultant mixture.
Filed: Dec 23, 2005 Issued: Sept 6, 2011 Expires: Dec 2025	8,012,269	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Nd-Fe-B rare earth permanent magnet material Abstract A rare earth permanent magnet material is based on an R--Fe--Co--B--Al--Cu system wherein R is at least one element selected from Nd, Pr, Dy, Tb, and Ho, 15 to 33% by weight of Nd being contained. At least two compounds selected from M-B, M-B--Cu and M-C compounds (wherein M is Ti, Zr or Hf) and an R oxide have precipitated within the alloy structure as grains having an average grain size of up to 5 .mu.m which are uniformly distributed in the alloy structure at intervals of up to 50 .mu.m. The invention claimed is: 1. A rare earth permanent magnet material consists ***[composition of matter]*** essentially of, in % by weight: 27 to 33% of R, wherein R is at least one element selected from the group consisting of Nd, Pr, Dy, Tb, and Ho, including 15 to 33% by weight of Nd, 0.1 to 10% of Co, 0.8 to 1.5% of B, 0.05 to 1.0% of Al, 0.02 to 1.0% of Cu, 0.02 to 1.0% of an element selected from Ti, Zr and Hf, 0.123 to 0.3% of C, 0.04 to 0.4% of O, 0.002 to 0.1% of N, and the balance of Fe and incidental impurities, wherein (i) at least two compounds

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			selected from the group consisting of an M-B based compound, an M-B--Cu based compound, and an M-C based compound, wherein M is at least one metal selected from the group consisting of Ti, Zr, and Hf, and (ii) an R oxide have precipitated within the alloy, and the precipitated compounds have an average grain size of up to 5 .mu.m and are distributed in the alloy at a maximum interval of up to 50 .mu.m between adjacent precipitated compounds.
Filed: June 30, 2009 Issued: Aug 23, 2011 Expires: June 2029	8,002,906	Assignee: Daido Tokushuko Kabushiki Kaisha (Nagoya, JAPAN)	Rare earth magnet and production process thereof Abstract The present invention provides a rare earth magnet, which is formed through at least hot molding, the rare earth magnet containing grains including an R.sub.2X.sub.14B phase as a main phase, and a grain boundary phase surrounding peripheries of the grains, in which R is at least one element selected from the group consisting of Nd, Pr, Dy, Tb and Ho, and X is Fe or Fe with a part being substituted by Co; in which an element RH is more concentrated in the grain boundary phase than in the grains, in which the element RH is at least one element selected from the group consisting of Dy, Tb and Ho; and the element RH is present with a substantially constant concentration distribution from the surface part of the magnet to the central part of the magnet. What is claimed is: 1. A rare earth magnet comprising ***[composition of matter]*** grains including an R.sub.2X.sub.14B phase as a main phase, and a grain boundary phase surrounding peripheries of the grains, in which R is at least one element selected from the group consisting of Nd, Pr, Dy, Tb and Ho, and X is Fe or Fe in part substituted by Co; wherein the grains have an average grain size of 1 .mu.m or less; wherein an element RH is more concentrated in the grain boundary phase than in the grains, in which the element RH is at least one

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			element selected from the group consisting of Dy, Tb and Ho; and wherein the rare earth magnet has a difference in concentration of the element RH in the depth direction from a surface part of the magnet to an interior of the magnet of within 10%. ….. 8. A process for producing ***[process/method]***a rare earth magnet according to claim 1, the process comprising: a step of preparing a raw material powder containing an R--X--B-based alloy powder mixed or coated with an RH metal and/or an RH alloy, in which R is at least one element selected from the group consisting of Nd, Pr, Dy, Tb and Ho, X is Fe or Fe with a part being substituted by Co, and RH is at least one element selected from the group consisting of Dy, Tb and Ho; a step of cold molding said prepared raw material powder to obtain a cold compact; and a step of hot molding said obtained cold compact to obtain a hot compact or subjecting said obtained hot compact further to hot plastic working to obtain a hot plastic worked body.
Filed: April 13, 2007 Issued: Aug 16, 2011 Expires: April 2027	7,998,283	Inventor: Yang; Yingchang (Beijing, CHINA)	Rare earth anisotropic hard magnetic material and processes for producing magnetic powder and magnet using the same Abstract The disclosure provides a rare earth anisotropic hard magnetic material, which has, on atomic percent basis, a composition of (Sm.sub.1-.alpha.R.sub..alpha.).sub.xFe.sub.100-x-y-zM.sub.yI.sub.z, wherein, R is Pr alone or a combination of Pr with at least one rare earth element selected from the group consisting of La, Ce, Nd, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y; M is at least one element selected from the group consisting of Si, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, Nb, Mo, Al, and Zr; I is N alone or a combination of N and C; 0.01.ltoreq..alpha..ltoreq.0.30; 7.ltoreq.x.ltoreq.12, 0.01.ltoreq.y.ltoreq.8.0, 6.ltoreq.z.ltoreq.14.4, and which anisotropic rare earth hard magnetic material is crystallized in a Th.sub.2Zn.sub.17-type structure, of which crystalline grains are in a flake shape with a gain size ranging from 1 to 5 .mu.m, and c-axis of the crystalline grains, an easy magnetization direction, being oriented

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			along the minor axis of the flake crystalline grains. The disclosure also provides a process for producing the powdery rare earth anisotropic hard magnetic material and a process for producing anisotropic calender flexible magnet. I claim: 1. An anisotropic rare earth hard magnetic material, which has, on atomic percent basis, a composition of ***[composition of matter]*** (Sm.sub.1-.alpha.R.sub..alpha.).sub.xFe.sub.100-x-y-zM.sub.yI.sub.z wherein: R is Pr alone or a combination of Pr with at least one rare earth element selected from the group consisting of La, Ce, Nd, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y; M is at least one element selected from the group consisting of Si, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, Nb, Mo, Al, and Zr; I is N alone or a combination of N and C; 0.01.ltoreq..alpha..ltoreq.0.30; 7.ltoreq.x.ltoreq.12; 0.01.ltoreq.y.ltoreq.8.0; and 6.ltoreq.z.ltoreq.14.4; and the anisotropic rare earth hard magnetic material comprises monocrystal particles having a Th.sub.2Zn.sub.17-structure, of which crystalline grains are in a flake shape with a grain size ranging from 1 to 3 .mu.m, and an easy magnetization direction of the crystalline grains being oriented along a minor axis of the flake crystalline grains….. 6. A process for producing ***[process/method]*** the anisotropic rare earth hard magnetic material according to claim 1, comprising the steps of: (1) preparing a master alloy with all components of (Sm.sub.1-.alpha.R.sub..alpha.).sub.xFe.sub.100-x-y-zM.sub.yI.sub.z except for N by using strip-casting technique, (2) treating the master alloy obtained in step (1) in nitrogen atmosphere at 450-600.degree. C. for 4-8 hours to carry out a gas-solid phase reaction, to form a nitride having the composition of (Sm.sub.1-.alpha.R.sub..alpha.).sub.xFe.sub.100-x-y-zM.sub.yI.sub.z as defined in claim 1; and (3) pulverizing the nitride obtained in step (2) into an anisotropic monocrystal powder having an average particle size of 1-3 .mu.m and being in

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			a flake shape.
Filed: May 17, 2010 Issued: Aug 2, 2011 Expires: May 2030	7,988,797	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Nano-composite magnet, quenched alloy for nano-composite magnet, and method for producing them and method for distinguishing them Abstract A nanocomposite magnet according to the present invention has a composition represented by the general formula: R.sub.xQ.sub.yM.sub.z(Fe.sub.1-mT.sub.m).sub.bal, where R is at least one rare-earth element, Q is at least one element selected from the group consisting of B and C, M is at least one metal element that is selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb and that always includes Ti, and T is at least one element selected from the group consisting of Co and Ni. The mole fractions x, y, z and m satisfy the inequalities of 6 at %.ltoreq.x<10 at %, 10 at %.ltoreq.y.ltoreq.17 at %, 0.5 at %.ltoreq.z.ltoreq.6 at % and 0.ltoreq.m.ltoreq.0.5, respectively. The nanocomposite magnet includes a hard magnetic phase and a soft magnetic phase that are magnetically coupled together. The hard magnetic phase is made of an R.sub.2Fe.sub.14B-type compound, and the soft magnetic phase includes an .alpha.-Fe phase and a crystalline phase with a Curie temperature of 610.degree. C. to 700.degree. C. (.omega. phase) as its main phases. What is claimed is: 1. A nanocomposite magnet having a composition ***[composition of matter]*** represented by the general formula: R.sub.xQ.sub.yM.sub.z(Fe.sub.1-mT.sub.m).sub.bal, where R is at least one rare-earth element, Q is at least one element selected from the group consisting of B and C, M is at least one metal element that is selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb and that always includes Ti, T is at least one element selected from the group consisting of Co and Ni, and

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			the mole fractions x, y, z and m satisfy the inequalities of 6 at %.ltoreq.x<10 at %, 10 at %.ltoreq.y.ltoreq.17 at %, 0.5 at %.ltoreq.z.ltoreq.6 at % and 0.ltoreq.m.ltoreq.0.5, respectively, the nanocomposite magnet including a hard magnetic phase and a soft magnetic phase that are magnetically coupled together, wherein the hard magnetic phase is made of an R.sub.2Fe.sub.14B-type compound, and wherein the soft magnetic phase includes an .alpha.-Fe phase and an Fe.sub.2B phase as its main phases. …. 3. A rapidly solidified ***[process/method]*** alloy to make a nanocomposite magnet, the alloy having a composition represented by the general formula: R.sub.xQ.sub.yM.sub.z(Fe.sub.1-mT.sub.m).sub.bal, where R is at least one rare-earth element, Q is at least one element selected from the group consisting of B and C, M is at least one metal element that is selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb and that always includes Ti, T is at T is at least one element selected from the group consisting of Co and Ni, and the mole fractions x, y, z and m satisfy the inequalities of 6 at %.ltoreq.x<10 at %, 10 at %.ltoreq.y.ltoreq.17 at %, 0.5 at %.ltoreq.z.ltoreq.6 at % and 0.ltoreq.m.ltoreq.0.5, respectively, wherein the rapidly solidified alloy includes an R.sub.2Fe.sub.14B-type compound, an .alpha.-Fe phase and an Fe.sub.2B phase.
Filed: Nov30, 2006 Issued: Aug 2, 2011 Expires:	7,988,795	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	R-T-B--C rare earth sintered magnet and making method Abstract An R-T-B--C rare earth sintered magnet (R.dbd.Ce, Pr, Nd, Tb, or Dy; T=Fe) is obtained by mixing an R-T-B--C magnet matrix alloy with an R fluoride and an R-rich R-T-B--C sintering aid alloy, followed by pulverization, compaction and sintering. The sintered structure consists of an R.sub.2T.sub.14B type crystal primary phase and a grain boundary phase. The grain boundary phase consists essentially of 40-98 vol % of R--O.sub.1-x--F.sub.1+2x and/or R--

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Nov 2026			F.sub.y, 1-50 vol % of R--O, R--O--C or R--C compound phase, 0.05-10 vol % of R-T phase, 0.05-20 vol % of B-rich phase or M-B.sub.2 phase (M=Ti, V, Cr, Zr, Nb, Mo, Hf, Ta or W), and the balance of an R-rich phase. The invention claimed is: 1. An R-T-B-C rare earth sintered magnet wherein R is at least one rare earth element selected from the group consisting of Ce, Pr, Nd, Tb, and Dy, T is iron or a mixture of iron and at least one other transition metal, B is boron, and C is carbon, which magnet is obtained by ***[process/method]*** : mixing (II) 1 to 20% by weight of an R-rich R-T-B--C sintering aid alloy consisting essentially of 50 wt %.ltoreq.R.ltoreq.65 wt %, 0.3 wt %.ltoreq.B.ltoreq.0.9 wt %, 0.01 wt %.ltoreq.C.ltoreq.0.5 wt %, 0.1 wt %.ltoreq.Al.ltoreq.1.0 wt %. 0.1 wt %.ltoreq.Cu.ltoreq.5.0 wt %, and the balance of T, (III) 10 to 50% by weight of an R--O.sub.1-x--F.sub.1+2x and/or R--F.sub.y powder having an average particle size of 0.5 to 50.mu.m wherein x is an arbitrary real number of 0 to 1 and y is 2 or 3, and (I) the remainder of a R-T-B--C primary phase magnet matrix alloy powder consisting essentially of 25 wt %.ltoreq.R.ltoreq.35 wt %, 0.8 wt %.ltoreq.B.ltoreq.1.4 wt %, 0.01 wt %.ltoreq.C.ltoreq.0.5 wt %, 0.1 wt %.ltoreq.Al.ltoreq.1.0 wt %, and the balance of T, pulverizing the mixture through a jet mill in a nitrogen stream to an average particle size of 0.01 to 30 .mu.m, compacting the mixture in a magnetic field into a compact, sintering and heat treating the compact, wherein the rare earth sintered magnet has a sintered structure consisting of an R.sub.2T.sub.14B structure crystal primary phase and a grain boundary phase, said grain boundary phase consisting essentially of 40 to 98% by volume (a volume fraction in the grain boundary phase) of R-O.sub.1-x-F.sub.1+2x and/or R-F.sub.y wherein x is an arbitrary real number of 0 to 1 and y is 2 or 3, 1 to 50% by volume of a compound phase selected from R-O, R-O-C, and R-C compounds, and mixtures thereof, 0.05 to 10% by volume of a R-T phase, 0.05 to 20% by volume of a B-rich phase (R.sub.1+.epsilon.Fe.sub.4B.sub.4) or M-B.sub.2 phase wherein M is at least

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			one element selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta and W, and the balance of an R-rich phase . .… 6. A method for preparing ***[process/method]*** a R-T-B--C sintered magnet wherein R is at least one rare earth element selected from the group consisting of Ce, Pr, Nd, Tb, and Dy, T is iron or a mixture of iron and at least one other transition metal, B is boron, and C is carbon, said method comprising the steps of mixing (II) 1 to 20% by weight of an R-rich R-T-B--C sintering aid alloy consisting essentially of 50 wt %.ltoreq.R.ltoreq.65 wt %, 0.3 wt %.ltoreq.B.ltoreq.0.9 wt %, 0.01 wt %.ltoreq.C.ltoreq.0.5 wt %, 0.1 wt %.ltoreq.Al.ltoreq.1.0 wt %, 0.1 wt %.ltoreq.Cu.ltoreq.5.0 wt %, and the balance of T, (III) 10 to 50% by weight of an R--O.sub.1-x--F.sub.1+2x and/or R--F.sub.y powder wherein x is an arbitrary real number of 0 to 1 and y is 2 or 3, and (I) the remainder of a R-T-B--C primary phase magnet matrix alloy powder consisting essentially of 25 wt %.ltoreq.R.ltoreq.35 wt %, 0.8 wt %.ltoreq.B.ltoreq.1.4 wt %, 0.01 wt %.ltoreq.C.ltoreq.0.5 wt %, 0.1 wt %.ltoreq.Al.ltoreq.1.0 wt %, and the balance of T, pulverizing the mixture through a jet mill in a nitrogen stream, compacting the mixture in a magnetic field into a compact, sintering and heat treating the compact.
Filed: Oct 27, 2010 Issued: July 26, 2011 Expires: Oct 2030	7,985,303	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare earth permanent magnet and its preparation Abstract A rare earth permanent magnet is prepared by disposing a powdered metal alloy containing at least 70 vol % of an intermetallic compound phase on a sintered body of R--Fe--B system, and heating the sintered body having the powder disposed on its surface below the sintering temperature of the sintered body in vacuum or in an inert gas for diffusion treatment. The advantages include efficient productivity, excellent magnetic performance, a minimal or zero amount of Tb or Dy used, an increased coercive force, and a minimized decline of remanence.

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			The invention claimed is: 1. A method for preparing ***[process/method]*** a rare earth permanent magnet, comprising the steps of: disposing an alloy powder on a surface of a sintered body of the composition R.sub.a-T.sup.1.sub.b-B.sub.c wherein R is at least one element selected from rare earth elements inclusive of Y and Sc, T.sup.1 is at least one element selected from Fe and Co, B is boron, "a," "b" and "c" indicative of atomic percent are in the range: 12.ltoreq.a.ltoreq.20, 4.0.ltoreq.c.ltoreq.7.0, and the balance of b, said alloy powder having the composition M.sup.1.sub.d-M.sup.2.sub.e wherein each of M.sup.1 and M.sup.2 is at least one element selected from the group consisting of Al, Si, C, P, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, In, Sn, Sb, Hf, Ta, W, Pb, and Bi, M.sup.1 is different from M.sup.2, "d" and "e" indicative of atomic percent are in the range: 0.1.ltoreq.e.ltoreq.99.9 and the balance of d, and containing at least 70% by volume of an intermetallic compound phase, and heat treating the sintered body having the powder disposed on its surface at a temperature equal to or below the sintering temperature of the sintered body in vacuum or in an inert gas, for causing at least one element of M.sup.1 and M.sup.2 in the powder to diffuse to grain boundaries in the interior of the sintered body and/or near grain boundaries within sintered body primary phase grains.
Filed: Dec 7, 2004 Issued: July 19, 2011 Expires: Dec 2024	7,981,359	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Rotor and process for manufacturing the same Abstract A rotor comprising bonded magnet portions mainly composed of magnet powder and a binder, which are embedded in a soft magnetic portion mainly composed of soft magnetic powder and a binder, the rotor being produced by a compression-molding method, and the magnetic pole surfaces of the bonded magnet portions being embedded in the soft magnetic portion.

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			What is claimed is: 1. A method for producing ***[process/method]*** a rotor comprising bonded magnet portions and a soft magnetic portion, the method comprising, in the order mentioned, (a) preliminarily molding steps consisting of compressing a magnet powder compound mainly composed of magnet powder and a binder to mold said bonded magnet portions; charging a soft magnetic powder compound mainly composed of soft magnetic powder and a binder, such that said soft magnetic portion is in contact with said bonded magnet portions, and compressing said soft magnetic powder compound to mold said soft magnetic portion; and (b) simultaneously compressing said bonded magnet portions and said soft magnetic portion to make said bonded magnet portions and said soft magnetic portion integral.
Filed: February 19, 2010 Issued: July 5, 2011 Expires: Feb 2030	7,972,450	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	High resistance magnet and motor using the same Abstract A magnet comprising grains of a ferromagnetic material whose main component is iron and a fluorine compound layer or an oxy-fluorine compound layer of fluoride compound particles of alkali metals, alkaline earth metals and rare earth elements, present on the surface of the ferromagnetic material grains, wherein an amount of iron atoms in the fluorine compound particles is 1 to 50 atomic %. What is claimed is: 1. A magnet composed of ***[composition of matter]*** united particles of a ferromagnetic material whose main component is iron, each of the particles comprising the ferromagnetic material and a layer of a fluorine compound of at least one member selected from the group consisting of alkali metals, alkaline earth metals and transition metals, coated on surfaces of the particles, wherein the layer of the fluorine compound contains iron in a range of from 1 to 50

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			atomic %, and the fluorine compound has a face-centered cubic crystal structure…. 6. The magnet according to claim 1, wherein the fluorine compound is at least one member selected from the group consisting of ***[composition of matter]*** NdF.sub.3LiF, MgF.sub.2, CaF.sub.2, ScF.sub.2, VF.sub.2, VF.sub.3, CrF.sub.2, CrF.sub.3, MnF.sub.2, MnF.sub.3, CoF.sub.2, CoF.sub.3, NiF.sub.2, ZnF.sub.2, AIF.sub.3, GaF.sub.3, SrF.sub.3, YF.sub.3, ZrF.sub.3, NbF.sub.5, AgF, InF.sub.3, SnF.sub.2, SnF.sub.4, BaF.sub.2, LaF.sub.2, LaF.sub.3, CeF.sub.3, PrF.sub.3, NdF.sub.2, SmF.sub.2, SmF.sub.3, EuF.sub.2, EuF.sub.3, GdF.sub.3, TbF.sub.3, TbF.sub.4, DyF.sub.2, DyF.sub.3, HoF.sub.2, HoF.sub.3, ErF.sub.2, ErF.sub.3, TmF.sub.2, TmF.sub.3, YbF.sub.2, YbF.sub.3, LuF.sub.2, LuF.sub.3, PbF.sub.2, and BiF.sub.3.
Filed: November 27, 2003 Issued: July 5, 2011 Expires: Nov 2023	7,972,448	Assignee: Vacuumschmelze GmbH & Co. KG (Hanau, GERMANY)	Method for the production of an anisotropic magnetic powder and a bonded anisotropic magnet produced therefrom Abstract Disclosed herein is a method for the production of an anisotropic magnetic powder or a magnet produced from said powder, wherein a hydrogenating and dehydrogenating method is applied to the starting material in order to produce the powder. An anisotropic oriented magnetic material, more particularly magnetic scrap metal, is advantageously used as starting material so that the complicated use of a molten mass with isotropic distribution of the c axes of the hard metal crystals is not required. The result is an anisotropic material having a fine grain structure and a crystallographic orientation matching a TM.sub.XB phase formed during hydrogenation. The invention claimed is:

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			1. A method for producing ***[process/method]*** an anisotropic magnetic powder, comprising: providing a starting material comprising an SE-TM-B alloy, wherein SE is a rare earth element and TM is a transition metal, said starting material comprising a magnetic material with an anisotropic orientation and an average grain size of less than 0.1 mm, said starting material further comprising a hard magnetic content greater than 90% by volume, foreign phases smaller than 0.5 mm in size, and a crystal size and article size such that the crystal size is at most 75% of the particle size; producing a mixture comprising a TM.sub.XB phase in said starting material by a hydrogenation/dehydrogenation treatment without homogenization treatment at high temperate comprising: a first hydrogenation comprising heating said starting material comprising said SE-TM-B alloy under a hydrogen pressure sufficient to produce a hydride of the SE-TM-B alloy, and then a second hydrogenation comprising exposing the hydride resulting from said first hydrogenation to a hydrogen pressure and an elevated temperature sufficient to induce a phase transition to produce said TM.sub.XB phase, and afterward dehydrogenating and producing a reverse phase transition to produce an anisotropic magnetic powder having a crystallographic orientation that matches a crystallographic orientation of said TM.sub.XB phase and that has a fine and uniformly granular microstructure.
Filed: May 26, 2005 Issued: June 28, 2011 Expires: May 2025	7,967,919	Assignee: Panasonic Corporation (Osaka, JAPAN)	Process for producing self-assembled rare earth-iron bonded magnet and motor utilizing the same Abstract The present invention provides a method for manufacturing a self-organized rare earth-iron bonded magnet, including: a first step of covering a rare earth-iron magnet powder with oligomer or prepolymer in which one molecule includes at least two or more reactive ground substances to provide a surface-treated magnet powder; a second step of melting and kneading stretchable polymer and the surface-treated magnet powder to coarsely crush the resultant

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			material to provide a granule; a third step of dry blending the granule with hardener to provide a compound; a fourth step of compressing the compound under temperature conditions by which the oligomer or prepolymer, the polymer, and the hardener are caused to melt and to flow to provide a green compact; a fifth step of causing the green compact to be a self-organized rare earth-iron bonded magnet by reacting the oligomer or prepolymer, and polymer with the hardener; and a sixth step of stretching the bonded magnet to transform the shape to any of a circular-shape or a circular arc-like shape. The invention claimed is: 1. A method for manufacturing ***[process/method]*** a rare earth-iron bonded magnet comprising: a first step of covering a rare earth-iron magnet powder with oligomer or prepolymer to provide a surface-treated magnet powder, wherein the oligomer or prepolymer has a functional group for fixing the rare earth-iron magnet powder; a second step of melting a stretchable polymer and kneading the melted stretchable polymer with the surface-treated magnet powder at a temperature equal to or higher than a melting point of the polymer to coarsely crush a resultant material to provide a granule; a third step of dry blending an additive and a hardener with the granule to provide a compound; a fourth step of compressing the compound under conditions in which the oligomer or prepolymer, the polymer, and the hardener are heated to melt and to flow at a temperature equal to or higher than the melting points of the oligomer or prepolymer, the polymer, and the hardener to provide a green compact; and a fifth step of stretching the rare earth-iron bonded magnet to transform the shape to any of a circular-shape or a circular arc-like shape.
Filed: April 11, 2007 Issued:	7,955,443	Assignee: Shin-Etsu Chemical Co., Ltd.	Method for preparing rare earth permanent magnet material Abstract A permanent magnet material is prepared ***[process/method]*** by covering an anisotropic sintered magnet body of formula: R.sup.1.sub.x(Fe.sub.1-yCo.sub.y).sub.100-x-z-aB.sub.zM.sub.a wherein R.sup.1 is a rare earth

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June 7, 2011 Expires: April 2027		(Tokyo, JAPAN)	element, M is Al, Cu or the like, with a powder comprising an oxide of R.sup.2, a fluoride of R.sup.3 or an oxyfluoride of R.sup.4 wherein R.sup.2, R.sup.3, and R.sup.4 are rare earth elements, and having an average particle size up to 100 .mu.m, heat treating the powder-covered magnet body in a hydrogen gas-containing atmosphere for inducing disproportionation reaction on R.sup.1.sub.2Fe.sub.14B compound, and continuing heat treatment at a reduced hydrogen gas partial pressure for inducing recombination reaction to said compound, thereby finely dividing said compound phase to a crystal grain size up to 1 .mu.m, and for effecting absorption treatment, thereby causing R.sup.2, R.sup.3 or R.sup.4 to be absorbed in the magnet body.
Filed: Nov16, 2004 Issued: June 7, 2011 Expires: Nov 2024	7,955,442	Assignee: TDK Corporation (JAPAN)	Method for producing sintered magnet and alloy for sintered magnet Abstract The present invention provides a method for producing ***[process/method]*** a sintered magnet, which can have a sufficient sintered density even when the magnet has a low-R composition. The method is for producing a sintered magnet comprising R (R: one or more rare-earth elements), T (T: one or more transition metal elements essentially comprising Fe, or Fe and Co) and B (boron) as the main components, wherein a starting alloy prepared by strip casting is pulverized to a given particle size to form a fine powder, where the starting alloy comprises discolored deposit 1 on the surface and the area ratio of the discolored deposit 1 is 1.5% or less, the resulting fine powder is compacted in a magnetic field to prepare a compact, and the compact is sintered.
Filed: Aug 3, 2006 Issued: May 10,	7,938,915	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN),	Rare earth alloy binderless magnet and method for manufacture thereof Abstract A method for producing a rare-earth alloy based binderless magnet according to the present invention includes the steps of: (A) providing a rapidly solidified rare-earth alloy magnetic powder; and (B) compressing and compacting the

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2011 Expires: Aug 2026		Nippon Kagaku Yakin Co., Ltd. (Osaka, JAPAN)	rapidly solidified rare-earth alloy magnetic powder by a cold process without using a resin binder, thereby obtaining a compressed compact, 70 vol % to 95 vol % of which is the rapidly solidified rare-earth alloy magnetic powder. 1. A method for producing ***[process/method]*** a rare-earth alloy based binderless magnet, the method comprising the steps of: (A) providing a rapidly solidified rare-earth alloy magnetic powder; (B) compressing and compacting the rapidly solidified rare-earth alloy magnetic powder by a cold process at a temperature of 100.degree. C. or less without using a resin binder, thereby obtaining a compressed compact, 70 vol % to 95 vol % of which is the rapidly solidified rare-earth alloy magnetic powder, wherein the rapidly solidified rare-earth alloy magnetic powder is compressed under a pressure of 500 MPa to 2,500 MPa; and (C) subjecting the compressed compact to a heat treatment process at a temperature of 350.degree. C. to 800.degree. C. after the step (B) has been performed. 2. The method of claim 1, wherein the step (C) includes conducting the heat treatment process within an inert gas atmosphere with a pressure of 1.times.10.sup.-2 Pa or less. 4. A method of making ***[process/method]*** a magnetic circuit component comprising: a rare-earth alloy based binderless magnet in which magnetic powder particles of a rapidly solidified rare-earth alloy are bound together without a resin binder, wherein the magnetic powder of the rapidly solidified rare-earth alloy accounts for 70 vol % to 95 vol % of the entire magnet; and a resin-less compressed powder magnetic core in which powder particles of a soft magnetic material are bound together without a resin binder, wherein the binderless magnet and the resin-less compressed powder magnetic core are joined together, the method comprising the steps of: (A) providing a rapidly solidified rare-earth alloy powder and a soft magnetic material powder; (B)

			compressing the rapidly solidified rare-earth alloy powder and the soft magnetic material powder by a cold process at a temperature of 100.degree. C. or less and under a pressure of 500 MPa to 2,500 MPa, thereby making a compact in which these two powders are joined together; and (C) subjecting the compressed and combined compact to a heat treatment process at a temperature of 350.degree. C. to 800.degree. C.
Filed: Nov 20, 2007 Issued: April 19, 2011 Expires: Nov 2027	7,927,501	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rare earth element magnet and method of manufacturing same Abstract A magnet comprising magnetic powder containing at least one rare earth metal element, and an oxide binder for binding the magnetic powder, wherein an inter-face distance of the binder determined by diffraction analysis is 0.25 to 2.94 nm. The disclosure also discloses a method of manufacturing a magnet comprising; compacting magnetic powder containing at least one rare earth element under pressure in a mold; impregnating the compacted magnetic powder molding with a precursor solution of an oxide material; and heat-treating the compacted magnetic molding impregnated with the precursor thereby to impart an inter-face distance determined by diffraction analysis to the binder in the compacted molding. The distance is 0.25 to 2.94 nm. What is claimed is: 1. A magnet comprising ***[composition of matter]*** magnetic powder containing at least one rare earth metal element, the magnetic powder being composed of particles each constituted by fine crystals having an average size of 10 to 100 nm, and an amorphous binder for binding the magnetic powder, wherein an inter-face distance of the binder determined by diffraction analysis is 0.25 to 2.94 nm, the magnet being compact-molded. … 12. A method of manufacturing ***[process/method]*** a magnet comprising:

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			compacting magnetic powder containing at least one rare earth element under pressure in a mold; impregnating the compacted magnetic powder molding with a precursor solution containing a precursor of an amorphous binder; and heat-treating the compacted magnetic molding impregnated with the precursor thereby to form fine crystals having a mean size of 10 to 100 nm and to form an inter-face distance of the binder determined by diffraction analysis to the binder in the compacted magnetic powder molding, the distance being 0.25 to 2.94 nm. According to embodiments of the present invention, it is possible to improve magnetic properties of magnets that use a binder for bonding the magnetic material powder. The magnet is manufactured by compacting the magnetic powder, without sintering the magnetic powder
Filed: Ap 6, 2007 Issued: April 12, 2011 Expires: April 2027	[7,922,832](7,922,832)	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Method for preparing permanent magnet material Abstract A permanent magnet material is prepared by machining an anisotropic sintered magnet body having the compositional formula: R.sub.x(Fe.sub.1-yCo.sub.y).sub.100-x-z-aB.sub.zM.sub.a wherein R is Sc, Y or a rare earth element, M is Al, Cu or the like, to a specific surface area of at least 6 mm.sup.-1, heat treating in a hydrogen gas-containing atmosphere at 600-1,100.degree. C. for inducing disproportionation reaction on the R.sub.2Fe.sub.14B compound, and continuing heat treatment at a reduced hydrogen gas partial pressure and 600-1,100.degree. C. for inducing recombination reaction to the R.sub.2Fe.sub.14B compound, thereby finely dividing the R.sub.2Fe.sub.14B compound phase to a crystal grain size .ltoreq.1 .mu.m. The invention claimed is:

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			1. A method for preparing ***[process/method]*** a permanent magnet material, comprising the steps of: providing an anisotropic sintered magnet body having the compositional formula: R.sub.x(Fe.sub.1-yCo.sub.y).sub.100-x-z-aB.sub.zM.sub.a wherein R is at least one element selected from rare earth elements inclusive of Sc and Y, M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, x, y, z, and a indicative of atomic percentage are in the range: 10.ltoreq.x.ltoreq.15, 0.ltoreq.y.ltoreq.0.4, 3.ltoreq.z.ltoreq.15, and 0.ltoreq.a.ltoreq.11, said magnet body containing a R.sub.2Fe.sub.14B compound as a primary phase, machining the magnet body to a specific surface area of at least 6 mm.sup.-1, heat treating the magnet body which has been machined in a hydrogen gas-containing atmosphere at 600 to 1,100.degree. C., for inducing disproportionation reaction on the R.sub.2Fe.sub.14B compound, continuing the heat treatment in an atmosphere having a reduced hydrogen gas partial pressure at 600 to 1,100.degree. C., for inducing recombination reaction to the R.sub.2Fe.sub.14B compound, thereby finely dividing the R.sub.2Fe.sub.14B compound phase to a crystal grain size equal to or less than 1 .mu.m, and washing the magnet body with at least one agent of alkalis, acids and organic solvents, after the recombination reaction treatment.
Filed: June 9, 2006 Issued: April 5, 2011 Expires: June 2026	7,919,200	Assignee: Nissan Motor Co., Ltd. (Yokohama, JAPAN)	Rare earth magnet having high strength and high electrical resistance Abstract This rare earth magnet having high strength and high electrical resistance has a structure including an R--Fe--B-based rare earth magnet particles 18 which are enclosed with a high strength and high electrical resistance composite layer 12. The high strength and high electrical resistance composite layer 12 is constituted from a glass-based layer 16 that has a structure comprising a glass phase or R oxide particles 13 dispersed in glass phase, and R oxide particle-based mixture layers 17 that are formed on both sides of the glass-based layer

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			16 and contain an R-rich alloy phase 14 which contains 50 atomic % or more of R in the grain boundary of the R oxide particles. What is claimed is: 1. A rare earth magnet having a structure ***[composition of matter]*** such that R--Fe--B-based rare earth magnet particles are enclosed within a composite layer, where R represents one or more kinds of rare earth element including Y, and wherein the composite layer comprises a glass-based layer having a glass phase or a structure of R oxide particles dispersed in a glass phase, and R oxide particle-based mixture layers that are formed on both sides of the glass-based layer and which contain an R-rich alloy phase containing 50 atomic % or more of R in a grain boundary of the R oxide particles
Filed: March 12, 2007 Issued: March 29, 2011 Expires: March 2027	7,914,695	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Magnet using binding agent and method of manufacturing the same Abstract The object of the present invention is to both reduce costs and improve magnetic characteristics of rare-earth bond magnets in which magnetic material is bound with a binding agent. In order to achieve this object, magnetic characteristics of a magnet are improved by performing cold forming on rare-earth magnetic powder by itself with no resin added. Then, in order to provide strength for the magnet, a low-viscosity SiO.sub.2 precursor is infiltrated and thermoset in the magnet shaped body. As a result, it is possible to obtain a rare-earth bond magnet in which magnetic characteristics are improved and costs are reduced. The invention claimed is: 1. A rare-earth magnet comprising ***[composition of matter]*** a rare-earth magnetic powder bound with a SiO.sub.2 binding agent containing an alkoxy group.

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Filed: September 13, 2004 Issued: March 15, 2011 Expires: Sept 2024	7,906,036	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Ferrite sintered magnet Abstract A sintered ferrite magnet having a basic composition represented by the general formula: A.sub.1-x-y+aCa.sub.x+bR.sub.y+cFe.sub.2n-zCo.sub.z+dO.sub.19 (atomic ratio), wherein a, b, c and d represent the amounts of an A element, Ca, an R element and Co added in the pulverization step of an oxide magnet material, which are numerals meeting the conditions of 0.03.ltoreq.x.ltoreq.0.4, 0.1.ltoreq.y.ltoreq.0.6, 0.ltoreq.z.ltoreq.0.4, 4.ltoreq.n.ltoreq.10, x+y<1, 0.03.ltoreq.x+b.ltoreq.0.4, 0.1.ltoreq.y+c.ltoreq.0.6, 0.1.ltoreq.z+d.ltoreq.0.4, 0.50.ltoreq.[(1-x-y+a)/(1-y+a+b)].ltoreq.0.97, 1.1.ltoreq.(y+c)/(z+d).ltoreq.1.8, 1.0.ltoreq.(y+c)/x.ltoreq.20, and 0.1.ltoreq.x/(z+d).ltoreq.1.2. What is claimed is: 1. A sintered ferrite magnet consisting ***[composition of matter]*** essentially of an M phase, which comprises as indispensable elements: an A element, which is Sr or Sr and Ba: an R element, which is La or La plus at least one of rare earth elements including Y; Ca; Fe and Co, said magnet being produced through steps of pulverization, molding and sintering of a calcined oxide magnet material consisting essentially of an M phase and, having a basic composition represented by the following general formula (1): A.sub.1-x-yCa.sub.xR.sub.yFe.sub.2n-zCo.sub.zO.sub.19 (atomic ratio) (1), wherein Ca is added in the form of a compound in an amount of x before calcining, and said sintered ferrite magnet having a basic composition represented by the following general formula (2): A.sub.1-x-y+aCa.sub.x+bR.sub.y+cFe.sub.2n-zCo.sub.z+dO.sub.19 (atomic ratio) (2), in the above general formulae (1) and (2), x, y, z and n representing the amounts of Ca, said R element and Co and a molar ratio in said oxide magnet material, and a, b, c and d representing the amounts of said A element, Ca, said R element and Co added to said calcined

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			oxide magnet material in said pulverization, which are numerals meeting the following conditions: 0.13.ltoreq.x.ltoreq.0.25, 0.1.ltoreq.y.ltoreq.0.6, 0.6.ltoreq.[(1-x-y)/(1-y)].ltoreq.0.79, 0.ltoreq.z.ltoreq.0.4, 4.ltoreq.n.ltoreq.10, 0.ltoreq.b.ltoreq.0.2, 0.13.ltoreq.x+b.ltoreq.0.4, 0.1.ltoreq.y+c.ltoreq.0.6, 0.1.ltoreq.z+d.ltoreq.0.4, 0.56.ltoreq.[(1-x-y+a)/(1-y+a+b)].ltoreq.0.72, 1.1.ltoreq.(y+c)/(z+d).ltoreq.1.8, 1.0.ltoreq.(y+c)/x.ltoreq.20, and 0.1.ltoreq.x/(z+d).ltoreq.1.2.
Filed: Dec 5, 2007 Issued: Feb 22, 2011 Expires: Dec 2027	7,892,365	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Rare earth element-iron-boron alloy, and magnetically anisotropic permanent magnet powder and method for production thereof Abstract A method of making a magnetically anisotropic magnet powder according to the present invention includes the steps of preparing a master alloy by cooling a rare-earth-iron-boron based molten alloy and subjecting the master alloy to an HDDR process. The step of preparing the master alloy includes the step of forming a solidified alloy layer, including a plurality of R.sub.2Fe.sub.14B-type crystals (where R is at least one element selected from the group consisting of the rare-earth elements and yttrium) in which rare-earth-rich phases are dispersed, by cooling the molten alloy through contact with a cooling member. What is claimed is: 1. A rare-earth-iron-boron based alloy comprising ***[composition of matter]*** : a first texture layer having gaps; and a second texture layer on the first texture layer, wherein the first texture layer accounts for less than 10 vol % of the overall alloy, the first texture layer consisting essentially of R.sub.2Fe.sub.14B crystals (where R is at least one element selected from the group consisting of the rare-earth elements and yttrium) with an average minor-axis size of less

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			than 20 .mu.m, wherein the second texture layer comprises columnar R.sub.2Fe.sub.14B crystals, the columnar R.sub.2Fe.sub.14B crystals having an average minor-axis size of 20 .mu.m to 110 .mu.m, and wherein rare-earth-rich phases are dispersed at an average interval of 50 .mu.m or less in the columnar R.sub.2Fe.sub.14B crystals of the second texture layer.
Filed: Nov16, 2007 Issued: Feb 8, 201 Expires: Nov 2027	7,883,587	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Method for preparing rare earth permanent magnet Abstract A rare earth permanent magnet is prepared by providing a sintered magnet body consisting of 12-17 at % of rare earth, 3-15 at % of B, 0.01-11 at % of metal element, 0.1-4 at % of O, 0.05-3 at % of C, 0.01-1 at % of N, and the balance of Fe, disposing on a surface of the magnet body a powder comprising an oxide, fluoride and/or oxyfluoride of another rare earth, and heat treating the powder-covered magnet body at a temperature below the sintering temperature in vacuum or in an inert gas, for causing the other rare earth to be absorbed in the magnet body. The invention claimed is: 1. A method for preparing a rare earth permanent magnet ***[process/method]*** , comprising the steps of: disposing a powder on a surface of a sintered magnet body of R.sup.1.sub.aT.sub.bB.sub.cM.sub.dO.sub.eC.sub.fN.sub.g composition wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y, T is at least one element selected from Fe and Co, M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, and "a" to "g" indicative of atomic percent based on the alloy are in the range: 12.ltoreq.a.ltoreq.17, 3.ltoreq.c.ltoreq.15, 0.01.ltoreq.d.ltoreq.11,

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			0.1.ltoreq.e.ltoreq.4, 0.05.ltoreq.f.ltoreq.3, 0.01.ltoreq.g.ltoreq.1, and the balance of b, and a.gtoreq.12.5+(e+f+g).times.0.67-c.times.0.11, said powder comprising at least one compound selected from among an oxide of R.sup.2, a fluoride of R.sup.3, and an oxyfluoride of R.sup.4 wherein each of R.sup.2, R.sup.3, and R.sup.4 is at least one element selected from rare earth elements inclusive of Sc and Y, and heat treating the magnet body having the powder disposed on its surface at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas for 1 minute to 100 hours, for causing at least one of R.sup.2, R.sup.3 and R.sup.4 in the powder to be absorbed in the magnet body.
Filed: February 5, 2004 Issued: February 1, 2011 Expires: Feb 2024	7,879,469	Assignee: TDK Corporation (JAPAN)	Ferrite magnet powder, sintered magnet, bond magnet, and magnetic recording medium Abstract A ferrite magnet powder is represented by the composition formula AFe.sup.2+.sub.a(1-x)M.sub.axFe.sup.3+.sub.bO.sub.27, wherein A represents at least one element selected from the group consisting of Sr, Ba, and Pb; and M represents at least one element selected from the group consisting of Zn, Co, Mn, and Ni, and wherein 0.05.ltoreq.x.ltoreq.0.80, 1.5.ltoreq.a.ltoreq.2.2, and 12.ltoreq.b.ltoreq.17. A high saturation magnetization 4.pi.Is can be achieved by the partial substitution of the Fe.sup.2+ site of a W-type ferrite with an element M such as Zn within a certain range. The invention claimed is: 1. A ferrite magnet powder represented by the composition formula ***[composition of matter]*** AFe.sup.2+.sub.a(1-x)M.sub.axFe.sup.3+.sub.bO.sub.27, wherein A represents at least one element selected from the group consisting of Sr, Ba, and Pb; and M represents at least

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			one element selected from the group consisting of Zn, Co, Mn, and Ni, characterized in that 0.30.ltoreq.x.ltoreq.0.70, 1.5.ltoreq.a.ltoreq.2.2, 12.ltoreq.b.ltoreq.17, and the ferrite magnet powder has a saturation magnetization of 5.0 kG or more. 7. A sintered magnet represented by the composition formula ***[composition of matter]*** AFe.sup.2+.sub.a(1-x)M.sub.axFe.sup.3+.sub.bO.sub.27, wherein A represents at least one element selected from the group consisting of Sr, Ba, and Pb; and M represents at least one element selected from the group consisting of Zn, Co, Mn, and Ni, characterized in that 0.30.ltoreq.x.ltoreq.0.70, 1.5.ltoreq.a.ltoreq.2.2, 12.ltoreq.b.ltoreq.17, and the sintered magnet has a saturation magnetization of 5.0 kG or more. 14. A bonded magnet comprising ***[composition of matter]*** : a ferrite magnet powder represented by the composition formula AFe.sup.2+.sub.a(1-x)M.sub.axFe.sup.3+.sub.bO.sub.27, wherein A represents at least one element selected from the group consisting of Sr, Ba, and Pb; and M represents at least one element selected from the group consisting of Zn, Co, Mn, and Ni, and wherein 0.30.ltoreq.x.ltoreq.0.70, 1.5.ltoreq.a.ltoreq.2.2, and 12.ltoreq.b.ltoreq.17: and a resin phase that disperses and retains said ferrite magnet powder, and the bonded magnet has a saturation magnetization of 5.0 kG or more.
Filed: Aug 3, 2009 Issued: Jan 18, 2011	7,871,475	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rare-earth magnet and manufacturing method thereof and magnet motor Abstract The object of the present invention is to provide a rare earth magnet which enables to achieve a good balance between high coercive force and high residual magnetic flux density, and its manufacturing method. The present invention provides a rare earth magnet in which a layered grain boundary phase is formed on a surface or a potion of a grain boundary of

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Expires: Aug 2029			Nd.sub.2Fe.sub.14B which is a main phase of an R--Fe--B (R is a rare-earth element) based magnet, and wherein the grain boundary phase contains a fluoride compound, and wherein a thickness of the fluoride compound is 10 .mu.m or less, or a thickness of the fluoride compound is from 0.1 .mu.m to 10 .mu.m, and wherein the coverage of the fluoride compound over a main phase particle is 50% or more on average. Moreover, after layering fluoride compound powder, which is formed in plate-like shape, in the grain boundary phase, the rare earth magnet is manufactured by quenching the layered compound after melting it at a vacuum atmosphere at a predetermined temperature, or by heating and pressing the main phase and the fluoride compound to make the fluoride compound into a layered fluoride compound along the grain boundary phase. What is claims is: 1. A rare-earth magnet in which ***[composition of matter]*** a layered grain boundary phase, having an average thickness of 1-100 nm, is formed in a coverage of 50% or more on a portion of a grain boundary of Nd.sub.2Fe.sub.14B which is a main phase of an R--Fe--B (R; rare-earth element) based magnet, wherein the grain boundary phase contains at least one fluoride compound, and wherein the at least one fluoride compound of the grain boundary phase contains plural rare-earth elements and iron.
Filed: June 26, 2007 Issued: January 11, 2011	7,867,343	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Rare earth magnet and method for production thereof Abstract In a rare earth magnet, an added heavy rare earth element R.sub.H such as Dy is effectively used without any waste, so as to effectively improve the coercive force. First, a molten alloy of a material alloy for an R-T-Q rare earth magnet (R is a rare earth element, T is a transition metal element, and Q is at least one element selected from the group consisting of B, C, N, Al, Si, and P), the rare

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Expires: June 2027			earth element R containing at least one kind of element R.sub.L selected from the group consisting of Nd and Pr and at least one kind of element R.sub.H selected from the group consisting of Dy Tb, and Ho is prepared. The molten alloy is quenched, so as to produce a solidified alloy. Thereafter, a thermal treatment in which the rapidly solidified alloy is held in a temperature range of 400.degree. C. or higher and lower than 800.degree. C. for a period of not shorter than 5 minutes nor longer than 12 hours is performed. By the thermal treatment, the element R.sub.H can be moved from the grain boundary phase to the main phase, so that the coercive force is increased. What is claimed is: 1. An R-T-B rare earth permanent sintered magnet containing ***[composition of matter]*** an R.sub.2T.sub.14B phase (R is a rare earth element, T is a transition metal element, and B is boron) as a main phase and an R-rich phase that is positioned in a grain boundary of the R.sub.2T.sub.14B phase, a concentration of the rare earth element R in the R-rich phase is higher than that in the R.sub.2T.sub.14B phase, wherein the rare earth element R contains at least one kind of element R.sub.L selected from the group consisting of Nd and Pr, and at least one kind of element R.sub.H selected from the group consisting of Dy, Tb, and Ho, and the element R.sub.H accounts for 10 at % or more of the total of the contained rare earth element, and a mole fraction of the element R.sub.H included in the R.sub.2T.sub.14B phase is larger than a mole fraction of the element R.sub.H in the total of the contained rare earth element, wherein the rare earth element R is 11 at % or more and 17 at % or less of the total, the transition metal element T is 75 at % or more and 84 at % or less of the total, and the element B is 5 at % or more and 8 at % or less of the total.
Filed: June 28, 2005	7,858,023	Assignee: TDK Corporation	Method for producing raw material powder for rare earth sintered magnet, method for producing rare earth sintered magnet, granule and sintered body Abstract

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Issued: Dec 28, 2010 Expires: June 2025		(Tokyo, JAPAN)	A method for producing a rare earth sintered magnet uses granules having an excellent fluidity to improve the dimensional accuracy and production of a compact formed of the granules without significant property losses. The granules are formed by adding an organic liquid to primary alloy particles having a predetermined composition to produce granules having the primary alloy particles adhered together by the organic liquid. Preferably, from 1.5 to 15.0% by weight of the organic liquid is added to the primary alloy particles. The invention claimed is: 1. A method for producing a rare earth sintered magnet comprising ***[process/method]*** the steps of: charging into a die cavity granules of primary alloy particles having a predetermined composition adhered together by an organic liquid free of polymer and comprising at least one member selected from the group consisting of ethanol, toluene, methyl isobutyl ketone, diethylene glycol monoethyl ether, terpene compounds, diethylene glycol monobutyl ether, diethylene glycol monobutyl ether acetate, n-butyl acetate, ethylene glycol monobutyl ether, cyclohexanol, terpineol, pinene, dibutyl ether, xylene, cyclohexanone, propionic anhydride, and menthane; obtaining a compacted body by applying a magnetic field to the granules and compressing the granules; and sintering the compacted body.
Filed: June 28, 2005 Issued: Dec 7, 2010 Expires: June 2025	7,846,273	Assignee: TDK Corporation (Tokyo, JAPAN)	R-T-B type alloy, production method of R-T-B type alloy flake, fine powder for R-T-B type rare earth permanent magnet, and R-T-B type rare earth permanent magnet Abstract An R-T-B type alloy (wherein R is at least one member selected from rare earth elements, T is a transition metal including Fe, and B includes boron) which is a raw material for use in a rare earth-based permanent magnet, wherein the volume percentage of the region containing an R.sub.2T.sub.17 phase having an average grain diameter of 3 .mu.m or less in the short axis

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			direction is from 0.5 to 10%. What is claimed is: 1. An R-T-B type alloy for use in a rare earth-based permanent magnet, comprising ***[composition of matter]*** an R.sub.2T.sub.14B phase as the main phase, and comprising a region containing an R.sub.2T.sub.17 phase having an average grain diameter of 3 .mu.m or less in a short axis direction, wherein R is at least one member selected from rare earth elements, and R is at least one of Dy or Tb, T is a transition metal comprising Fe, and B comprises boron, and wherein the volume percentage of the region containing the R.sub.2T.sub.17 phase having an average grain diameter of 3 .mu.m or less in the short axis direction is from 0.5 to 10% of the entire alloy.
Filed: Dec 13, 2005 Issued: Nov 30, 2010 Expires: Dec 2025	7,842,140	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Iron-based rare-earth nanocomposite magnet and method for producing the magnet Abstract The iron-based rare-earth nanocomposite magnet of the present invention has a composition T.sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n, where T is Fe or a transition metal element in which Fe is partially replaced by Co and/or Ni; Q is B and/or C; R is at least one rare-earth element including substantially no La or Ce; and M is at least one metal element selected from Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb. x, y, z and n satisfy 5.ltoreq.x.ltoreq.10 at %, 7.ltoreq.y.ltoreq.10 at %, 0.1.ltoreq.z.ltoreq.5 at % and 0.ltoreq.n.ltoreq.10 at %, respectively. The magnet includes R.sub.2Fe.sub.14B-type compound phases and .alpha. --Fe phases forming a magnetically coupled nanocomposite magnet structure. The R.sub.2Fe.sub.14B-type compound phases have an average crystal grain size of 30 nm to 300 nm and the .alpha. --Fe phases have an average crystal grain size of 1 nm to 20 nm. The magnet has magnetic properties including a

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			coercivity of at least 400 kA/m and a remanence of at least 0.9 T The invention claimed is: 1. An iron-based rare-earth nanocomposite magnet having a composition ***[composition of matter]*** represented by the formula:T.sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n, where T is either Fe alone or Fe in combination with at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one rare-earth element including substantially no La or Ce; and M is at least one metal element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, the mole fractions x, y, z and n satisfying the inequalities of 5 at % .ltoreq.x .ltoreq.8 at %, 7 at % .ltoreq.y .ltoreq.10 at %, 0.1 at % .ltoreq.z .ltoreq.5 at % and 0 at % .ltoreq.n .ltoreq.10 at %, respectively, wherein the magnet includes R.sub.2T.sub.14Q compound phases and .alpha. --Fe phases that form a magnetically coupled nanocomposite magnet structure, and wherein the R.sub.2T.sub.14Q compound phases have an average crystal grain size of 20 nm or more and the .alpha. --Fe phases are present at grain boundary triple points in a grain boundary region between the R.sub.2T.sub.14Q compound phases, the grain boundary region having a thickness of 20 nm or less, wherein a ratio of the average crystal grain size of the R.sub.2T.sub.14Q compound phases relative to that of the .alpha. --Fe phases is 2.0 or more, and wherein the magnet has magnetic properties including a coercivity of at least 400 kA/m and a remanence of at least 0.9 T. 5. A method for producing an iron-based rare-earth nanocomposite magnet ***[process/method]*** , the method comprising the steps of: preparing a molten alloy having a composition represented by the formula: T.sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n , where T is either Fe alone or Fe in combination with at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and

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			C; R is at least one rare-earth element including substantially no La or Ce; and M is at least one metal element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, the mole fractions x, y, z and n satisfying the inequalities of 5 at %.ltoreq.x.ltoreq.8 at %, 7 at %.ltoreq.y.ltoreq.10 at %, 0.1 at %.ltoreq.z.ltoreq.5 at % and 0 at %.ltoreq.n.ltoreq.10 at %, respectively; rapidly cooling and solidifying the molten alloy to make a rapidly solidified alloy including at least 20 vol % of R.sub.2T.sub.14 Q compound phases with an average crystal grain size of 80 nm or less; and heating the rapidly solidified alloy, thereby making an iron-based rare-earth nanocomposite magnet including the R.sub.2T.sub.14Q compound phases and .alpha. --Fe phases that form a magnetically coupled nanocomposite magnet structure, where the R.sub.2T.sub.14Q compound phases have an average crystal grain size of 20 nm or more, the .alpha. --Fe phases are present at grain boundary triple points in a grain boundary region between the R.sub.2T.sub.14Q compound phases, the grain boundary region having a thickness of 20 nm or less, wherein a ratio of the average crystal grain size of the R.sub.2T.sub.14Q compound phases relative to that of the .alpha. --Fe phases is 2.0 or more, and the magnet has magnetic properties including a coercivity of at least 400 kA/m and a remanence of at least 0.9 T
Filed: March 10, 2006 Issued: Nov 23, 2010 Expires: March 2026	7,837,893	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN	Oxide-type, magnetic material and its production method, and sintered ferrite magnet and its production method Abstract A sintered ferrite magnet having an M-type ferrite structure and comprising Ca, an R element which is at least one rare earth element indispensably including La, Ba, Fe and Co as indispensable elements, which is represented by Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z, wherein (1-x-y), x, y, z and n are numbers representing the amounts of Ca, the R element, Ba and Co and a molar ratio, meeting 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.03.ltoreq.z.ltoreq.0.65, and 4.ltoreq.n.ltoreq.7.

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			What is claimed is: 1. An oxide-type, magnetic material ***[composition of matter]*** based on ferrite having a hexagonal structure, comprising Ca, an R element which is at least one rare earth element indispensably including La, Ba, Fe and Co as indispensable elements, the composition ratios of Ca, R, Ba, Fe and Co being represented by the following general formula: Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z (by atomic ratio), wherein (1-x-y), x, y, z and n are numbers representing the amounts of Ca, the R element, Ba and Co and a molar ratio, respectively, meeting the following conditions: 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.3.ltoreq.1-x-y.ltoreq.0.6, 0.03.ltoreq.z.ltoreq.0.65, and 4.ltoreq.n.ltoreq.7. 9. A method for producing ***[process/method]*** an oxide-type, magnetic material based on ferrite having a hexagonal structure and comprising Ca, an R element which is at least one rare earth element indispensably including La, Ba, Fe and Co as indispensable elements, the composition ratios of Ca, R, Ba, Fe and Co being represented by the following general formula: Ca.sub.1-x-yR.sub.xBa.sub.yFe.sub.2n-zCo.sub.z (by atomic ratio), wherein (1-x-y), x, y, z and n are numbers representing the amounts of Ca, the R element, Ba and Co and a molar ratio, respectively, meeting the following conditions: 0.2.ltoreq.x.ltoreq.0.65, 0.001.ltoreq.y.ltoreq.0.2, 0.3.ltoreq.1-x-y.ltoreq.0.6, 0.03.ltoreq.z.ltoreq.0.65, and 4.ltoreq.n.ltoreq.7, said method comprising the steps of mixing a Ca compound, an R compound, a Ba compound, an iron compound and a Co compound to obtain said composition, and calcining the resultant mixture.
Filed: July 22, 2005	7,828,988	Assignee: Panasonic Corporation	Anisotropic rare earth bonded magnet having self-organized network boundary phase and permanent magnet motor utilizing the same Abstract

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Issued: November 9, 2010 Expires: July 2025		(Osaka, JAPAN)	An anisotropic rare-earth bonded magnet having a network boundary phase is provided by imparting melt fluidity accompanied by a slip to a composite granule and compressing and molding the composite granule in a magnetic field together with extensible polymer molecules and a chemical contact. In the bonded magnet, the maximum energy product is 147 kJ/m.sup.3 in the thickness of 1 mm, or 127 kJ/m.sup.3 in the thickness of 300 .mu.m. This bonded magnet contributes to increase in output and decrease in size and weight of a permanent-magnet motor. The invention claimed is: 1. An anisotropic rare-earth bonded magnet including ***[composition of matter]*** a structure where a composite granule having rare-earth magnet powder, one of oligomer and prepolymer having a reaction substrate, and extensible polymer molecules is compressed and molded together with the extensible polymer molecules and a chemical contact, a boundary phase mainly made of the extensible polymer molecules is arranged in a network shape around the composite granule, the composite granule and the extensible polymer molecules are chemically bonded together at a chemical contact point, and wherein, pentaerythritol fatty triester compound (PETE) is used as a lubricant.
Filed: December 14, 2005 Issued: November 2, 2010 Expires: Dec 2025	7,824,506	Assignee: Japan Science and Technology Agency, (JAPAN) Osaka University (JAPAN)	Nd-Fe-B magnet with modified grain boundary and process for producing the same Abstract In known methods, an improvement of the coercive force is realized by allowing the Dy metal or the like to present selectively in crystal grain boundary portions of a sintered magnet. However, since these are based on a physical film formation method, e.g., sputtering, through the use of a vacuum vessel, there is a mass productivity problem when a large number of magnets are treated. Furthermore, there is a magnet cost problem from the viewpoint

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			that, for example, an expensive, high-purity Dy metal or the like must be used as a raw material for film formation. The method for modifying grain boundaries of a Nd--Fe--B base magnet includes the step of allowing an M metal component to diffuse and penetrate from a surface of a Nd--Fe--B base sintered magnet body having a Nd-rich crystal grain boundary phase surrounding principal Nd.sub.2Fe.sub.14B crystals to the grain boundary phase through a reduction treatment of a fluoride, an oxide, or a chloride of an M metal element (where M is Pr, Dy, Tb, or Ho). The invention claimed is: 1. A method ***[process/method]*** for modifying grain boundaries of a Nd--Fe--B base magnet comprising: placing a Nd--Fe--B base sintered magnet body in contact with a compound selected from a fluoride, an oxide, or a chloride of an M metal element (where M is Pr, Dy, Tb, or Ho); reducing the compound of M metal element by using a chemical reducing agent selected from the group consisting of Ca metal, Mg metal or a hydride thereof such that M metal element deposits on the Nd--Fe--B base sintered magnet body; and keeping the Nd--Fe--B base sintered magnet body at a temperature in a range of 800.degree. C. to 1100.degree. C., wherein the M metal element to diffuse and penetrate from a surface of the Nd--Fe--B base sintered magnet body having a Nd-rich crystal grain boundary phase surrounding principal Nd.sub.2Fe.sub.14B crystals to the grain boundary phase.
Filed: Jan 28, 2009 Issued: Sept 21, 2010	7,800,271	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Sintered magnet and rotating machine equipped with the same Abstract The sintered magnet and the rotating machine equipped with the same are disclosed. The sintered magnet includes crystal grains of a ferromagnetic material consisting mainly of iron, and a fluoride compound or oxyfluoride compound layer containing at least one element selected from an alkali metal element, an alkali earth metal element, and a rare earth element. The layer is

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Expires: Jan 2029			formed inside some of the crystal grains or in a part of a grain boundary part. An oxyfluoride compound or fluoride compound layer containing carbon in a stratified form is formed on an outermost surface of the crystal grains. The fluoride compound or oxyfluoride compound layer has a concentration gradient of carbon, contains at least one light rare earth element and at least one heavy rare earth element. The heavy rare earth element has a concentration lower than that of the light rare earth element. What is claimed is: 1. A rotating machine comprising a sintered magnet, wherein the sintered magnet includes ***[composition of matter]*** crystal grains of a ferromagnetic material consisting mainly of iron, and a layer of a fluoride compound or a layer of an oxyfluoride compound, containing at least one element selected from the group consisting of an alkali metal element, an alkali earth metal element, and a rare earth element, the layer of the fluoride compound or the layer of the oxyfluoride compound being formed inside some of the crystal grains or in a part of a grain boundary part, a fluoride compound or oxyfluoride compound containing carbon in a stratified form is formed on an outermost surface of the sintered magnet, the layer of fluoride compound or the layer of oxyfluoride compound formed inside some of the crystal grains or in the part of the grain boundary contains at least one light rare earth element and at least one heavy rare earth element, and the at least one heavy rare earth element has a concentration lower than that of the light rare earth element, and the layer of the fluoride compound or the layer of the oxyfluoride compound formed in some of the crystal grains or in the part of the grain boundary has a difference in continuity thereof between a direction parallel to a direction of anisotropy and a direction perpendicular to the direction of anisotropy.
Filed: Oct 2, 2006	7,794,859	Assignee: TDK Corporation	Rare-earth magnet Abstract

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Issued: Sept 14, 2010 Expires: Oct 2026		(Tokyo, JAPAN)	A rare-earth magnet having a protective film for enhancing a corrosion resistance is provided. The protective film is a three-layer film including a first protective layer with a crystalline structure .alpha. (for example, a polycrystalline structure), a second protective layer with a crystalline structure .beta. (for example, a columnar-crystalline structure), and a third protective layer with the crystalline structure .alpha. from the side near a magnet body. Since the adjoining first and second protective layers have different crystalline structures from each other, and the adjoining second and third protective layers have also different crystalline structures from each other, compactness among the three layers in the protective film may be improved. Therefore, development of a pinhole is restrained, and corrosion of the protective film can be restrained. What is claimed is: 1. A rare-earth magnet comprising: a magnet body constituted of ***[composition of matter]*** a sintered magnet containing a transition metal element and a rare earth element; and a protective film covering a surface of the magnet body; wherein the protective film includes a four-layered structure composed of a first protective layer, a second protective layer, a third protective layer and a fourth protective layer, the first protective layer having a polycrystalline structure and being adjacent to the magnet body, the second protective layer having a polycrystalline structure and being away from the magnet body, the third protective layer having a columnar-crystalline structure grown in a radial pattern which is interposed between the first protective layer and the second protective layer and being adjacent to the first protective layer, and the fourth protective layer having a columnar-crystalline structure grown in a radial pattern which is interposed between the second protective layer and the third protective layer and being adjacent to the second protective layer and the third protective layer.
Filed:	7,790,300	Assignee:	R-Fe-B based thin film magnet and method for preparation thereof

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March 23, 2005 Issued: September 7, 2010 Expires: March 2025		Japan Science and Technology Agency (Saitama, JAPAN) , Hitachi Metals, Ltd. (Tokyo, JAPAN), Namiki Precision Jewel Co., Ltd. (Tokyo, JAPAN)	Abstract An R--Fe--B based thin film magnet including an R--Fe--B based alloy which contains 28 to 45 percent by mass of R element (where R represents at least one type of rare-earth lanthanide elements) and which is physically formed into a film, wherein the R--Fe--B based alloy has a composite texture composed of R.sub.2Fe.sub.14B crystals having a crystal grain diameter of 0.5 to 30 .mu.m and R-element-rich grain boundary phases present at boundaries between the crystals. The magnetization characteristics of the thin film magnet are improved. The R--Fe--B based thin film magnet can be prepared by heating to 700.degree. C. to 1,200.degree. C. during physical film formation or/and the following heat treatment, so as to grow crystal grains and form R-element-rich grain boundary phases. The invention claimed is: 1. An R--Fe--B alloy based thin film magnet comprising ***[composition of matter]*** an R--Fe--B based alloy which contains 28 to 45 percent by mass of R element (where R represents at least one type of rare-earth lanthanide elements) and which is deposited on a base material by a physical film forming method into an alloy film, wherein the alloy film has a thickness is 0.2 to 400 .mu.m, and wherein the R--Fe--B based alloy has a composite texture comprising R.sub.2Fe.sub.14B crystals grown by heat treatment of said alloy film and having a crystal grain diameter of 3 to 30 .mu.m which is larger than a single-magnetic-domain grain diameter, wherein a plurality of magnetic domains are present in the crystal grains, and R-element-rich grain boundary phases formed by the heat treatment is present at boundaries between the crystals, and the R--Fe--B alloy has a nucleation type coercive force. 3. A method for preparation ***[process/method]*** of the R--Fe--B alloy based thin film magnet, the method comprising the step of: forming an alloy film having a

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			thickness of 0.2 to 400 .mu.m by depositing on a base material by a physical film forming method an R--Fe--B based alloy which contains 28 to 45 percent by mass of R element (where R represents at least one type of rare-earth lanthanide elements); heating the R--Fe--B based alloy in a vacuum or in a non-oxidizing atmosphere to 800.degree. C. to 1,200.degree. C. during physical alloy film formation or/and the following heat treatment, so as to grow crystal grains to diameters of 3 to 30 .mu.m and form R-element-rich grain boundary phases present at boundaries between the crystals, whereby obtaining the R--Fe--B alloy based thin film magnet comprising an R--Fe--B based alloy which contains 28 to 45 percent by mass of R element (where R represents at least one type of rare-earth lanthanide elements) on a base material and which is deposited by a physical film forming method into an alloy film, wherein the alloy film has a thickness is 0.2 to 400 .mu.m, and wherein the R--Fe--B based alloy has a composite texture comprising R.sub.2Fe.sub.14B crystals grown by heat treatment of said alloy film and having a crystal grain diameter of 3 to 30 .mu.m which is larger than a single-magnetic-domain grain diameter, wherein a plurality of magnetic domains are present in the crystal grains and R-element-rich grain boundary phases formed by the heat treatment are present at boundaries between the crystals, and the R--Fe--B alloy has a nucleation type coercive force.
Filed: Sept 18, 2009 Issued: Sept 7, 2010 Expires: Sept 2029	7,789,933	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-T-B based sintered magnet Abstract An R-T-B based sintered magnet according to the present invention comprises: 12 at % to 15 at % of a rare-earth element R; 5.0 at % to 8.0 at % of boron B; 0.02 at % to 0.2 at % of Mn; and a transition metal T as the balance. The rare-earth element R is at least one element selected from the rare-earth elements, including Y (yttrium), and includes 0.2 at % to 8 at % of Pr. And the transition element T includes Fe as its main element. What is claimed is:

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			1. An R-T-B based sintered magnet having a composition comprising ***[composition of matter]*** : 12 at % to 15 at % of a rare-earth element R; 5.0 at % to 8.0 at % of boron B; 0.02 at % to less than 0.2 at % of Mn; and a transition metal T as the balance; wherein the rare-earth element R is at least one element selected from the group of elements consisting of the rare-earth elements and Y and includes at least Nd and Pr, where the content of Pr being 0.2 at % to 8 at % of the sintered magnet; and the transition metal T includes Fe as its main element
Filed: Nov 16, 2007 Issued: February 8, 2011 Expires: Nov 2027	7,883,587	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Method for preparing rare earth permanent magnet Abstract A rare earth permanent magnet is prepared by providing a sintered magnet body consisting of 12-17 at % of rare earth, 3-15 at % of B, 0.01-11 at % of metal element, 0.1-4 at % of O, 0.05-3 at % of C, 0.01-1 at % of N, and the balance of Fe, disposing on a surface of the magnet body a powder comprising an oxide, fluoride and/or oxyfluoride of another rare earth, and heat treating the powder-covered magnet body at a temperature below the sintering temperature in vacuum or in an inert gas, for causing the other rare earth to be absorbed in the magnet body. The invention claimed is: 1. A method for preparing a rare earth permanent magnet ***[process/method]*** , comprising the steps of: disposing a powder on a surface of a sintered magnet body of R.sup.1.sub.aT.sub.bB.sub.cM.sub.dO.sub.eC.sub.fN.sub.g composition wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y, T is at least one element selected from Fe and Co, M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, and "a" to "g" indicative of atomic percent based on the alloy are in the range: 12.ltoreq.a.ltoreq.17, 3.ltoreq.c.ltoreq.15, 0.01.ltoreq.d.ltoreq.11,

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			0.1.ltoreq.e.ltoreq.4, 0.05.ltoreq.f.ltoreq.3, 0.01.ltoreq.g.ltoreq.1, and the balance of b, and a.gtoreq.12.5+(e+f+g).times.0.67-c.times.0.11, said powder comprising at least one compound selected from among an oxide of R.sup.2, a fluoride of R.sup.3, and an oxyfluoride of R.sup.4 wherein each of R.sup.2, R.sup.3, and R.sup.4 is at least one element selected from rare earth elements inclusive of Sc and Y, and heat treating the magnet body having the powder disposed on its surface at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas for 1 minute to 100 hours, for causing at least one of R.sup.2, R.sup.3 and R.sup.4 in the powder to be absorbed in the magnet body.
Filed: Aug 9, 2005 Issued: Aug 31, 2010 Expires: Aug 2025	7,785,460	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Method for producing rare earth metal-based permanent magnet having copper plating film on the surface thereof Abstract [Problems] To provide a method for producing a rare earth metal-based permanent magnet having on the surface thereof a copper plating film by using a novel plating solution for use in a copper electroplating treatment capable of forming a copper plating film having excellent adhesiveness on the surface of a rare earth metal-based permanent magnet. [Means for Resolution] The method for producing a rare earth metal-based permanent magnet having a copper plating film on the surface thereof according to the invention is characterized in that it comprises forming a copper plating film on the surface of a rare earth metal-based permanent magnet by means of a copper electroplating treatment by using a plating solution having its pH adjusted to a range from 9.0 to 11.5 and containing at least the following three components: (1) Cu.sup.2+ ions, (2) a chelating agent having a chelate stability constant of 10.0 or higher for Cu.sup.2+ ions, and (3) a chelating agent having a chelate stability constant of 16.0 or higher for Fe.sup.3+ ions (where, the aforementioned chelate stability constants are confined to conditions of pH 9.0 to 11.5). The invention claimed is:

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			1. A method for producing ***[process/method]*** a rare earth metal-based permanent magnet having a copper plating film on the surface thereof, characterized in that it comprises forming a copper plating film on the surface of a rare earth metal-based permanent magnet by means of a copper electroplating treatment by using a plating solution having its pH adjusted to a range from 9.0 to 11.5 and containing at least the following three components: (1) Cu.sup.2+ ions, (2) a chelating agent having a chelate stability constant of 10.0 or higher for Cu.sup.2+ ions at pH of 9.0 to 11.5, and (3) a chelating agent having a chelate stability constant of 16.0 or higher for Fe.sup.3+ ions at pH of 9.0 to 11.5.
Filed: September 8, 2005 Issued: July 20, 2010 Expires: Sept 2025	7,758,767	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Oxide magnetic material and sintered magnet Abstract An oxide magnetic material according to the present invention is represented by the formula: (1-x)CaO.(x/2)R.sub.2O.sub.3.(n-y/2)Fe.sub.2O.sub.3.yMO, where R is at least one element selected from the group consisting of La, Nd and Pr and always includes La, M is at least one element selected from the group consisting of Co, Zn, Ni and Mn and always includes Co, and the mole fractions x, y and n satisfy 0.4.ltoreq.x.ltoreq.0.6, 0.2.ltoreq.y.ltoreq.0.35, 4.ltoreq.n.ltoreq.6, and 1.4.ltoreq.x/y.ltoreq.2.5. The oxide magnetic material includes a ferrite having a hexagonal M-type magnetoplumbite structure as a main phase. The invention claimed is: 1. A sintered magnet comprising an oxide magnetic material having a composition ***[composition of matter]*** represented by the formula: (1-x)CaO.(x/2)R.sub.2O.sub.3.(n-y/2)Fe.sub.2O.sub.3.yMO, where R is at least one element selected from the group consisting of La, Nd and Pr and always includes La, M is at least one element selected from the group consisting of Co, Zn, Ni and Mn and always includes Co, and the mole fractions x, y and n

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			satisfy 0.4.ltoreq.x.ltoreq.0.6, 0.2.ltoreq.y.ltoreq.0.35, 4.ltoreq.n.ltoreq.6, and 1.4.ltoreq.x/y.ltoreq.2.5, wherein the oxide magnetic material consists essentially of a ferrite having a hexagonal M-type magnetoplumbite structure, and wherein the sintered magnet has a coercivity HcJ of 370 kA/m or more.
Filed: Nov 17, 2005 Issued: June 22, 2010 Expires: Nov 2025	7,740,716	Assignee: TDK Corporation (Tokyo, JAPAN)	Rare earth sintered magnet Abstract The present invention provides a technique to improve an adhesion strength between a magnet main body and a protective film. The rare earth sintered magnet of the present invention comprises a magnet main body of a sintered body containing a rare earth element and a protective film formed on the magnet main body, wherein the ratio of a 10-point average surface roughness Rz of the magnet main body on which the protective film is formed to a mean grain size D50 in the magnet main body (Rz/D50 ratio) is kept in a range from 0.20 to 10.00, inclusive. This gives the rare earth sintered magnet which is coated with the protective film having a high adhesion strength of 100 N/m or more and exhibits high corrosion resistance. The invention claimed is: 1. A rare earth sintered magnet comprising ***[composition of matter]*** a magnet main body of a sintered body containing a rare earth element and a protective film formed on the magnet main body, characterized in that the ratio of a 10-point average surface roughness Rz of the magnet main body on which the protective film is formed to a mean grain size D50 in the magnet main body (Rz/D50 ratio) is in a range from 0.20 to 0.81 inclusive, the D50 is 2.0 to 15.0 .mu.m, and the Rz is 1.5 to 11 .mu.m, the rare earth sintered magnet is an R-T-B system sintered magnet, and the protective film has an adhesion strength of 100 N/m or more.
Filed: September 16, 2009	7,740,715	Assignee: Hitachi Metals, Ltd.	R-T-B based sintered magnet Abstract An R-T-B based sintered magnet according to the present invention has a

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Issued: June 22, 2010 Expires: Sept 2029		(Tokyo, JAPAN)	composition comprising: 12 at % to 15 at % of a rare-earth element R; 5.0 at % to 8.0 at % of boron B; 0.1 at % to at % of Al; 0.02 at % to less than 0.2 at % of Mn; and a transition metal T as the balance. The rare-earth element R is at least one element selected from the rare-earth elements, including Y (yttrium), and includes at least one of Nd and Pr. The transition element T includes Fe as its main element. What is claimed is: 1. An R-T-B based sintered magnet having a composition comprising ***[composition of matter]*** : 12 at % to 15 at % of a rare-earth element R; 5.0 at % to 8.0 at % of B; 0.1 at % to 1.0 at % of Al; 0.02 at % to less than 0.2 at % of Mn; and a transition metal T as the balance; wherein the rare-earth element R is at least one element selected from a group of elements consisting of the rare-earth elements and Y and includes at least one of Nd and Pr; and the transition metal T includes Fe as its main element.
Filed: March 31, 2005 Issued: May 25, 2010 Expires: March 2025	7,722,726	Assignee: Santoku Corporation (Hyogo, JAPAN)	Process for producing alloy slab for rare-earth sintered magnet, alloy slab for rare-earth sintered magnet and rare-earth sintered magnet Abstract The invention provides a method for producing alloy flakes for rare earth sintered magnets, which makes uniform the intervals, size, orientation, and shape of the R-rich region and the dendrites of the 2-14-1 phase, which inhibits formation of chill, and which produces flakes that are pulverized into powder of a uniform particle size in the pulverization step in the production of a rare earth sintered magnet, and that are pulverized into powder compactable into a product with a controlled shrink ratio, and alloy flakes for a rare earth sintered magnet obtained by the method, and a rare earth sintered magnet having excellent magnetic properties. The present method includes preparing an alloy melt of a composition consisting of R of rare earth metal elements and the

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			balance M including B and Fe, and supplying and solidifying the alloy melt on a cooling roll, wherein the roll has on its surface linear nucleation inhibiting portions for inhibiting formation of dendrites or the like, and nucleating portions for formation of the dendrites, and wherein the inhibiting portions have a region with a width of more than 100 .mu.m. What is claimed is: 1. A method for producing alloy flakes ***[process/method]*** for a rare earth sintered magnet, said alloy flakes having a structure containing an R-rich region and dendrites of an R.sub.2Fe.sub.14B phase with a dendrite content of not less than 80 vol %, said method comprising the steps of: (A) preparing an alloy melt of a composition consisting of: at least one element R selected from the group consisting of rare earth metal elements including yttrium, boron, and at least one element M selected from the group consisting of transition metals, silicon, carbon, and mixtures thereof, with iron being essential, (B) supplying and solidifying said alloy melt prepared in step (A) on a cooling roll under such conditions as to generate an alloy structure having an R-rich region and dendrites of an R.sub.2Fe.sub.14B phase with a dendrite content of not less than 80 vol %, and an average size of crystal grains including said R-rich region and said dendrites of the R.sub.2Fe.sub.14B phase of not smaller than 40 .mu.m, wherein said cooling roll has on its roll surface a plurality of linear nucleation inhibiting portions for inhibiting formation of dendrites of a R.sub.2Fe.sub.14B phase and chill crystals, and a plurality of nucleating portions for formation of said dendrites, and wherein said nucleation inhibiting portions have a region with a width of more than 100 .mu.m. 9. Alloy flakes for a rare earth sintered magnet obtained by the method of claim 1, comprising ***[composition of matter]*** at least one element R selected from the group consisting of rare earth metal elements including yttrium, boron, and at least one element M selected from the group consisting of

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			transition metals, silicon, carbon, and mixtures thereof, with iron being essential, and having an alloy structure containing an R-rich region and dendrites of a R.sub.2Fe.sub.14B phase, with a dendrite content of not lower than 80 vol % and a chill crystal content of not higher than 1 vol %, wherein an average size of crystal grains including said R-rich region and said dendrites of the R.sub.2Fe.sub.14B phase in the alloy structure is not smaller than 40 .mu.m.
Filed: Feb 22, 2005 Issued: May 11, 2010 Expires: Feb 2025	7,713,360	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare earth permanent magnet Abstract It is an object of the present invention to provide a permanent magnet which is observed as a uniform structure without microstructures, but shows a pinning type initial magnetization curve. There is provided a rare earth permanent magnet comprising a magnetic intermetallic compound comprising R, T, N and an unavoidable impurity, wherein R is one or more rare earth elements comprising Y, T is two or more transition metal elements and comprises principally Fe and Co; wherein the magnetic intermetallic compound has an T/R atomic ratio of 6 to 14; a magnetocrystalline anisotropy energy of at least 1 MJ/m.sup.3; a Curie point of at least 100.degree. C.; average particle diameter of at least 3 .mu.m; and a substantially uniform structure; wherein the rare earth permanent magnet has a structure that gives a pinning-type initial magnetization curve; and wherein the magnetic intermetallic compound has a Th.sub.2Zn.sub.17-type structure, and the like. The invention claimed is: 1. A rare earth permanent magnet comprising ***[composition of matter]*** a magnetic intermetallic compound comprising R, T and an unavoidable impurity, wherein R is one or more rare earth elements, T is three or more transition metal elements and comprises principally Fe, Cu and Co; wherein the magnetic intermetallic compound has an T/R atomic ratio of 6 to 14; a

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			magnetocrystalline anisotropy energy of at least 1 MJ/m.sup.3; a Curie point of at least 100.degree. C.; average particle diameter of at least 3 .mu.m; wherein the rare earth permanent magnet has a structure that gives a pinning initial magnetization curve and lacks microstructure of 1 nm or above inside the magnetic intermetallic compound; wherein no less than 25 to 35 atomic % of the transition metal T content is replaced by Cu; and wherein the magnetic intermetallic compound has a TbCu.sub.7 structure, and wherein the intermetallic compound has a composition formula: R'(Co.sub.1-x-y-aFe.sub.xCu.sub.yT'.sub.a).sub.z Formula (II) wherein R' is one or more rare earth elements comprising Y and comprises principally Sm or Ce; T' is one or more transition metal elements selected from the group consisting of Zr, Ti, V, Mo, Nb, W, Hf, Mn, Cr, and Ni; and x, y, a and z are numbers that satisfy 0.05.ltoreq.x.ltoreq.0.30, 0.25.ltoreq.y.ltoreq.0.35, 0.001.ltoreq.a.ltoreq.0.05 and 6.ltoreq.z.ltoreq.14.
Filed: October 22, 2003 Issued: April 13, 2010 Expires: Oct 2023	7,695,574	Assignee: Showda Denko K.K. (Tokyo, JAPAN)	Alloy containing rare earth element, production method thereof, magnetostrictive device, and magnetic refrigerant material Abstract A method for producing an RE-containing alloy represented by formula R(T.sub.1-xA.sub.x)13.sub.-y (wherein R represents Ce, etc.; T represents Fe, etc.; and A represents Al, etc; 0.05.ltoreq.x.ltoreq.0.2; and -1.ltoreq.y.ltoreq.1) including a melting step of melting alloy raw materials at 1,200 to 1,800.degree. C.; and a solidification step of rapidly quenching the molten metal produced through the above step, to thereby form the first RE-containing alloy, wherein the solidification step is performed at a cooling rate of 10.sup.2 to 10.sup.4.degree. C./second, as measured at least within a range of the temperature of the molten metal to 900.degree. C.; and an RE-containing alloy, which is represented by a compositional formula of R.sub.rT.sub.tA.sub.a (wherein R and A represent the same meaning as above, T represents Fe, etc.; 5.0 at. %.ltoreq.r.ltoreq.6.8 at. %, 73.8 at. %.ltoreq.t.ltoreq.88.7 at. %, and 4.6 at. %.ltoreq.a.ltoreq.19.4 at. %) and has an alloy microstructure containing an

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			NaZn.sub.13-type crystal structure in an amount of at least 85 mass % and .alpha.-Fe in an amount of 5-15 mass % inclusive. The invention claimed is: 1. A method for producing ***[process/method]*** an RE-containing alloy represented by formula R(T.sub.1-xA.sub.x).sub.13-y (wherein R represents at least one species selected from among La, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Tm, Yb, Gd, and Lu; T represents at least one species selected from among Fe, Co, Ni, Mn, Pt, and Pd; and A represents at least one species selected from among Al, As, Si, Ga, Ge, Mn, Sn, and Sb (0.05.ltoreq.x.ltoreq.0.2; and -1.ltoreq.y.ltoreq.1)) comprising: a melting step of melting alloy raw materials at 1,200 to 1,800.degree. C.; and a solidification step of solidifying the molten metal produced through the above melting step by rapidly quenching the molten metal, to thereby form the RE-containing alloy, wherein the solidifying is performed at a cooling rate of 10.sup.2 to 10.sup.4.degree. C./second, as measured at least within a range of the temperature of the molten metal to 900.degree. C., and wherein in the solidification step, the molten metal is rapid-quenched through any of strip casting, centrifugal casting with a tundish having a rotatable disk, and centrifugal casting. 6. An RE-containing alloy ***[composition of matter]*** , which is represented by the formula R(T.sub.1-xA.sub.x).sub.13-y (wherein R represents at least one species selected from among La, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Tm, Yb, Gd, and Lu; T represents at least one species selected from among Fe, Co, Ni, Mn, Pt, and Pd; and A represents at least one species selected from among Al, As, Si, Ga, Ge, Mn, Sn, and Sb (0.05.ltoreq.x.ltoreq.0.2; and -1.ltoreq.y.ltoreq.1)), and which comprises an R-rich phase, having a relatively high rare earth metal (R) content, and an R-poor phase, having a relatively low rare earth metal (R) content, wherein the R-rich phase and the R-poor phase are dispersed at a phase spacing of 0.01 to 100 .mu.m.

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Filed: March 7, 2008 Issued: April 6, 2010 Expires: March 2028	7,691,323	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare-earth alloy, rare-earth sintered magnet, and methods of manufacturing Abstract A rare-earth alloy ingot is produced by melting an alloy composed of 20-30 wt % of a rare-earth constituent which is Sm alone or at least 50 wt % Sm in combination with at least one other rare-earth element, 10-45 wt % of Fe, 1-10 wt % of Cu and 0.5-5 wt % of Zr, with the balance being Co, and quenching the molten alloy in a strip casting process. The strip-cast alloy ingot has a content of 1-200 .mu.m size equiaxed crystal grains of at least 20 vol % and a thickness of 0.05-3 mm. Rare-earth sintered magnets made from such alloys exhibit excellent magnetic properties and can be manufactured under a broad optimal temperature range during sintering and solution treatment. The invention claimed is: 1. A method of manufacturing ***[process/method]*** an anisotropic rare-earth sintered magnet having a maximum energy product (BH).sub.max of at least 25 MGOe, the method comprising heat-treating a Sm.sub.2Co.sub.17-based permanent magnet alloy consisting essentially of 20 to 30 wt % of a rare-earth constituent R which is samarium alone or is at least 50 wt % samarium in combination with at least one other rare-earth element, 10 to 45 wt % of iron, 1 to 10 wt % of copper, 0.5 to 5 wt % of zirconium and 0.01 to 1.0 wt % of titanium, with the balance being cobalt and inadvertent impurities, at 1100 to 1250.degree. C. for 0.5 to 20 hours to give the alloy a TbCu.sub.7-type crystal structure content of at least 50 vol %; milling the magnet alloy; molding the milled alloy to form a compact; sintering the compact; solution-treating the sintered compact; and carrying out aging treatment on the solution-treated compact.
Filed: June 25, 2008	7,655,325	Assignee: Hitachi Metals, Ltd.	Rare earth magnet and method for producing same Abstract A rare-earth magnet includes a magnet body made of an R--Fe--B based rare-earth magnet material (where R is at least one rare-earth element) and a metal

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Issued: Feb 2, 2010 Expires: June 2028		(Tokyo, JAPAN)	film that has been deposited on the surface of the magnet body. The magnet further includes a plurality of reaction layers between the magnet body and the metal film. The reaction layers include: a first reaction layer, which contacts with at least some of R.sub.2Fe.sub.14B type crystals, included in the magnet body, to have received the rare-earth element that has been included in the R.sub.2Fe.sub.14B type crystals; and a second reaction layer, which is located between the first reaction layer and the metal film and which has a lower rare-earth element concentration than that of the first reaction layer. What is claimed is: 1. A rare-earth sintered magnet comprising ***[composition of matter]*** : a magnet body made of an R--Fe--B based rare-earth sintered magnet material, where R is at least one rare-earth element; a metal film on the surface of the magnet body; a plurality of reaction layers disposed between the magnet body and the metal film and including: a first reaction layer, which contacts with at least some of R.sub.2Fe.sub.14B type crystals included in the magnet body, to have received the rare-earth element that has been included in the R.sub.2Fe.sub.14B type crystals; and a second reaction layer, which is located between the first reaction layer and the metal film and which has a lower rare-earth element concentration than that of the first reaction layer; wherein the second reaction layer has received boron that has been included in the R.sub.2Fe.sub.14B type crystals and has a higher boron concentration than that of the first reaction layer.
Filed: Oct 10, 2006 Issued: Jan 12,	7,645,349	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Sintered R-Fe-B permanent magnet and its production method Abstract A sintered permanent magnet having a composition comprising, by mass, 27-33.5% of R, which is at least one of rare earth elements including Y, 0.5-2% of B, 0.002-0.15% of N, 0.25% or less of O, 0.15% or less of C, and 0.001-0.05%

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2010 Expires: Oct 2026			of P, the balance being Fe, wherein it is in the shape of a ring having an outer diameter of 10-100 mm, an inner diameter of 8-96 mm, and a height of 10-70 mm, with a plurality of magnetic poles axially extending on an outer circumferential surface. The distribution of a surface magnetic flux density B.sub.0 on magnetic poles in an axial direction of the ring magnet is in a range of 92.5% or more of the maximum of B.sub.0. What is claimed is: 1. A method for producing ***[process/method]*** a radially anisotropic sintered R--Fe--B permanent magnet wherein R is at least one of rare earth elements including Y, comprising the steps of (a) pulverizing a rare earth magnet material to fine powder, and recovering said fine powder directly in a mineral oil, a synthetic oil or their mixture to form a slurry, (b) injecting said slurry under pressure into a ring-shaped die cavity between a hollow cylindrical die member and a solid cylindrical core, in which said slurry is wet-molded in a radially oriented magnetic field, (c) heating the resultant ring-shaped green body under reduced pressure to remove said mineral oil, said synthetic oil or their mixture from said green body, and (d) sintering said green body, which has said mineral oil, said synthetic oil, or their mixture removed, in vacuum, wherein said slurry is injected into said ring-shaped die cavity through an aperture open at an inner surface of said hollow cylindrical die member at an angle .theta. of 5.degree. to 90.degree., wherein .theta. is an angle (right or acute angle) between a center axis of said aperture and a line AO, wherein A is a point at which the center axis of said aperture intersects the inner surface of said hollow cylindrical die member, and O is a center point of said solid cylindrical core.
Filed: May 13, 2004	[7,632,360](#)	Assignee: Nissan Motor Co., Ltd.	Abstract A rare earth magnet powder has a chemical composition which includes R: 5 to 20% (wherein, R represents one or two or more rare earth elements being

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Issued: Dec 15, 2009 Expires: May 2024		(Yokohama, JAPAN)	inclusive of Y but exclusive of Dy and Tb), one or two of Dy and Tb: 0.01 to 10%, and B: 3 to 20%, with the balance comprising Fe and inevitable impurities; and an average particle diameter of 10 to 1,000 .mu.m, wherein 70% or more of the entire surface of the rare earth magnet powder is covered with a layer being rich in the content of one or two of Dy and Tb and having a thickness of 0.05 to 50 .mu.m. The invention claimed is: 1. A rare earth magnet powder comprising ***[composition of matter]*** : a chemical composition comprising R: 5 to 20 atom % (wherein R represents one, or two or more rare earth elements being inclusive of Y but exclusive of Dy and Tb), one or both of Dy and Tb: 0.01 to 10 atom %, and B: 3 to 20 atom %, with the balance comprising Fe and inevitable impurities, an average particle diameter being 10 to 1,000 .mu.m, wherein 70% or more of the entire surface of the rare earth magnet powder is covered with a Dy--Tb rich layer being rich in content of the one or both of Dy and Tb and having a thickness of 0.05 to 50 .mu.m, and a concentration of the one or both of Dy and Tb in the Dy--Tb rich layer is such that the maximum detected intensity of the one or both of Dy and Tb, as measured by wavelength dispersive X-ray spectroscopy, is 1.2 to 5 times the average detected intensity in the central portion being present in the range of 1/3 of the particle diameter of a particle of the rare earth magnet powder.
Filed: June 24, 2004 Issued: November 17, 2009	7,618,497	Assignee: TDK Corporation (Tokyo, JAPAN)	R-T-B based rare earth permanent magnet and method for production thereof Abstract An R-T-B system rare earth permanent magnet, which comprises ***[composition of matter]*** main phase grains consisting of R.sub.2T.sub.14B compounds and a grain boundary phase having a higher amount of R than the above described main phase grains, and which satisfies AVE(X)/Y=0.8 to 1.0; and (X/Y)max/(X/Y)min=2.0 to 13.0, wherein X represents (weight ratio of heavy

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Expires: June 2024			rare earth elements)/(the weight ratio of all rare earth elements) for a given number of the above described main phase grains Y represents (weight ratio of heavy rare earth elements)/(weight ratio of all rare earth elements) for the sintered body as a whole; AVE(X) represents the mean value of X obtained for the given number of main phase grains; (X/Y)min represents the minimum value of (X/Y) obtained for the given number of main phase grains; and (X/Y)max represents the maximum value of (X/Y) obtained for the given number of main phase grains.
Filed: Dec 21, 2004 Issued: October 27, 2009 Expires: Dec 2024	7,608,153	Assignee: Nissan Motor Co., Ltd. (Yokohama, JAPAN)	Rare earth magnet and method therefor Abstract A rare earth magnet includes rare earth magnet particles; and amorphous and/or crystalline terbium oxide present at the boundary of the rare earth magnet particles and represented by the formula: TbO.sub.n, wherein 1.5<n.ltoreq.2. The rare earth magnet prevents decrease eddy current effectively. What is claimed is: 1. A rare earth magnet, comprising ***[composition of matter]*** : rare earth magnet particles; and amorphous and/or crystalline terbium oxide present at a boundary of the rare earth magnet particles and represented by the formula: TbO.sub.n, wherein 1.5 <n.ltoreq.2; wherein said rare earth magnet particles are connected by said terbium oxide, and wherein individual rare earth magnet particles comprise a cluster of fine crystal grains; wherein the terbium oxide is contained in an amount of 1 to 10 wt % based on a weight of the rare earth magnet. 7. A method for producing ***[process/method]*** a rare earth magnet, comprising: a coating process of covering whole of or a part of a surface of rare earth magnet powder with terbium alkoxide by applying a liquid including the

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			terbium alkoxide to the surface of the rare earth magnet powder under a dry atmosphere; a hydrolysis process of hydrolyzing the terbium alkoxide at the surface of the rare earth magnet powder to obtain a first intermediate magnetic powder; a heating process of heat-treating the first intermediate magnetic powder under a vacuum atmosphere or an inert gas atmosphere to obtain a second intermediate magnetic powder; a filling process of filling the second intermediate magnetic powder into a mold; and a molding process of molding the second intermediate magnetic powder filled in the mold to produce a rare earth magnet comprising rare earth magnet particles and amorphous and/or crystalline terbium oxide present at a boundary of the rare earth magnet particles represented by the formula: TbO.sub.n, wherein 1.5 <n.ltoreq.2; wherein said rare earth magnet particles are connected by said terbium oxide, and at least one rare earth magnetic particle comprises a cluster of fine crystal grains; wherein the terbium oxide is contained in an amount of 1 to 10 wt % based on a weight of the rare earth magnet.
Filed: April 7, 2005 Issued: September 29, 2009 Expires: April 2025	7,594,972	Assignee: Showda Denko K.K (Tokyo, JAPAN)	Alloy lump for R-T-B type sintered magnet, producing method thereof, and magnet Abstract The present invention is an alloy lump for R-T-B type sintered magnets, including an R.sub.2T.sub.14B columnar crystal and an R-rich phase (in which R is at least one rare earth element including Y, T is Fe or Fe with at least one transition metal element except for Fe, and B is boron or boron with carbon), in which in the as-cast state, R-rich phases nearly in the line-like or rod-like shape (the width direction of the line or rod is a short axis direction) are dispersed in the cross section, and the area percentage of the region where R.sub.2T.sub.14B columnar crystal grains have a length of 500 .mu.m or more in the long axis direction and a length of 50 .mu.m or more in the short axis direction is 10% or more of the entire alloy. The invention claimed is: 1. A cast alloy lump for R-T-B type sintered magnets, comprising

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			[composition of matter] an R.sub.2T.sub.14B columnar crystal and an R-rich phase, wherein R is at least one rare earth element including Y, T is Fe or Fe with at least one transition metal element except for Fe, and B is boron or boron with carbon, wherein in the as-cast state, R-rich phases having a line or rod shape, with the width direction of the line or rod being a short axis direction, are dispersed in a cross section, and an area percentage of the region where R.sub.2T.sub.14B columnar crystal grains have a length of 500 .mu.m or more in a long axis direction and a length of 50 .mu.m or more in the short axis direction is 10% or more of the entire alloy, and wherein the aspect ratio of the R-rich phase is 10 or more. 11. A method for producing ***[process/method]*** the cast alloy lump for R-T-B type sintered magnets set forth in claim 1, comprising: producing the alloy lump for R-T-B type sintered magnets by a centrifugal casting method of pouring a molten alloy on a rotary body, sprinkling the molten alloy by the rotation of the rotary body, and depositing and solidifying the molten alloy sprinkled on the inner surface of a cylindrical mold, and wherein the casting rate is increased at the initiation of casting and thereafter decreased.
Filed: April 27, 2005 Issued: Sept 8, 2009 Expires: Ap 2025	7,585,378	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Methods for producing raw material alloy for rare earth magnet, powder and sintered magnet Abstract A method of making a material alloy for an R-T-Q based rare-earth magnet according to the present invention includes the steps of: preparing a melt of an R-T-Q based rare-earth alloy, where R is rare-earth elements, T is a transition metal element, Q is at least one element selected from the group consisting of B, C, N, Al, Si and P, and the rare-earth elements R include at least one element R.sub.L selected from the group consisting of Nd, Pr, Y, La, Ce, Pr, Sm, Eu, Gd, Er, Tm, Yb and Lu and at least one element R.sub.H selected from the group consisting of Dy, Tb and Ho; cooling the melt of the alloy to a

			temperature of 700.degree. C. to 1,000.degree. C. as first cooling process, thereby making a solidified alloy; maintaining the solidified alloy at a temperature within the range of 700.degree. C. to 900.degree. C. for 15 seconds to 600 seconds; and cooling the solidified alloy to a temperature of 400.degree. C. or less as a second cooling process. The invention claimed is: 1. A method of making a material alloy ***[process/method]*** for an R-T-Q based rare-earth magnet, the method comprising the steps of: (a) preparing a melt of an R-T-Q based rare-earth alloy, where R is rare-earth elements, T is a transition metal element, Q is at least one element selected from the group consisting of B, C, N, Al, Si and P, and the rare-earth elements R include at least one element R.sub.L selected from the group consisting of Nd, Pr, Y, La, Ce, Pr, Sm, Eu, Gd, Er, Tm, Yb and Lu and at least one element R.sub.H selected from the group consisting of Dy, Tb and Ho; (b) cooling the melt of the alloy to a temperature of 700.degree. C. to 1,000.degree. C. as first cooling process, thereby making a solidified alloy; (c) maintaining the solidified alloy at a temperature within the range of 700.degree. C. to 900.degree. C. for 15 seconds to 600 seconds; and (d) cooling the solidified alloy of step (c) to a temperature of 400.degree. C. or less as a second cooling process. …. 12. A method of making a material alloy powder ***[process/method]*** for an R-T-Q based rare-earth magnet, the method comprising the steps of: decrepitating the R-T-Q based rare-earth magnet material alloy, which has been made by the method of claim 1, by a hydrogen decrepitation process; and pulverizing the R-T-Q based rare-earth magnet material alloy that has been decrepitated.
Filed: July 12, 2007	7,571,757	Assignee: Showa Denko K.K.	Alloy flake for rare earth magnet, production method thereof, alloy powder for rare earth sintered magnet, rare earth sintered magnet, alloy powder for bonded magnet and bonded magnet

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Issued: Aug 11, 2009 Expires: July 2027		(Tokyo, JAPAN)	Abstract Disclosed is a rare earth magnet in the R--T--B (rare earth element-transition metal-boron) system that is made from an improved composition and properties of main phase alloy in the R--T--B system containing Pr and a boundary alloy. Disclosed also is a manufacturing method of the rare earth magnet alloy flake by a strip casting method with improved rotating rollers such that the alloy flake has a specified fine surface roughness and has a small and regulated amount of fine R-rich phase regions. Consequently, the alloy flake for the rare earth magnet does not containing .alpha.-Fe and has a homogeneous morphology so that the rare earth magnet formed by sintering or bonding the alloy flakes exhibits excellent magnetic properties. What is claimed is: 1. A method for producing a rare-earth-containing alloy flake ***[process/method]*** including a strip casting method, comprising pouring molten metal onto a rotating roller for casting to solidify the metal, the roller having, on the cast surface, a plurality of elongated raised/dented segments and having a surface roughness provided by a plurality of elongated raised/dented segments, as represented by 10-point average roughness (Rz), falling within a range of 3 .mu.m to 60 .mu.m, wherein 30% or more of raised/dented segments among entire elongated raised/dented segments extend in a direction forming an angle of 45.degree. or more to a roller rotation direction, and removing the metal from the rotating roller to obtain the alloy flake. … 4. A method for producing a rare-earth-containing alloy flake according to claim 1, wherein the rare-earth-containing alloy flake comprises ***[composition of matter]*** an R--T--B alloy (R represents at least one rare earth element including Y; T represents transition metals including Fe as an essential element; and B represents boron) which serves as a raw material for producing a rare earth magnet in the production of the rare-earth-containing alloy flake by

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			the strip casting method.
Filed: Jan 12, 2007 Issued: Aug 4, 2009 Expires: Jan 2027	7,569,114	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rare-earth magnet and manufacturing method thereof and magnet motor Abstract The object of the present invention is to provide a rare earth magnet which enables to achieve a good balance between high coercive force and high residual magnetic flux density, and its manufacturing method. The present invention provides a rare earth magnet in which a layered grain boundary phase is formed on a surface or a portion of a grain boundary of Nd.sub.2Fe.sub.14B which is a main phase of an R--Fe--B (R is a rare-earth element) based magnet, and wherein the grain boundary phase contains a fluoride compound, and wherein a thickness of the fluoride compound is 10 .mu.m or less, or a thickness of the fluoride compound is from 0.1 .mu.m to 10 .mu.m, and wherein the coverage of the fluoride compound over a main phase particle is 50% or more on average. Moreover, after layering fluoride compound powder, which is formed in plate-like shape, in the grain boundary phase, the rare earth magnet is manufactured by quenching the layered compound after melting it at a vacuum atmosphere at a predetermined temperature, or by heating and pressing the main phase and the fluoride compound to make the fluoride compound into a layered fluoride compound along the grain boundary phase. What is claimed is: 1. A magnet comprising ***[composition of matter]*** : NdFeB based magnetic powder; and a fluoride film formed on a portion or whole of a surface of said magnetic powder, wherein said fluoride film is mainly composed of at least one compound selected from the group consisting of TbF.sub.3 and DyF.sub.3, wherein said magnetic powder has an average particle size of 1 to 100 .mu.m, wherein a rare earth rich phase is formed on a surface of the magnetic powder,

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			and said fluoride film is formed on an outer side of said rare earth rich phase, and wherein said fluoride film has a thickness of 1 to 100 nm on average. 9. A magnet motor, including a rotor which has a magnet, wherein the magnet comprises: NdFeB based magnetic powder; and a fluoride film formed on a portion or whole of a surface of said magnetic powder, wherein said fluoride film is mainly composed of at least one compound selected from the group consisting of TbF.sub.3 and DyF.sub.3, wherein said magnetic powder has an average particle size of 1 to 100 .mu.m, and said fluoride film has a thickness of 1 to 100 .mu.m on average.
Filed: July 20, 2006 Issued: July 14, 2009 Expires: July 2026	7,559,996	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare earth permanent magnet, making method, and permanent magnet rotary machine Abstract A rare earth permanent magnet is prepared from a sintered magnet body of a R.sup.1--Fe--B composition wherein R.sup.1 is a rare earth element inclusive of Y and Sc, by forming a plurality of slits in a surface of the magnet body, disposing a powder on the magnet body surface, the powder comprising an oxide of R.sup.2, a fluoride of R.sup.3, or an oxyfluoride of R.sup.4 wherein each of R.sup.2, R.sup.3, and R.sup.4 is a rare earth element, and heat treating the magnet body and the powder below the sintering temperature in vacuum or in an inert gas. The invention claimed is: 1. A method for preparing ***[process/method]*** a rare earth permanent magnet from a sintered magnet body of a R.sup.1--Fe--B composition wherein R.sup.1 is at least one element selected from among rare earth elements inclusive of Y and Sc, the method comprising the steps of: forming a plurality of slits in at least one surface of the magnet body, disposing a powder on the magnet body surface, the powder comprising at least one compound selected from among an oxide of R.sup.2, a fluoride of R.sup.3, and an oxyfluoride of R.sup.4 wherein

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			each of R.sup.2, R.sup.3, and R.sup.4 is at least one element selected from among rare earth elements inclusive of Y and Sc, and heat treating the magnet body and the powder at a temperature equal to or below the sintering temperature of the magnet body in vacuum or in an inert gas, wherein the formation of the slits facilitates absorption of at least one of R.sup.2, R.sup.3 and R.sup.4 in the magnet body from the powder comprising at least one of the oxide of R.sup.2, fluoride of R.sup.3, and oxyfluoride of R.sup.4 present on the magnet surface, thereby increasing a coercive force.
Filed: July 19, 2005 Issued: June 30, 2009 Expires: July 2025	7,553,561	Assignee: TDK Corporation (Tokyo, JAPAN)	Rare earth magnet Abstract A rare earth magnet having excellent corrosion resistance is provided. It has a magnet body (10) containing a rare earth element, and a protective film (20) formed on the magnet body (10). In the protective film (20), a first protective film (21), a second protective film (22) and a third protective film (23) are laminated in this order from the side of the magnet body (10). These are in a polycrystalline state and composed of a metal plated film, for example. The first protective film (21) and the third protective film (23) have a smaller mean crystal grain size than that of the second protective film (22). Microcrystallization of the first protective film (21) can improve the density of the interface between the protective film (20) and the magnet body (10), and decrease the number of pinholes. The invention claimed is: 1. A rare earth magnet that has a magnet body containing ***[composition of matter]*** a rare earth element and a protective film disposed on the magnet body, the protective film consisting of a three-layer structure comprising: a first protective film that is in a microcrystalline state; a second protective film that is in a columnar crystal state and has a larger mean crystal size than that of the first protective film; and a third protective film that is in a microcrystalline

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			state and has a smaller mean crystal grain size than that of the second protective film; wherein: the first protective film, the second protective film and the third protective film are disposed sequentially from the side of the magnet body; the first protective film as an undermost layer covers a surface of the magnet body and is covered by the second protective film; the second protective film as an intermediate layer covers a surface of the first protective film and is covered by the third protective film; the third protective film as an uppermost layer covers a surface of the second protective film and is exposed; the first protective film and the third protective film have a mean crystal grain size of 0.5 .mu.m or less; and the second protective film has a mean crystal grain size of 2 .mu.m or more in the major axis direction and has a mean crystal grain size of 1 .mu.m or less in the minor axis direction.
Filed: December 18, 2002 Issued: June 23, 2009 Expires: Dec 2022	7,550,047	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Rare earth element-iron-boron alloy and magnetically anisotropic permanent magnet powder and method for production thereof Abstract A method of making a magnetically anisotropic magnet powder according to the present invention includes the steps of preparing a master alloy by cooling a rare-earth-iron-boron based molten alloy and subjecting the master alloy to an HDDR process. The step of preparing the master alloy includes the step of forming a solidified alloy layer, including a plurality of R.sub.2Fe.sub.14B-type crystals (where R is at least one element selected from the group consisting of the rare-earth elements and yttrium) in which rare-earth-rich phases are dispersed, by cooling the molten alloy through contact with a cooling member. The invention claimed is: 1. A method of making ***[process/method]*** a magnetically anisotropic magnet powder, the method comprising the steps of: preparing a master alloy by cooling a rare-earth-iron-boron based molten alloy; and subjecting the master

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			alloy to an HDDR process, wherein the step of preparing the master alloy includes the step of forming a solidified alloy layer, including a plurality of R.sub.2Fe.sub.14B-type crystals (where R is at least one element selected from the group consisting of the rare-earth elements and yttrium) in which rare-earth-rich phases are dispersed, by cooling the molten alloy through contact with a cooling member, wherein the step of forming the solidified alloy layer includes forming a first texture layer in contact with the cooling member by feeding the molten alloy onto the cooling member and then feeding the molten alloy onto the first texture layer to grow the R.sub.2Fe.sub.14B-type crystals on the first texture layer, thereby forming a second texture layer thereon, wherein the first texture layer consists essentially of R.sub.2Fe.sub.14B-type crystals with an average minor-axis size of less than 20 .mu.m, and wherein a cooling rate for forming the second texture layer is adjusted to be lower than that for the first texture layer by feeding the molten alloy more slowly when forming the second texture layer than when forming the first texture layer…. 13. A method for producing an anisotropic bonded magnet, the method comprising the steps of: preparing a magnetically anisotropic magnet powder by the method of claim 1, and mixing the magnetically anisotropic magnet powder with a binder and compacting the mixture under an aligning magnetic field.
Filed: Nov 28, 2005 Issued: June 16, 2009 Expires:	7,547,365	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Process for producing, through strip casting, raw alloy for nanocomposite type permanent magnet Abstract To make a raw alloy, consisting mostly of amorphous structure, highly productively and at a reduced cost for a nanocomposite magnet, a molten alloy represented by Fe.sub.100-x-y-zR.sub.xQ.sub.yM.sub.z (where R is at least one element selected from Pr, Nd, Dy and Tb; Q is B and/or C; M is at least one element selected from Co, Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo,

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Nov 2025			Ag, Pt, Au and Pb; and 1 at %.ltoreq.x<6 at %, 15 at %.ltoreq.y.ltoreq.30 at % and 0 at %.ltoreq.z.ltoreq.7 at %) is prepared. This molten alloy is rapidly cooled by a strip casting process in which the alloy is fed onto a chill roller, rotating at a peripheral velocity of 3 m/s to less than 20 m/s, at a feeding rate per unit contact width of 0.2 kg/min/cm to 5.2 kg/min/cm. In this manner, an alloy including at least 60 volume percent of amorphous phase can be obtained. The invention claimed is: 1. A method of making ***[process/method]*** a raw alloy for a magnet, the method comprising the steps of: measuring a coercivity of a solidified alloy prior to annealing the solidified alloy, the solidified alloy being obtained by rapidly cooling a melt of a magnetic alloy; estimating a percentage of an amorphous phase of the solidified alloy based on the coercivity measured; and heating and crystallizing the solidified alloy that has been prepared under such a condition that the estimated percentage of the amorphous phase becomes at least equal to a predetermined percentage.
Filed: Aug 10, 2004 Issued: May 19, 2009 Expires: Aug 2024	7,534,311	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-t-b sintered magnet and rare earth alloy Abstract A rare-earth sintered magnet according to the present invention, of which the main phase is an R.sub.2T.sub.14B type compound phase, includes: 27 mass % through 32 mass % of R, which is at least one rare-earth element that is selected from the group consisting of Nd, Pr, Tb, and Dy and that always includes at least one of Nd and Pr; 60 mass % through 73 mass % of T, which is either Fe alone or a mixture of Fe and Co; 0.85 mass % through 0.98 mass % of Q, which is either B alone or a mixture of B and C and which is converted-into B on a number of atoms basis when its mass percentage is calculated; more than 0 mass % through 0.3 mass % of Zr; at most 2.0 mass % of an

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			additive element M, which is at least one element selected from the group consisting of Al, Cu, Ga, In and Sn; and inevitably contained impurities. The invention claimed is: 1. A rare-earth sintered magnet, a main phase of which includes ***[composition of matter]*** an R.sub.2T.sub.14B type compound phase, the magnet comprising: 27 mass % through 32 mass % of R, which is at least one rare-earth element that is selected from the group consisting of Nd, Pr, Tb, and Dy and that always includes at least one of Nd and Pr; 60 mass % through 73 mass % of T, which is either Fe alone or a mixture of Fe and Co; 0.85 mass % through 0.98 mass % of Q, which is either B alone or a mixture of B and C and which is converted into B on a number of atoms basis when its mass percentage is calculated; more than 0 mass % through 0.3 mass % of Zr; at most 2.0 mass % of an additive element M, which is at least one element selected from the group consisting of Al, Cu, Ga, In and Sn; and inevitably contained impurities; wherein the additive element includes Ga, which accounts for 0.01 mass % through 0.08 mass % of the magnet. 6. A material alloy for a rare-earth sintered magnet, a main phase of which includes ***[composition of matter]*** an R.sub.2T.sub.14B type compound phase, the alloy comprising: 27 mass % through 32 mass % of R, which is at least one rare-earth element that is selected from the group consisting of Nd, Pr, Tb, and Dy and that always includes at least one of Nd and Pr; 60 mass % through 73 mass % of T, which is either Fe alone or a mixture of Fe and Co; 0.85 mass % through 0.98 mass % of Q, which is either B alone or a mixture of B and C; more than 0 mass % through 0.3 mass % of Zr; at most 2.0 mass % of an additive element M, which is at least one element selected from the group consisting of Al, Cu, Ga, In and Sn; and inevitably contained impureties; wherein the additive element includes Ga, which accounts for 0.01 mass % through 0.08 mass % of the magnet.
Filed:	7,531,050	Assignee:	Method for manufacturing bonded magnet and method for manufacturing

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September 19, 2003 Issued: May 12, 2009 Expires: Sept 2023		Nec Tokin Corporation (Sendai-Shi, JAPAN)	magnetic device having bonded magnet Abstract A viscous material (4) is obtained by mixing an alloy magnetic powder, magnetized in advance, with a resin. The viscous material (4) thus obtained is applied to an upper surface of a center magnetic leg of an E-shaped core (2). A coil (3) and an I-shaped core are coupled to the E-shaped core (2). An orientation magnetic field is applied by a permanent magnet (5) while the resin is hardened. As a consequence, a bond magnet is obtained which is formed in tight contact with both of a pair of surfaces defining a magnetic gap between the E-shaped core (2) and the I-shaped core. The invention claimed is: 1. A method of manufacturing a bond magnet ***[process/method]*** , wherein: an alloy magnetic powder magnetized in advance by applying a magnetic field ranging from 5 T to 10 T is mixed with a resin at a weight ratio within a range from 70:30 to 97:3 to obtain a viscous material with 10 poises or more, the viscous material is located at a predetermined position of a magnetic device in contact therewith, and a magnetic field ranging from 30 mT to 500 mT is applied to the viscous material to magnetically orient the alloy magnetic powder included in the viscous material while the resin is hardened. 4. The method of manufacturing a bond magnet according to claim 1, wherein as the alloy magnetic powder, a rare earth magnetic powder having a coercive force not smaller than 5 kOe, a Curie temperature not lower than 300.degree. C., and an average particle size of 2.0 to 50 .mu.m is used.
Filed: Jan 27, 2006	7,520,941	Assignee: Shin-Etsu Chemical Co., Ltd.	Functionally graded rare earth permanent magnet Abstract A functionally graded rare earth permanent magnet is in the form of a sintered

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Issued: April 21, 2009 Expires: Jan 2025		(Tokyo, JAPAN)	magnet body having a composition R.sup.1.sub.aR.sup.2.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g wherein the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in grain boundaries surrounding primary phase grains of (R.sup.1,R.sup.2).sub.2T.sub.14A tetragonal system within the sintered magnet body is on the average higher than the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in the primary phase grains, R.sup.2 is distributed such that its concentration increases on the average from the center toward the surface of the magnet body, the oxyfluoride of (R.sup.1,R.sup.2) is present at grain boundaries in a grain boundary region that extends from the magnet body surface to a depth of at least 20 .mu.m, and the magnet body includes a surface layer having a higher coercive force than in the interior. The invention provides permanent magnets having improved heat resistance. The invention claimed is: 1. A functionally graded rare earth permanent magnet in the form of a sintered magnet body having an alloy composition R.sup.1.sub.aR.sup.2.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g ***[composition of matter]*** wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y and exclusive of Tb and Dy, R.sup.2 is one or both of Tb and Dy, T is one or both of iron and cobalt, A is one or both of boron and carbon, F is fluorine, O is oxygen, and M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, a through g indicative of atom percents of the corresponding elements in the alloy have values in the range: 10.ltoreq.a+b.ltoreq.15, 3.ltoreq.d.ltoreq.15, 0.01.ltoreq.e.ltoreq.4, 0.04.ltoreq.f.ltoreq.4, 0.01.ltoreq.g.ltoreq.11, the balance being c, said magnet body having a center and a surface, wherein grain boundaries surround primary phase grains of (R.sup.1,R.sup.2).sub.2T.sub.14A tetragonal system within the sintered magnet body, the concentration of

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			R.sup.2/(R.sup.1+R.sup.2) contained in the grain boundaries is on the average higher than the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in the primary phase grains, R.sup.2 is distributed such that its concentration increases on the average from the center toward the surface of the magnet body, an oxyfluoride of (R.sup.1,R.sup.2) is present at grain boundaries in a grain boundary region that extends from the magnet body surface to a depth of at least 20 .mu.m, and the magnet body includes a surface layer having a higher coercive force than in the magnet body interior.
Filed: July 19, 2002 Issued: March 24, 2009 Expires: July 2022	7,507,302	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Method for producing nanocomposite magnet using atomizing method Abstract A rare-earth alloy powder is obtained by rapidly cooling a melt of an alloy by an atomization process. The alloy has a composition represented by (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yTi.sub.zM.sub.n, where T is at least one of Co and Ni, Q is at least one of B and C, R is at least one of the rare-earth metal elements and yttrium, and M is at least one of Nb, Zr, Mo, Ta and Hf. The mole fractions x, y, z, m and n satisfy 10 at %<x.ltoreq.25 at %, 6 at %.ltoreq.y<10 at %, 0.1 at %.ltoreq.z.ltoreq.12 at %, 0.ltoreq.m.ltoreq.0.5, and 0 at %.ltoreq.n.ltoreq.10 at %, respectively. By adding Ti to the alloy, the nucleation and growth of .alpha.-Fe during the rapid quenching process can be minimized. The invention claimed is: 1. A nanocomposite magnet powder of an iron-based rare-earth alloy having a composition ***[composition of matter],*** represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n (where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one element selected from the group consisting of the rare-earth metal elements and yttrium; and M is at least one element selected from the group

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			consisting of Nb, Zr, Mo, Ta and Hf), the mole fractions x, y, z, m and n satisfying the inequalities of: 10 at %<x.ltoreq.25 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; 0.ltoreq.m.ltoreq.0.5; and 0 at %.ltoreq.n.ltoreq.10 at %, respectively, wherein the nanocomposite magnet powder is obtained by an atomization process and includes at least two types of ferromagnetic crystalline phases, in which an R.sub.2Fe.sub.14B type compound phase serving as a hard magnetic phase has an average grain size of 10 nm to 200 nm and a soft magnetic phase has an average grain size of 1 nm to 50 nm; a ferromagnetic iron-based boride phase and an .alpha.-Fe phase serving as the soft magnetic phase are present on a grain boundary or sub-boundary of the R.sub.2Fe.sub.14B type compound phase; and the average crystal grain size of the ferromagnetic iron-based boride phase and .alpha.-Fe is smaller than that of the R.sub.2Fe.sub.14B type compound phase. 7. A method of making ***[process/method]*** an iron-based rare-earth alloy nanocomposite magnet powder, the method comprising the steps of: obtaining a rare-earth alloy magnet powder by rapidly cooling a melt of an alloy by an atomization process, the alloy having a composition represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n (where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one element selected from the group consisting of the rare-earth metal elements and yttrium; and M is at least one element selected from the group consisting of Nb, Zr, Mo, Ta and Hf), the mole fractions x, y, z, m and n satisfying the inequalities of: 10 at %<x.ltoreq.25 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; 0.ltoreq.m.ltoreq.0.5, and 0 at %.ltoreq.n.ltoreq.10 at %, respectively; and thermally treating the magnet powder, thereby forming a structure that includes at least two types of ferromagnetic crystalline phases, in which an R.sub.2Fe.sub.14B type compound phase serving as a hard magnetic phase has an average grain size of 10 nm to 200 nm and a soft magnetic phase has an average grain size of 1 nm

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			to 50 nm; wherein a ferromagnetic iron-based boride phase and an .alpha.-Fe phase serving as the soft magnetic phase are present on a grain boundary or sub-boundary of the R.sub.2Fe.sub.14B type compound phase; and the average crystal grain size of the ferromagnetic iron-based boride phase and .alpha.-Fe is smaller than that of the R.sub.2Fe.sub.14B type compound phase.
Filed: December 20, 2004 Issued: February 24, 2009 Expires: Dec 2024	7,494,600	Assignee: Hoganas AB (Hoganas, Sweden)	Composition for producing soft magnetic composites by powder metallurgy Abstract The invention concerns powder compositions consisting of electrically insulated particles of a soft magnetic material of an iron or iron-based powder and 0.1-2% by weight of a lubricant selected from the group consisting of fatty acid amides having 14-22 C atoms. Optionally a thermoplastic binder such as polyphenylene sulphide may be included in the composition. The invention also concerns a method for the preparation of soft magnetic composite components. The invention claimed is: 1. Powder composition ***[composition of matter]*** consisting of irregularly shaped particles of a soft magnetic material of substantially pure water-atomized iron or sponge iron, said particles being provided with an electrically insulating layer, 0.05-2% by weight of a lubricant selected from the group consisting of primary amides of saturated or unsaturated straight fatty acids having 12-24 C atoms, and optionally polyphenylene sulfide in a concentration less than 2% by weight, wherein said powder composition is capable of producing by uniaxial compaction a soft magnetic component.
Filed: Jan 27, 2006	7,488,395	Assignee: Shin-Etsu Chemical Co., Ltd.	Functionally graded rare earth permanent magnet Abstract A functionally graded rare earth permanent magnet having a reduced eddy

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Issued: February 10, 2009 Expires: Jan 2026		(Tokyo, JAPAN)	current loss in the form of a sintered magnet body having a composition R.sub.aE.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g is obtained by causing E and fluorine atoms to be absorbed in a R--Fe--B sintered magnet body from its surface. F is distributed such that its concentration increases on the average from the center toward the surface of the magnet body, the concentration of E/(R+E) contained in grain boundaries surrounding primary phase grains of (R,E).sub.2T.sub.14A tetragonal system is on the average higher than the concentration of E/(R+E) contained in the primary phase grains, the oxyfluoride of (R,E) is present at grain boundaries in a grain boundary region that extends from the magnet body surface to a depth of at least 20 .mu.m, particles of the oxyfluoride having an equivalent circle diameter of at least 1 .mu.m are distributed in the grain boundary region at a population of at least 2,000 particles/mm.sup.2, the oxyfluoride is present in an area fraction of at least 1%. The magnet body includes a surface layer having a higher electric resistance than in the interior. In the permanent magnet, the generation of eddy current within a magnetic circuit is restrained. The invention claimed is: 1. A functionally graded rare earth permanent magnet having a reduced eddy current loss in the form of a sintered magnet body having an alloy composition ***[composition of matter]*** of formula (1): R.sub.aE.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g (1) wherein R is at least one element selected from rare earth elements inclusive of Sc and Y, and E is at least one element selected from alkaline earth metal elements and rare earth elements, R and E do not contain the same element(s), T is one or both of iron and cobalt, A is one or both of boron and carbon, F is fluorine, O is oxygen, and M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, a through g indicative of atom percents of the corresponding elements in the alloy have values in the range: 10.ltoreq.a.ltoreq.15 and

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			0.005.ltoreq.b.ltoreq.2, 3.ltoreq.d.ltoreq.15, 0.01.ltoreq.e.ltoreq.4, 0.04.ltoreq.f.ltoreq.4, 0.01 .ltoreq.g.ltoreq.11, the balance being c, said magnet body having a center and a surface and being obtained by causing E and fluorine atoms to be absorbed in a R--Fe--B sintered magnet body from its surface, wherein said sintered magnet body is obtained by heat treating the magnet body packed with a powder containing E and fluorine atoms to absorb and infiltrate E and fluorine atoms into the magnet body, and wherein constituent element F is distributed such that its concentration increases on the average from the center toward the surface of the magnet body, grain boundaries surround primary phase grains of (R,E).sub.2T.sub.14A tetragonal system within the sintered magnet body, the concentration of E/(R+E) contained in the grain boundaries is on the average higher than the concentration of E/(R+E) contained in the primary phase grains, an oxyfluoride of (R,E) is present at grain boundaries in a grain boundary region that extends from the magnet body surface to a depth of at least 20 .mu.m, particles of said oxyfluoride having an equivalent circle diameter of at least 1 .mu.m are distributed in said grain boundary region at a population of at least 2,000 particles/mm.sup.2, said oxyfluoride is present in an area fraction of at least 1%, and said magnet body includes a surface layer having a higher electric resistance than in the magnet body interior.
Filed: Jan 7, 2006 Issued: February 10, 2009 Expires: Jan 2026	[7,488,394](https://cmi.ameslab.gov/resources/magnet-table)	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare earth permanent magnet Abstract A rare earth permanent magnet is in the form of a sintered magnet body having a composition R.sup.1.sub.aR.sup.2.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g wherein F and R.sup.2 are distributed such that their concentration increases on the average from the center toward the surface of the magnet body, and grain boundaries having a concentration of R.sup.2/(R.sup.1+R.sup.2) which is on the average higher than the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in primary phase grains of (R.sup.1,R.sup.2).sub.2T.sub.14A

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			tetragonal system form a three-dimensional network structure which is continuous from the magnet body surface to a depth of at least 10 .mu.m. The invention provides R--Fe--B sintered magnets which exhibit a high coercive force. The invention claimed is: 1. A rare earth permanent magnet in the form of a sintered magnet body having an alloy composition R.sup.1.sub.aR.sup.2.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g ***[composition of matter]*** wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y and exclusive of Tb and Dy, R.sup.2 is one or both of Tb and Dy, T is one or both of iron and cobalt, A is one or both of boron and carbon, F is fluorine, O is oxygen, and M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, a through g indicative of atom percents of the corresponding elements in the alloy have values in the range: 10.ltoreq.a+b.ltoreq.15, 3.ltoreq.d.ltoreq.15, 0.01.ltoreq.e.ltoreq.4, 0.04.ltoreq.f.ltoreq.4, 0.01.ltoreq.g.ltoreq.11, the balance being c, said magnet body having a center and a surface, wherein constituent elements F and R.sup.2 are distributed such that their concentration increases on the average from the center toward the surface of the magnet body, and grain boundaries having a concentration of R.sup.2/(R.sup.1+R.sup.2) which is on the average higher than the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in primary phase grains of (R.sup.1,R.sup.2).sub.2T.sub.14A tetragonal system form a three-dimensional network structure which is continuous from the magnet body surface to a depth of at least 10 .mu.m.
Filed: Jan 27, 2006	7,488,393	Assignee: Shin-Etsu Chemical Co., Ltd.	Rare earth permanent magnet Abstract A rare earth permanent magnet is in the form of a sintered magnet body having

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Issued: February 10, 2009 Expires: Jan 2026		(Tokyo, JAPAN)	a composition R.sup.1.sub.aR.sup.2.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g wherein F and R.sup.2 are distributed such that their concentration increases on the average from the center toward the surface of the magnet body, the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in grain boundaries surrounding primary phase grains of (R.sup.1,R.sup.2).sub.2T.sub.14A tetragonal system within the sintered magnet body is on the average higher than the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in the primary phase grains, and the oxyfluoride of (R.sup.1,R.sup.2) is present at grain boundaries in a grain boundary region that extends from the magnet body surface to a depth of at least 20 .mu.m. The invention provides R--Fe--B sintered magnets which exhibit high magnet performance despite minimal amounts of Tb and Dy used. The invention claimed is: 1. A rare earth permanent magnet in the form of a sintered magnet body having an alloy composition R.sup.1.sub.aR.sup.2.sub.bT.sub.cA.sub.dF.sub.eO.sub.fM.sub.g ***[composition of matter]*** wherein R.sup.1 is at least one element selected from rare earth elements inclusive of Sc and Y and exclusive of Tb and Dy, R.sup.2 one or both of Tb and Dy, T is one or both of iron and cobalt, A is one or both of boron and carbon, F is fluorine, O is oxygen, and M is at least one element selected from the group consisting of Al, Cu, Zn, In, Si, P, S, Ti, V, Cr, Mn, Ni, Ga, Ge, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Hf, Ta, and W, a through g indicative of atom percents of the corresponding elements in the alloy have values in the range: 10.ltoreq.a+b.ltoreq.15, 3.ltoreq.d.ltoreq.15, 0.01.ltoreq.e.ltoreq.4,0.04.ltoreq.f.ltoreq.4, 0.01 .ltoreq.g.ltoreq.11, the balance being c, said magnet body having a center and a surface, wherein constituent elements F and R.sup.2 are distributed such that their concentration increases on the average from the center toward the surface of the magnet body, grain

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			boundaries surround primary phase grains of (R.sup.1,R.sup.2).sub.2T.sub.14A tetragonal system within the sintered magnet body, the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in the grain boundaries is on the average higher than the concentration of R.sup.2/(R.sup.1+R.sup.2) contained in the primary phase grains, and an oxyfluoride of (R.sup.1,R.sup.2) is present at grain boundaries in a grain boundary region that extends from the magnet body surface to a depth of at least 20 .mu.m.
Filed: June 20, 2005 Issued: February 3, 2009 Expires: June 2025	7,485,193	Assignee: Shin-Etsu Chemical Co., Ltd (Tokyo, JAPAN)	R-FE-B based rare earth permanent magnet material Abstract A R--Fe--B base rare earth permanent magnet material consists of, in percents by weight, 25 to 45 wt % of R, 0.1 to 4.5 wt % of Co, 0.8 to 1.4 wt % of B, 0.05 to 3.0 wt % of Al, 0.02 to 0.5 wt % of Cu, 0.03 to 0.5 wt % of M, 0.01 to 0.5 wt % of C, 0.05 to 3.0 wt % of O, 0.002 to 0.1 wt % of N, 0.001 to 2.0 wt % of F, with the balance of Fe and incidental impurities, wherein R is at least one element selected from among Nd, Pr, Dy, Tb and Ho, and M is at least one element selected from among Zr, Hf, Ti, Cr, Nb, Mo, Si, Sn, Zn, V, W and Cr. The invention claimed is: 1. A R--Fe--B base rare earth permanent magnet material consisting of, in percents by weight, R 25 to 45 wt %, Co 0.1 to 4.5 wt %, B 0.8 to 1.4 wt %, Al 0.05 to 3.0 wt %, Cu 0.02 to 0.5 wt %, M 0.03 to 0.5 wt %, C 0.01 to 0.5 wt %, O 0.05 to 3.0 wt %, N 0.002 to 0.1 wt %, F 0.001 to 2.0 wt %, with the balance of Fe and incidental impurities ***[composition of matter]*** , wherein R is at least one element selected from the group consisting of Nd, Pr, Dy, Tb and Ho, and M is at least one element selected from the group consisting of Zr, Hf, Ti, Nb, Mo, Si, Sn, Zn, V, W and Cr, said magnet material comprising a R--O--F compound which is localized at triple points in the magnet.

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Filed: January 20, 2004 Issued: January 27, 2009 Expires: Jan 2024	7,481,895	Assignee: Daido Steel Co., Ltd. (Nagoya, JAPAN)	Isotropic powdery magnet material, process for preparing and resin-bonded magnet Abstract Disclosed is an isotropic SmFeN powdery magnet material for producing resin-bonded magnets. The magnet powder is prepared by melt-spinning of a molten alloy and nitriding the alloy powder thus obtained to form a magnet alloy having an alloy composition of one of the formulae, by atomic %: Sm.sub.xFe.sub.100-x-vN.sub.v, Sm.sub.xFe.sub.100-x-y-vM.sup.1.sub.yN.sub.v and Sm.sub.xFe.sub.100-x-z-vM.sup.2.sub.zN.sub.v wherein M.sup.1 is at least one member selected from the group consisting of Hf and Zr; and M.sup.2 is at least one member selected from the group consisting of Si, Nb, Ti, Ga, Al, Ta and C; 7.ltoreq.x.ltoreq.12, 0.1.ltoreq.y.ltoreq.1.5, 0.1.ltoreq.z.ltoreq.1.0 and 0.5.ltoreq.v.ltoreq.20; the crystal structure is TbCu.sub.7 type; and the thickness of the flakes is 10-40 .mu.m. The invention claimed is: 1. A flaky, isotropic SmFeN powdery magnet material ***[composition of matter]*** prepared by roll-quenching a molten alloy and nitriding the alloy powder thus obtained to form a magnet alloy; the magnet alloy consisting of an alloy composition of the formula, by atomic %: Sm.sub.xCe.sub.aFe.sub.100-x-vCo.sub.bN.sub.v wherein 7.1.ltoreq.x.ltoreq.12 and 0.5.ltoreq.v.ltoreq.20, a TbCu.sub.7 crystal structure, and flakes with a thickness is 10-40 .mu.m. wherein a=0.3 at. % of the alloy composition up to 30 at. % of Sm, and b=2.0 at. % of the alloy composition up to 35 at. % of Fe, and wherein the magnet alloy has an intrinsic coercive force (iHc) of 7 kOe higher.
Filed: Ma	7,479,252	Assignee:	Method for manufacturing throwaway tip and apparatus for aligning green compact

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rch 26, 2004 Issued: January 20, 2009 Expires; March 2024		Mitsubishi Materials Corp (Tokyo, JAPAN)	Abstract A method for manufacturing a throwaway tip is presented in which a green compact Q obtained by press-forming raw material powder for the throwaway tip is placed and sintered on a sintering plate. The green compact Q is press-formed so that the density of the raw material powder is gradually decreased toward a predetermined direction R, and the direction R is oriented substantially toward the outer circumference of the sintering plate 8 in plan view. Thus, it is possible to obtain a throwaway tip having sintering accuracy. What is claimed is: 1. A method of simultaneously making a plurality of sintered articles f***[process/method]*** or throwaway tips of an accuracy of at least M-grade accuracy from green compacts, said method comprising the steps of: filling raw material powder into a cavity formed in a die; press forming said raw material powder to form a plurality of green compacts, placing said green compacts on a sintering plate having a center; and sintering said green compacts simultaneously to form said sintered articles, wherein each of said green compacts is formed having at least one of a density gradient or a dimensional gradient, said at least one gradient decreasing in a predetermined direction across said green compact, and wherein each of said green compacts is substantially oriented on said sintering plate in plan view with said gradient decreasing outwardly from the center of said sintering plate.
Filed: Ma rch 1, 2004 Issued: January 6,	[7,473,343](https://cmi.ameslab.gov/resources/magnet-table)	Assignee: TDK Corporation (Tokyo, JAPAN)	Method of manufacturing rare-earth magnet, and plating bath Abstract Provided are a method of manufacturing a rare-earth magnet with superior corrosion resistance, and a plating bath used for the method. A first protective film including nickel and a second protective film including nickel and sulfur

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2009 Expires: March 2024			are laminated in order on a magnet body including a rare-earth element. The first protective film is formed through electroplating with a first plating bath including a nickel source, a conductive salt and a pH stabilizer, and having a concentration of the nickel source of 0.3 mol/l to 0.7 mol/l on a nickel atom basis and a conductivity of 80 mS/cm or over. Thereby, a rare-earth-rich phase can be prevented from being leached out, and the production of pinholes can be reduced. Therefore, the corrosion resistance of the rare-earth magnet can be improved. What is claimed is: 1. A method of manufacturing ***[process/method]*** a rare-earth magnet, comprising the steps of: electroplating a first protective film including nickel on a magnet body including a rare-earth element with a first plating bath of a water solution, the first plating bath consisting of a nickel source, a conductive salt, a pH stabilizer, and a semi-brightener and having a concentration of the nickel source of 0.3 mol/l to 0.7 mol/l on a nickel atom basis and a conductivity of 80 mS/cm or over, the nickel source is selected from the group consisting of nickel sulfate, nickel chlorides and nickel bromides and the pH stabilizer is selected from the group consisting of boric acid, sodium borate, potassium borate, lithium borate and magnesium borate; and forming a second protective film including nickel and sulfur on the first protective film.
Filed: January 28, 2004 Issued: December 16, 2008	7,465,363	Assignee: TDK Corporation (Tokyo, JAPAN)	Hard magnetic composition, permanent magnet powder, method for permanent magnet powder, and bonded magnet Abstract A single phase consisting of a ThMn.sub.12 phase can be obtained by having the composition thereof represented by a general formula R(Fe.sub.100-y-wCo.sub.wTi.sub.y).sub.xSi.sub.zA.sub.v (in the general formula, R is at least one element selected from rare earth elements (here the rare earth elements

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Expires: Jan 2024			signify a concept inclusive of Y), Nd accounts for 50 mol % or more of R, and A is N and/or C) in which the molar ratios in the general formula are such that x=10 to 12.5, y=(8.3-1.7.times.z) to 12.3, z=0.1 to 2.3, v=0.1 to 3 and w=0 to 30, and the relation (Fe+Co+Ti+Si)/R>12 is satisfied The invention claimed is: 1. A hard magnetic compound, characterized in that: the hard magnetic compound ***[composition of matter]*** is represented by a general formula R(Fe.sub.100-y-wCo.sub.wTi.sub.y).sub.xSi.sub.zA.sub.v (in the general formula, R is at least one element selected from rare earth elements (here the rare earth elements signify a concept inclusive of Y), Nd accounts for 50 mol % or more of R, and A is N and/or C); and the molar ratios in said general formula are such that x=10 to 12.5, y=(8.3-1.7.times.z) to 12.3, z=0.1 to 2.3, v=0.1 to 3 and w=0 to 30, and the relation (Fe+Co+Ti+Si)/R>12 is satisfied; wherein said hard magnetic compound shows a single phase consisting of a phase having a ThMn.sub.12-type structure.
Filed: June 24, 2004 Issued: December 9, 2008 Expires: Filed: June 2024	7,462,403	Assignee: TDK Corporation (Tokyo, JAPAN)	R-T-B system permanent magnet Abstract An R-T-B system permanent magnet 1 comprises a magnet body 2 comprising a sintered body comprising at least a main phase comprising R.sub.2T.sub.14B grains (wherein R represents one or more rare earth elements, and T represents one or more transition metal elements including Fe or Fe and Co essentially) and a grain boundary phase containing R in a larger amount than the main phase, the magnet body 2 having a 300 .mu.m or less thick (not inclusive of zero thick) hydrogen-rich layer 21 having a hydrogen concentration of 300 ppm or more formed in the surface layer portion, and an overcoat 3 covering the surface of the magnet body 2 can improve the corrosion resistance of the R-T-B system permanent magnet 1 with an overcoat 3 formed thereon without

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			degrading the magnetic properties thereof. The present invention can be applied to formation of the overcoat 3 by electrolytic plating, can fully ensure the corrosion resistance as a primary target of the overcoat 3 formation without substantially degrading the production efficiency, and can provide the R-T-B system permanent magnet 1 with a high dimensional precision by suppressing the partial collapse (detachment of grains) of the surface thereof. The invention claimed is: 1. An R-T-B system permanent magnet characterized by comprising ***[composition of matter]*** : a magnet body comprising a sintered body comprising at least a main phase comprising R.sub.2T.sub.14B grains (wherein R represents one or more rare earth elements, and T represents one or more transition metal elements including Fe or Fe and Co essentially) and a grain boundary phase containing R in a larger amount than the main phase, the magnet body having a 10-200 .mu.m thick hydrogen-rich layer having a hydrogen concentration of 300 ppm or more formed in the surface layer portion; and an overcoat covering the surface of the magnet body. 8. The R-T-B system permanent magnet according to claim 2, characterized in that the hydrogen-rich layer has a hydrogen concentration ***[composition of matter]*** decreased from the surface of the magnet body toward the inside of the magnet body.
Filed: Dec 18, 2002 Issued: Oct 28, 2008 Expires:	7,442,262	Assignee: Showa Denko K.K. (Tokyo, JAPAN)	Alloy flake for rare earth magnet, production method thereof, alloy powder for rare earth sintered magnet, rare earth Abstract Disclosed is a rare earth magnet in the R-T-B (rare earth element-transition metal-boron) system that is made from an improved composition and properties of main phase alloy in the R-T-B system containing Pr and a boundary alloy. Disclosed also is a manufacturing method of the rare earth

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Dec 2022			magnet alloy flake by a strip casting method with improved rotating rollers such that the alloy flake has a specified fine surface roughness and has a small and regulated amount of fine R-rich phase regions. Consequently, the alloy flake for the rare earth magnet does not containing .alpha.-Fe and has a homogeneous morphology so that the rare earth magnet formed by sintering or bonding the alloy flakes exhibits excellent magnetic properties. The invention claimed is: 1. A main phase alloy for a rare earth magnet to be processed through a two-alloy-blending method, the main phase alloy containing ***[composition of matter]*** R (R represents at least one rare earth element including Y) in an amount of 26 to 30% by mass and B in an amount of 0.9 to 1.1% by mass, with the balance being T (T represents transition metals including Fe as an essential element), characterized in that R has a Pr content of at least 5% by mass and the main phase alloy has a percent volume of region containing .alpha.-Fe on the basis of the entire microstructure of 5% or less, and wherein at least one surface thereof has a surface roughness, as represented by 10-point average roughness (Rz), falling within a range of 5 .mu.m to 50 .mu.m. 5. A method for producing ***[process/method]*** a main phase alloy for a rare earth magnet according to claim 1, wherein the method comprises strip casting.
Filed: December 24, 2002 Issued: October 21, 2008	7,438,768	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare earth element sintered magnet and method for producing rare earth element sintered magnet Abstract Hydrogen embrittlement is prevented in Sm.sub.2Co.sub.17-based magnets and R.sub.2Fe.sub.14B-based magnets by metal plating the magnet, then carrying out heat treatment, or by forming a metal oxide or metal nitride layer

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Disclaimer: This U.S. Rare Earth Magnet Patents Table contains a sample of the rare earth-magnet patents issued by the U.S. Patent and Trademark Office. It was created with key word searching. The Table is not all inclusive of U.S. magnet patents and does not include foreign patents. Some cells in the Table contain estimates, approximations or assessments. Please consult with a professional patent attorney or patent agent, possessing license to represent clients before the United States Patent and Trademark Office, before proceeding from informal patent database searches to formal patent actions.

Expires; Dec 2022			on the metal plating layer or directly on the magnet itself. The invention claimed is: 1. A method of manufacturing ***[process/method]*** rare-earth sintered magnets, characterized by subjecting an alloy composed of 20 to 30 wt % of a constituent R (R being samarium alone or at least 50 wt % samarium in combination with one or more other rare-earth element), 10 to 45 wt % iron, 1 to 10 wt % copper and 0.5 to 5 wt % zirconium, with the balance being cobalt and inadvertent impurities, to the steps of, in order, melting, casting, coarse size reduction, milling, molding in a magnetic field, sintering and aging so as to form a sintered magnet, surface machining the sintered magnet by cutting and/or grinding, metal plating the surface-machined magnet with a metal-plating metal, then heat treating the metal-plated magnet at 80 to 850.degree. C. for a period of from 10 minutes to 50 hours in an argon, nitrogen, air or low-pressure vacuum atmosphere having an oxygen partial pressure of 10.sup.-4Pa to 50 kPa to form an oxide layer of the metal-plating metal as a hydrogen resistance layer, the metal-plating metal being one or more selected from among copper, nickel, cobalt, tin, and alloys thereof. 2. A rare-earth sintered magnet comprising ***[composition of matter]*** : 20 to 30 wt % of a constituent R (R being samarium alone or at least 50 wt % samarium in combination with one or more other rare-earth element); 10 to 45 wt % iron; 1 to 10 wt % copper; and 0.5 to 5 wt % zirconium, with the balance being cobalt and inadvertent impurities, wherein said rare-earth sintered magnet has a metal oxide layer and/or a metal nitride layer on a surface thereof, over an intervening metal-plating layer, the intervening metal-plating layer comprising one or more selected from among copper, nickel, cobalt, tin, and alloys thereof.
Filed: Jan 12, 2006	7,431,070	Assignee: Showa Denko K.K.	Rare earth magnet alloy ingot, manufacturing method for the same, R-T-B type magnet alloy ingot, R-T-B type magnet, R-T-B type bonded magnet, R-T-B type exchange spring magnet alloy ingot, R-T-B type exchange spring magnet,

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Issued: Oct 7, 2008 Expires: Jan 2026		(Tokyo, JAPAN)	and R-T-B type exchange spring bonded magnet Abstract One object of the present invention is to provide a rare earth magnet alloy ingot, which has improved magnetic properties. In order to achieve the object, the present invention provides a rare earth magnet alloy ingot, wherein the rare earth magnet alloy ingot comprises an R-T-B type magnet alloy (R represents at least one element selected from among rare earth elements, including Y; and T represents a substance predominantly comprising Fe, with a portion of Fe atoms being optionally substituted by Co, Ni, Cu, Al, Ga, Cr, and Mn) containing at least one element selected from among Nd, Pr, and Dy in a total amount of 11.8 to 16.5% by atom and B in an amount of 5.6 to 9.1% by atom; and wherein as determined in an as-cast state of the alloy ingot, R-rich phase that measures 100 .mu.m or more is substantially absent on a cross section. What is claimed is: 1. A production method ***[process/method]*** for a rare earth magnet alloy ingot, wherein the production method comprising receiving molten metal by means of a rotary body; sprinkling the molten metal by the effect of rotation of the rotary body; and causing the sprinkled molten metal to be deposited and solidify on an inner surface of a rotating cylindrical mold; and wherein the inner surface includes a non smooth surface is comprised of grooves having a depth of 0.5 to 1 mm. 4. A production method for a rare earth magnet alloy ingot comprising receiving a molten alloy of rare earth metal alloy by means of a rotary body; sprinkling the molten alloy by the effect of rotation of the rotary body, and causing the sprinkled molten alloy to be deposited and solidify on an inner wall surface of a rotating cylindrical mold; wherein a film having a thermal conductivity lower than that of material comprising the mold is provided to the

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			inner wall surface of the cylindrical mold.
Filed: October 28, 2005 Issued: September 16, 2008 Expires: Oct 2025	7,425,280	Assignee: TDK Corporation (Tokyo, JAPAN)	Ferrite magnetic material and process for producing the same Abstract The present invention provides a ferrite magnet material comprising, as a main phase, a ferrite having a hexagonal structure, the main phase containing A, La, R, Fe and Co, wherein A is at least one element selected from Sr, Ba and Pb, R is Pr and/or Nd, and the proportions of the total metal elements A, La, R, Fe and Co in the main phase are respectively A: 1 to 13 atomic %, La: 0.003 to 10 atomic %, R: 0 to 10 atomic % (excluding 0) Fe: 80 to 95 atomic % and Co: 0.05 to 5 atomic % based on the total amounts of metal elements. The residual magnetic flux density Br and coercive force HcJ can be improved without increasing the content of Co by incorporating Pr and/or Nd along with La and Co in the ferrite magnet material. What is claimed is: 1. A ferrite sintered magnet, comprising, as a main component, a composition ***[composition of matter]*** represented by the composition formula: A.sub.1-x(La.sub.1-mR.sub.m).sub.x(Fe.sub.12-yCo.sub.y).sub.zO.sub.19 wherein A is at least one element selected from Sr, Ba and Pb; R is Pr and/or Nd; and 0.04.ltoreq.x<0.80; 0.02.ltoreq.y<0.20; 0.00<m<0.90; 0.90<z<1.10; and 1.3.ltoreq.x/yz<2.5.
Filed: January 21, 2005 Issued: August 26, 2008 Expires:	7,416,613	Assignee: TDK Corporation (Tokyo, JAPAN)	Method for compacting magnetic powder in magnetic field, and method for producing rare-earth sintered magnet Abstract A method for compacting a magnetic powder in a magnetic field comprising steps of filling a die with a magnetic powder, applying a pulsed magnetic field to the magnetic powder in the die to orientate the powder, and compressing the magnetic powder, wherein the pulsed magnetic field is applied twice or more when density .rho. of a compacted body of said magnetic powder satisfies the

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Jan 2025			relationship .rho.=.alpha..times.H.sup.0.5+.beta.(.alpha.=0.63 and .beta.=1 to 2), where H is intensity (T) of the applied magnetic field. What is claimed is: 1. A method for producing ***[process/method]*** a rare-earth sintered magnet, comprising the steps of: compacting a magnetic powder in a magnetic field in which a pulsed magnetic field with damped oscillation is applied to a compacted body of starting magnet powder, sintering said compacted body at a given temperature into a sintered body, and heat-treating said sintered body for aging, wherein: said pulsed magnetic field with damped oscillation is applied twice or more when density .rho. of said compacted body of starting magnet powder at least satisfies the relationship .rho.=.alpha..times.H.sup.0.5+.beta.(.alpha.=0.63 and .beta.=1 to 2), where H is intensity (T) of the applied magnetic field.
Filed: September 19, 2005 Issued: August 26, 2008 Expires: Sept 2025	[7,416,578](#)	Assignee: Hoganas AB (Hoganas, SWEDEN)	Powder metal composition Abstract The invention concerns a powder metal composition comprising an iron based powder and a lubricant and/or binder comprising at least one secondary amide of the general formula: R.sub.1--NH--CO--R.sub.2, wherein R.sub.1 and R.sub.2 are the same or different, straight or branched, saturated or unsaturated aliphatic hydrocarbon groups. The invention further concerns a method of making green bodies of the powder metal composition according to the invention, a method of producing a bonded iron-based powder composition, as well as the use of the at least one secondary amide as a lubricating and/or binding agent for iron based powders and the use as a die wall lubricant. The invention claimed is:

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			1. Powder metal composition ***[composition of matter]*** for compaction when producing powder metal components comprising an iron based powder selected from pure iron, iron powder pre-alloyed, diffusion annealed or mixed with alloying, element(s) selected from Cu, Mo, Cr, Mn, P, C, Ni, Si, B, V, Ti, Al, Co, W, or mixtures thereof and a lubricant and/or binder comprising 0.05-2% by weight of at least one secondary amide of the general formula: R.sub.1--NH--CO--R.sub.2 wherein R.sub.1 and R.sub.2 are the same or different, straight or branched, saturated or unsaturated aliphatic hydrocarbon groups. 2. Composition according to claim 1, wherein R.sub.1 and R.sub.2 independently include 10 to 24 carbon atoms. 3. Composition according to claim 1 wherein R.sub.1 and R.sub.2 are selected from the group consisting of alkyl and alkenyl.
Filed: July 20, 2004 Issued: September 30, 2008 Expires: Sept 2024	RE40,524	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Magnet powder-resin compound particles, method for producing such compound particles and resin-bonded rare earth magnets formed therefrom Abstract The magnet powder-resin compound particles substantially composed of rare earth magnet powder and a binder resin are in such a round shape that a ratio of the longitudinal size a to the transverse size b (a/b) is more than 1.00 and 3 or less, and that an average particle size defined by (a/b)/2 is 50-300 .mu.m. They are produced by charging a mixture of rare earth magnet powder and a binder resin into an extruder equipped with nozzle orifices each having a diameter of 300 .mu.m or less; extruding the mixture while blending under pressure though the nozzle orifices to form substantially cylindrical, fine pellets; and rounding the pellets by rotation. What is claimed is:

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			1. .[.A.]. .I add.An isotropic, .I addend. resin-bonded rare earth magnet substantially composed of ***[composition of matter]*** an R--T--B alloy powder, wherein R is at least one rare earth element including Y, and T is Fe or Fe+Co, and a binder resin, said R--T--B alloy powder comprising an R.sub.2T.sub.14B.[.-type.]. intermetallic compound as a main phase and having an average crystal grain size of 0.01-0.5 .mu.m, and wherein said resin bonded rare earth magnet is in the shape of a ring having a radial thickness of 0.3-3 mm and a length of 50 mm or less, .[.the.]. .Iadd.a .Iaddend.deviation of an outer periphery of said resin-bonded rare earth magnet from a circle being 10 .mu.m or less in said radial thickness of 0.3-3 mm along the circularity of an outer diameter of 50 mm or less, said resin-bonded rare earth magnet having two end portions and a center portion therebetween along the length thereof and having a density of 6.0 g/cm.sup.3 or more with a density distribution showing higher density in the two end portions than in the center portion between the two end portions of the resin-bonded rare earth magnet, the difference between the highest density in the two end portions and the lowest density in the center portion being 0.3 g/cm.sup.3 or less, said resin-bonded rare earth magnet having a (BH).sub.max of .[.10.5 MGOe or more.]. .Iadd.greater than about 10.1 MGOe, and said resin-bonded rare earth magnet being produced by a compression molding method.Iaddend.
Filed: Issued: July 22, 2008 Expires:	7,402,226	Assignees: Japan Science and Technology Agency (JAPAN) Hitachi Metals, Ltd. (Tokyo, JAPAN)	Minute high-performance rare earth magnet for micromini product and process for producing the same Abstract A method of manufacturing a rare earth permanent magnet comprises the steps of: forming a rare earth magnet by applying mechanical processing to a magnet block material, thereby damaging the surface of the magnet and causing a magnetic characteristic (BH)max of the magnet to deteriorate, followed by transforming a rare earth metal or an alloy thereof into fine particles or a vapor, and allowing the fine particles or vapor to diffuse and permeate the magnet,

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		Machida; Kenichi (JAPAN)	thereby improving the quality of the damaged magnet surface portion so that the magnetic characteristic (BH)max is recovered. We claim: 1. A method of manufacturing ***[process/method]*** a small rare earth permanent magnet comprising the steps of: forming a cylindrical or disc-shaped rare earth magnet with a hole forming an inner surface, wherein the magnet has a surface to volume ratio of 2 mm.sup.-1 or more and a volume of 100 mm.sup.3 or less, the forming step including a step of applying mechanical processing to a sintered Nd--Fe--B system or Pr--Fe--B system rare earth magnet block material so as to damage the surface of the magnet and to cause a magnetic characteristic (BH).sub.max of the magnet to deteriorate, inserting an electrode wire into the hole of the cylindrical or disc-shaped magnet, supporting the magnet on the electrode wire in a depressurized tank, placing the electrode wire between oppositely-disposed targets in the tank, wherein the oppositely-disposed targets are ring-shaped targets disposed concentrically with respect to the center axis of the cylindrical or disc-shaped magnet, the electrode wire extending and being fixed on a rotation shaft of a motor located outside of one of the ring-shaped targets, reverse-sputtering the magnet while the magnet is made to be electrically negative through the electrode wire, transforming an R metal (R denotes at least one kind of rare earth elements selected from the group consisting of Y, Nd, Dy, Pr, Ho and Tb) or an alloy containing an R metal into fine particles by a sputtering method, rotating the magnet with the electrode wire as a rotation shaft, allowing the fine particles to fly three-dimensionally and deposit to form uniform film onto the whole or part of the surface of the magnet, allowing the film to diffuse and permeate from the surface of the magnet to the inside of the magnet to at least a depth corresponding to a radius of a grain exposed on the outermost surface of the magnet, and thereby modifying the damaged magnet surface so that the magnetic characteristic (BH).sub.max is recovered to 280 kJ/m.sup.3 or more.

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Filed: Feb 22, 2005 Issued: June 24, 2008 Expires: Feb 2025	7,391,291	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Sealed rare earth magnet and method for manufacturing the same Abstract It is an object of the present invention to provide a rare earth magnet that will not decompose due to hydrogen embrittlement when used in a hydrogen gas atmosphere, and furthermore, does not pose the risk of contaminating a reaction bath with the surface treated film of the magnet. The present invention provides a sealed rare earth magnet comprising: a rare earth magnet; and a case of aluminum or aluminum alloy, wherein the case covers entirety of the rare earth magnet and is sealed by HIP; and the methods for manufacturing the same. What is claimed is: 1. A sealed rare earth magnet comprising ***[composition of matter]*** : a rare earth magnet; and a case of aluminum or aluminum alloy having a lid portion sealed to a case portion, wherein the case covers entirety of the rare earth magnet and has substantially no pinholes such that penetration of hydrogen gas into an interior of the case is prevented, and wherein the magnet has a size and shape approximating the interior shape of the case. 5. The sealed rare earth magnet according to claim 1, wherein the rare earth magnet is a R--Co-based rare earth magnet and wherein R is selected from the group consisting of lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu), scandium (Sc) and yttrium (Y). 7. The sealed rare earth magnet according to claim 1, wherein the rare earth magnet is a R--Fe--B -based rare earth magnet and wherein R is selected from

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			the group consisting of lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), europium (Eu), gadolinium (Gd), terbium (Tb), samarium (Sm), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu), scandium (Sc) and yttrium (Y).
Filed: November 23, 2004 Issued: June 24, 2008 Expires: Nov 2024	7,390,579	Assignee: Magnequench, Inc. (Singapore, Republic of Singapore)	Coating formulation and application of organic passivation layer onto iron-based rare earth powders Abstract The present disclosure relates to coating formulations for neodymium-iron-boron type magnetic powders manufactured from rapid solidification processes for the purpose, inter alia, of corrosion and oxidation resistance when exposed to aggressive environments. The coating formulation preferably contains an epoxy binder, curing agent, an accelerating agent, and a lubricant. By incorporating coupling agents and optionally, other specialty additives with the magnetic powder and the organic epoxy components, additional oxidation and corrosion prevention, enhanced adhesion and dispersion between the filler and matrix phases can be achieved. This disclosure relates to all such rare earth-transition metal-boron (RE-TM-B) powders produced by rapid solidification and encompasses both the bonded magnet products that include combinations of the materials mentioned and the application processes. What is claimed is: 1. A rapidly solidified rare earth-transition metal-boron magnet material, comprising ***[composition of matter]*** a coated rare earth-transition metal-boron magnet powder comprising the magnet powder and a coating formulation, wherein the coating formulation comprises a combination, in an amount by weight of the magnet powder, of about 0.1 weight percent to about 1 weight percent of an organotitanate or organozirconate coupling agent, about

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			0.18 weight percent to about 4.46 weight percent of an epoxy resin, about 0.01 weight percent to about 0.27 weight percent of an amine-based hardener, about 0.004 weight percent to about 0.09 weight percent of an accelerator, and about 0.003 weight percent to about 0.27 weight percent of a lubricant; wherein the general form of the coupling agent is (RO--).sub.n(Ti or Zr)(--OR'Y).sub.4-n where R is a neopentyl(diallyl), dioctyl, or (2,2-diallyloxymethyl)butyl group, Ti or Zr has a coordination number of 4, R' is a phosphito, pyrophosphato or cyclic pyrophosphato segment, and Y is a dioctyl or ditridecyl end group with 1.ltoreq.n.ltoreq.4. 3. A rapidly solidified rare earth-transition metal-boron magnet material comprising ***[composition of matter]*** a coated rare earth-transition metal-boron magnet powder comprising the magnet powder and a coating formulation, wherein the coating formulation comprises a combination, in an amount by weight of the magnet powder, of about 0.225 weight percent to about 4.25 weight percent of epichlorohydrin/cresol novolac epoxy resin, about 0.01 weight percent to about 0.26 weight percent of dicyandiamide hardener, about 0.005 weight percent to about 0.085 weight percent of an aromatic, tertiary amine accelerator, about 0.004 weight percent to about 0.27 weight percent of zinc stearate lubricant, and about 0.35 weight percent to about 0.75 weight percent of an organotitanate coupling agent of the form (RO--)Ti(--OR'Y).sub.3 where R is a neopentyl(diallyl), Ti has a coordination number of 4, R' is a pyrophosphato segment, and Y is a dioctyl end group.
Filed: Filed: April 21, 2004 Issued: June 24, 2008	7,390,369	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co.,*	Method for producing rare earth based alloy powder and method for producing rare earth based sintered magnet Abstract An inventive method of making a rare-earth alloy powder is used to produce a rare-earth sintered magnet, whose main phase has a composition R.sub.2T.sub.14A (where R is one of the rare-earth elements including Y; T is Fe with or without a non-Fe transition metal; and A is boron with or without

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Expires: April 2024		*Ltd., now a 100% subsisidiary of Hitachi Metals.*	carbon). The method includes the steps of: preparing a first rare-earth rapidly solidified alloy, having a columnar texture with an average dendritic width within a first range, by subjecting a melt of a first rare-earth alloy with a first composition to a rapid cooling process; preparing a second rare-earth rapidly solidified alloy, having a columnar texture with an average dendritic width smaller than that of the first rare-earth rapidly solidified alloy and falling within a second range, by subjecting a melt of a second rare-earth alloy with a second composition to the rapid cooling process; making a first rare-earth alloy powder by pulverizing the first solidified alloy; making a second rare-earth alloy powder by pulverizing the second solidified alloy; and making a powder blend including the first and second rare-earth alloy powders. The invention claimed is: 1. A method of making ***[process/method]*** a rare-earth alloy powder for use to produce a rare-earth sintered magnet, of which a main phase has a composition represented by R.sub.2T.sub.14A (where R is one of the rare-earth elements including Y; T is either Fe alone or a mixture of Fe and a transition metal element other than Fe; and A is either boron alone or a mixture of boron and carbon), the method comprising the steps of: preparing a first R--Fe--B based rare-earth rapidly solidified alloy, which has a columnar texture with an average dendritic width falling within a first range, by subjecting a melt of a first R--Fe--B based rare-earth alloy with a first composition to a rapid cooling process; preparing a second R--Fe--B based rare-earth rapidly solidified alloy, which has a columnar texture with an average dendritic width that is smaller than that of the first R--Fe--B based rare-earth rapidly solidified alloy and that falls within a second range, by subjecting a melt of a second R--Fe--B based rare-earth alloy with a second composition to the rapid cooling process; making a first R--Fe--B based rare-earth alloy powder by pulverizing the first R--Fe--B based rare-earth rapidly solidified alloy; making a second R--Fe--B based rare-earth alloy powder by pulverizing the second R--Fe--B based rare-

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			earth rapidly solidified alloy; and making a powder blend including the first and second R--Fe--B based rare-earth alloy powders. 13. A method for producing ***[process/method]*** a rare-earth sintered magnet, of which a main phase has a composition represented by R.sub.2T.sub.14A (where R is one of the rare-earth elements including Y; T is either Fe alone or a mixture of Fe and a transition metal element other than Fe; and A is either boron alone or a mixture of boron and carbon), the method comprising the steps of: preparing a R--Fe--B based rare-earth alloy powder by the method of claim 1; compacting a powder material, including the R--Fe--B based rare-earth alloy powder, thereby obtaining a compact; and sintering the compact.
Filed: February 8, 2006 Issued: June 10, 2008 Expires: Feb 2026	7,384,487	Assignee: TDK Corporation (Tokyo, JAPAN)	Method for producing magnetostrictive element and container for sintering Abstract It is an object of the present invention to provide a method for producing a magnetostrictive element, capable of assuredly producing a magnetostrictive element by powder metallurgy. In a container for sintering , a compact is sintered into a magnetostrictive element having a composition of SmFe.sub.2 while held by a support of SmFe.sub.2 or Nb stable during the sintering step. The support is composed of particles coming into contact with the compact at multiple points, to control fusion-bonding between the support and the compact to a limited extent. What is claimed is: 1. A method for producing a magnetostrictive element ***[process/method]*** having a composition of SmFe.sub.2, comprising the steps of: compacting a starting powder containing at least Sm and Fe into a compact in a magnetic field, and sintering the compact while being supported by a support of Nb and/or SmFe.sub.2 in a container.

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Filed: December 9, 2005 Issued: May 27, 2008 Expires: Dec 2015	7,377,985	Assignee: Shanxi Huiqiang Magnetic Material Manufacturing Co., Ltd. (Shanxi, CHINA)	Temper process of sintered Nd-Fe-B permanent magnet Abstract The present invention provides a tempering process for sintered Nd--Fe--B permanent magnet material, which optimizes the microstructure of the Nd--Fe--B magnet and improves intrinsic coercive force and its consistency by increasing the cooling rate after tempering. After heating to a temper temperature, the magnetic material is cooled in a cooling liquid within a cooling chamber into which a pressurized cooling gas is introduced. The invention claimed is: 1. A temper method ***[process/method]*** for a Nd--Fe--B permanent magnet, comprising (a) heating the magnet in a primary temper process to a primary temper temperature; (b) cooling the magnet in the primary temper process in a cooling liquid in a chamber into which a pressurized cooling exchange gas under a pressure of about 1.8-3.5 times higher than the normal pressure of the cooling gas is introduced; (c) re-heating the magnet in a secondary temper process to a secondary temper temperature; and (d) cooling the magnet in the secondary temper process in a cooling liquid in a chamber into which a pressurized cooling gas under a pressure of about 1.8-3.5 times higher than the normal pressure of the cooling gas is introduced. … 10. A temper method for a Nd--Fe--B permanent magnet, comprising (a) heating the magnet in a primary temper process to a primary temper temperature, wherein the primary temper temperature is in the range of about 900-930.degree. C. and is held for about 2-3 hours; (b) cooling the magnet in the primary temper process in a cooling liquid in a chamber into which a pressurized cooling exchange gas under a pressure of about 1.8-3.5 times higher than the normal pressure of the cooling gas is introduced, wherein the

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			magnet is cooled at a rate of about 80-120.degree. C. per minute; (c) re-heating the magnet in a secondary temper process to a secondary temper temperature, wherein the secondary temper temperature is in the range of about 500-630.degree. C. and is held for about 2-4.5 hours; and (d) cooling the magnet in the secondary temper process in a cooling liquid in a chamber into which a pressurized cooling gas under a pressure of about 1.8-3.5 times higher than the normal pressure of the cooling gas is introduced, wherein the magnet is cooled at a rate of about 80-120.degree.C. per minute.
Filed: November 12, 2003 Issued: May 13, 2008 Expires: Nov 2023	7,371,292	Assignee: Nissan Motor Co., Ltd. (Kanagawa, JAPAN)	Nd-Fe-B type anisotropic exchange spring magnet and method of producing the same Abstract A Nd--Fe--B type anisotropic exchange spring magnet is produced by a method of obtaining powder of a Nd--Fe--B type rare earth magnet alloy which comprises hard magnetic phases and soft magnetic phases wherein a minimum width of the soft magnetic phases is smaller than or equal to 1 .mu.m and a minimum distance between the soft magnetic phases is greater than or equal to 0.1 .mu.m, obtaining a compressed powder body by compressing the powder, and obtaining the Nd--Fe--B type anisotropic exchange spring magnet by sintering the compressed powder body using a discharge plasma sintering unit. What is claimed is: 1. A Nd--Fe--B type rare earth magnet alloy for a Nd--Fe--B type anisotropic exchange spring magnet ***[composition of matter]*** comprising: hard magnetic phases and soft magnetic phases; wherein a minimum width of the soft magnetic phases is smaller than or equal to 1 .mu.m; a minimum distance between the soft magnetic phases is greater than or equal to 0.1 .mu.m; and a composition of the Nd--Fe--B type rare earth magnet alloy is expressed by the following chemical formula (1) Nd.sub.xFe.sub.100-x-y-zB.sub.yV.sub.z (1)

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			where x is within a range from 9 to 11, y is within a range from 5 to 8 and z is within a range from 0 to 2, wherein chemical formula (1) optionally comprises Co, and if Co is present in the alloy 0.01 to 30 atom % of Fe is replaced with Co. 5. The Nd--Fe--B type rare earth magnet alloy as claimed in claim 1, wherein the Nd--Fe--B type rare earth magnet alloy is a thin strip crystalline alloy produced by ***[process/method]*** a strip casting method. 7. Powder of a Nd--Fe--B type rare earth magnet alloy, the Nd--Fe--B type rare earth magnet alloy comprising: hard magnetic phases and soft magnetic phases, wherein a minimum width of the soft magnetic phases is smaller than or equal to 1 .mu.m; a minimum distance between the soft magnetic phases is greater than or equal to 0.1 .mu.m; and a composition of the Nd--Fe--B type rare earth magnet alloy is expressed by the following chemical formula (1) Nd.sub.xFe.sub.100-x-y-zB.sub.yV.sub.z (1) where x is within a range from 9 to 11, y is within a range from 5 to 8 and z is within a range from 0 to 2, wherein chemical formula (1) optionally comprises Co, and if Co is present in the alloy 0.01 to 30 atom % of Fe is replaced with Co.
Filed: December 2, 2002 Issued: May 13, 2008 Expires: Dec 2022	7,371,290	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Production method for permanent magnet and press device Abstract To avoid various problems caused by remnant magnetization and produce an anisotropic bonded magnet at a reduced cost, a method for producing an anisotropic bonded magnet by feeding a magnetic powder (such as an HDDR powder) into the cavity of a press machine and compacting it is provided. A weak magnetic field is created as a static magnetic field in a space including the cavity by using a magnetic member that is steadily magnetized. The magnetic powder being transported into the cavity is aligned parallel to the direction of the weak magnetic field. Next, the magnetic powder is compressed

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			in the cavity, thereby obtaining a compact. The invention claimed is: 1. A method for producing a permanent magnet ***[process/method]*** by feeding a magnetic powder into a cavity of a press machine and compacting the magnetic powder, the method comprising the steps of: creating a magnetic field having a strength of 8 kA/m to 120 kA/m as a static magnetic field in a space including the cavity and transporting the magnetic powder toward the inside of the cavity while aligning the magnetic powder parallel to the direction of the magnetic field; and compacting the magnetic powder inside of the cavity, thereby obtaining a compact.
Filed: April 24, 2002 Issued: April 29, 2008 Expires: April 2022	7,364,628	Assignee: Asahi Kasei Kabushiki Kaisha (Osaka, JAPAN)	Solid material for magnet Abstract A solid material for a magnet, comprising a rare-earth/iron/nitrogen/hydrogen system magnetic material. The invention claimed is: 1. A method of producing ***[process/method]*** a solid material for a magnet comprising a rare-earth/iron/nitrogen/hydrogen system magnetic material, said method comprising subjecting said solid material to shock-compaction via underwater shock-waves. 3. A method as claimed in claim 1, wherein raw-material powders are subjected to powder compacting in a magnetic field. 4. A method as claimed in claim 1, comprising the step of heat-treating said material at least once at a temperature of 100.degree. C. or more but less than a

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			decomposition temperature.
Filed: March 24, 2011 Issued: January 29, 2013 Expires: March 2031	8,361,242	Assignee: Vacuumschmeize GmbH & Co. KG (GERMANY)	Powders for rare earth magnets, rare earth magnets and methods for manufacturing the same Abstract A powder consists essentially by weight, of 28.00.ltoreq.R.ltoreq.32.00%, where R is at least one rare earth element including Y and the sum of Dy+Tb>0.5, 0.50.ltoreq.B.ltoreq.2.00%, 0.50.ltoreq.Co.ltoreq.3.50%, 0.050.ltoreq.M.ltoreq.0.5%, where M is one or more of the elements Ga, Cu and Al, 0.25 wt %<O.ltoreq.0.5%, 0.15% or less of C, balance Fe. What is claimed: 1. A method to produce powders ***[process/method]*** for use in R--Fe--B--M type permanent magnets comprising: melting an alloy consisting of, by weight, 28.00.ltoreq.R.ltoreq.32.00%, where R is at least one rare earth element including Y and the sum of Dy+Tb>0.5, 0.50.ltoreq.B.ltoreq.2.00%, 0.50.ltoreq.Co.ltoreq.3.50%, 0.050.ltoreq.M.ltoreq.0.5%, where M is one or more of the elements Ga, Cu and Al, 0.25 wt %<O.ltoreq.0.5%, 0.15% or less of C, 0.15% or less of N, balance Fe; casting said alloy to form at least one ingot, wherein the solidified ingot comprises finely dispersed .alpha.-Fe phase, and R.sub.2Fe.sub.14B and R-rich constituents; annealing said ingot at a temperature in the range of 800.degree. C. to 1200.degree. C. under an inert atmosphere of Ar or under vacuum to form an ingot which is free of said .alpha.-Fe phase; hydrogenating said ingots in hydrogen gas in order to hydrogenate the R-rich constituents; coarsely pulverising said ingot to form a coarsely pulverised powder; performing a fine pulverisation of said coarsely pulverised powder in an atmosphere comprising oxygen, thereby forming an oxidized, finely pulverised powder; wherein said finely pulverised powder comprises an oxygen content of 0.25 wt %<O.ltoreq.0.5 wt %

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Filed: November 18, 2003 Issued: April 15, 2008 Expires: Nov 2023	7,357,880	Assignee: Aichi Steel Corporation \ (Tokai-shi, JAPAN)	Composite rare-earth anisotropic bonded magnet, composite rare-earth anisotropic bonded magnet compound, and methods for their production Abstract The bonded magnet of the present invention, in which average particle diameter and compounding ratio are specified, is comprised of Cobalt-less R1 d-HDDR coarse magnet powder that has been surface coated with surfactant, R2 fine magnet powder that has been surface coated with surfactant (R1 and R2 are rare-earth metals), and a resin which is a binder. The resin, a ferromagnetic buffer in which R2 fine magnet powder is uniformly dispersed, envelops the outside of the Cobalt-less R1 d-HDDR coarse magnet powder. Despite using Cobalt-less R1 d-HDDR anisotropic magnet powder, which is susceptible to fracturing and therefore vulnerable to oxidation, the bonded magnet of the present invention exhibits high magnetic properties along with extraordinary heat resistance. Contrary to the technology's conventional wisdom coarse Co-less NdFeB anisotropic magnet powder, which has poor resistance to oxidation, , combined with fine SmFeN anisotropic magnet powder, having similarly poor oxidation resistance, succeeded at obtaining a composite rare-earth anisotropic bonded magnet which has excellent initial magnetic properties, and exhibits ample heat resistance (irreversible loss properties) the same or greater than bonded magnets that use Co-containing anisotropic magnet powder. What is claimed is: 1. A composite rare-earth anisotropic bonded magnet, comprising ***[composition of matter]*** : (A) Cobalt-less R1 d-HDDR coarse powder with an average grain diameter of 40-200 .mu.m and having micro-cracks, comprising: 1. Cobalt-less R1 d-HDDR anisotropic magnet powder, obtained by performing a d-HDDR treatment on a cobalt-less R1 alloy of a rare-earth element including yttrium (Y) (hereafter, "R1"), iron (Fe), and boron (B) as the

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			main ingredients and fundamentally not containing cobalt; and 2. #1 surfactant that coats at least one part of the grain surface of said cobalt-less R1 d-HDDR anisotropic magnet powder; and (B) R2 fine magnet powder with an average aspect ratio of 2 or less and average grain diameter 1-10 .mu.m, comprising: 1. R2 anisotropic magnet powder with a maximum energy product (BH)max 240 kJ/m.sup.3 or more and with a rare-earth element including yttrium (hereafter, "R2") as one of the principle ingredients; and 2. #2 surfactant that coats at least one part of the grain surface of said R2 anisotropic magnet Powder and (C) a thermosetting resin as binder; wherein the said bonded magnet contains 50-84 wt % of said Co-less R1 d-HDDR coarse magnet powder, 15-40 wt % of said R2 fine magnet powder, and 1-10 wt % of said thermosetting resin; and wherein relative density (.rho./.rho..sub.th) of the said bonded magnet, which is the ratio of volume density (.rho.) to theoretical density (.rho..sub.th), is 91-99%; and wherein normalized grain count of the said Co-less R1 d-HDDR coarse magnet powder in the said bonded magnet, where per unit area apparent grain diameter is 20 .mu.m or less, is 1.2.times.10.sup.9 pieces/m.sup.2 or less; the said composite rare-earth anisotropic bonded magnet having the special characteristics of outstanding magnetic properties and heat tolerance.
Filed: October 18, 2002 Issued: March 18, 2008 Expires: Oct 2022	7,344,606	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Permanent magnet manufacturing method and press apparatus Abstract An anisotropic bonded magnet is produced at a low cost by avoiding various problems caused by remanence. Also, the unit weight and density of a compact is increased by filling even a cavity, having no easily feedable shape, with a magnet powder just as intended. An anisotropic bonded magnet is produced by feeding the cavity of a press machine with a magnetic powder (e.g., an HDDR powder) and compacting it. After the magnetic powder has been positioned outside of the cavity, an oscillating magnetic field (e.g., an alternating magnetic field) is created in a space including the cavity. The magnetic powder is transported into the cavity while being aligned parallel to the oscillating

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			direction of the oscillating magnetic field. Thereafter, the magnetic powder is compressed within the cavity to make a compact for an anisotropic bonded magnet. The invention claimed is: 1. A method for producing a permanent magnet ***[process/method]*** by feeding a magnetic powder into a cavity of a press machine and compacting the magnetic powder, the method comprising the steps of: applying an oscillating magnetic field to a space including the cavity; moving the magnetic powder toward the inside of the cavity while aligning the magnetic powder parallel to the direction of the oscillating magnetic field; and compacting the magnetic powder inside of the cavity, thereby obtaining a compact, wherein the oscillating magnetic field within the cavity has its maximum value adjusted such that the compact, which has just been pressed by the press machine, has a surface flux density of 0.005 tesla or less, and wherein the maximum value of the oscillating magnetic field within the cavity is adjusted to 120 kA/m or less.
Filed: December 20, 2005 Issued: March 18, 2008 Expires: Dec 2025	7,344,605	Assignee: Nissan Motor Co., Ltd (Kanagawa, JAPAN)	Exchange spring magnet powder and a method of producing the same Abstract An anisotropic exchange spring magnet powder complexing a hard magnetic material and a soft magnetic material, wherein a rare earth metal element, a transition metal element, boron and carbon and the like are contained, and the hard magnetic material and soft magnetic material have crystal particle diameters of 150 nm or less. A method of producing an anisotropic exchange spring magnet powder comprises treating a crystalline mother material containing a hard magnetic material and soft magnetic material or the crystalline mother material having amorphous parts, in a continuous process composed of an amorphising process and the following crystallizing process, repeated once or more times. An anisotropic exchange spring magnet is

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			obtained by treatment, in an anisotropy- imparting molding process and a solidification process, of an anisotropic exchange spring magnet powder. What is claimed is: 1. A method of producing an anisotropic exchange spring magnet powder ***[process/method]*** comprising: preparing a crystalline mother material containing a hard magnetic material phase containing a rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), and a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), wherein the crystalline mother material partially having a content of amorphous parts of below about 95%; amorphising said crystalline mother material by a ball milling method, and crystallizing said crystalline mother material amorphisated in the amorphising process by heat treating.
Filed: October 18, 2002 Issued: March 4, 2008 Expires: Oct 2022	7,338,573	Assignee: MagnetNotes, Ltd (Toledo, OH, USA)	Magnetic substrates with high magnetic loading Abstract A method of forming a magnetic assembly having at least one magnetic layer having dimensions of thickness, width and length, and at least one printable substrate layer having dimensions of thickness, width and length, including the steps of providing a molten magnetic composition including about 70 wt-% to about 95 wt-% of at least one magnetic material and about 5 wt-% to about 30 wt-% of at least one thermoplastic binder, forming the magnetic composition into a magnetic layer at an elevated temperature and directly applying the magnetic layer at an elevated temperature to a first surface of a printable substrate layer wherein. An adhesion promoting composition may be further provided between the magnetic layer and the printable substrate layer for improving adhesion between the magnetic layer and the printable substrate

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			layer. The invention claimed is: 1. The method of forming a multi-layer magnetic assembly in-line ***[process/method]*** , said multi-layer magnetic assembly consisting of a magnetic layer, an adhesion promoting layer, and a printable substrate layer, said method comprising the steps of: a) providing a hot melt magnetic composition, said hot melt magnetic composition comprising comprises about 80 wt-% to about 95 wt-% of at least one magnetic material and about 5 wt-% to about 20 wt-% of at least one thermoplastic material at an elevated temperature with an extruder; b) providing a printable substrate layer; c) providing an adhesion promoting layer on said printable substrate layer; and d) applying said hot melt magnetic composition at an elevated temperature directly to said printable substrate layer with a first slot die application head to form a magnetic layer having a thickness of about 50 microns to about 305 microns on said printable substrate layer, the adhesion promoting layer between said printable substrate layer and said magnetic layer.
Filed: November 8, 2002 Issued: March 4, 2008 Expires: Nov 2022	7,338,566	Assignee: Santoku Corporation (Kobe-shi, JAPAN)	Alloy for sm-co based magnet, method for production thereof, sintered magnet and bonded magnet Abstract The present invention relates to a Sm--Co based magnet alloy useful as a raw material for producing magnets having high magnetic properties, such as sintered or bonded magnets, methods for producing such an alloy, and sintered or bonded magnets having excellent corrosion resistance and high magnetic properties, such as high coercivity and good squareness. The magnetic alloy is composed of an alloy represented by the formula RM with 32.5 to 35.5 wt % R such as Sm and the balance of M such as Co, wherein ratio (B/A) of the X-ray diffraction intensity (B) corresponding to the (119) plane of R.sub.2M.sub.7 phase to the X-ray diffraction intensity (A) corresponding to the (111) plane of

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			RM.sub.5 phase is not higher than 0.1. What is claimed is: 1. A method of producing a Sm--Co based magnet alloy ***[process/method]*** consisting of an alloy represented by the formula RM with 32.5 to 35.5 wt % R and the balance of M, wherein R is Sm alone, or Sm in combination with at least one rare earth metal selected from the group consisting of Ce, Pr, Nd, and Gd, M is Co alone, or Co in combination with at least one transition metal, provided that R and M may include inevitable elements, wherein a ratio (B/A) of an X-ray diffraction intensity (B) corresponding to (119) plane of R.sub.2M.sub.7 phase to an X-ray diffraction intensity (A) corresponding to (111) plane of RM.sub.5 phase is not higher than 0.1, said method comprising cooling an alloy melt of 32.5 to 35.5 wt % raw material alloy for R and the balance of raw material alloy for M from a melting point of said alloy to 800.degree. C. over 0.5 to 20 seconds, and from 800.degree. C. to 200.degree. C. over not less than 600 seconds.
Filed: November 28, 2003 Issued: February 26, 2008 Expires: Nov 2023	7,335,392	Assignee : Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Method for producing corrosion-resistant rare earth metal-based permanent magnet Abstract The objectives of the present invention are to provide a stable and simple method for producing a rare earth metal-based permanent magnet having on the surface thereof a corrosion-resistant film containing fine zinc particles dispersed therein, a corrosion-resistant rare earth metal-based permanent magnet produced by the method, a dip spin coating method being suitable for forming a coating film on thin type work pieces having various shapes, and a method for forming a coating film on a work piece. A method for producing a corrosion-resistant rare earth metal-based permanent magnet of the present invention, characterized in that it comprises providing an aqueous treating fluid, which contains a hydrolysis polymerization product of alkyl silicate and

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			fine zinc particles having an average particle diameter of 1 .mu.m to 50 .mu.m and has a pH value of 6 to 8 and a viscosity of 1000 cP or less, applying the fluid on the surface of a rare earth metal-based permanent magnet, and subjecting the resultant magnet to a heat treatment at 250.degree. C. to 400.degree. C., to thereby form a corrosion-resistant film containing fine zinc particles dispersed therein. The invention claimed is: 1. A method for producing a corrosion-resistant rare earth metal-based permanent magnet ***[process/method]*** , characterized in that it comprises providing an aqueous treating fluid, which contains a hydrolysis polymerization product of alkyl silicate and zinc particles having an average particle diameter of 1 .mu.m to 50 .mu.m and has a pH value of 6 to 8 and a viscosity of 1000 cP or less, applying the fluid on the surface of a rare earth metal-based permanent magnet, and subjecting the resultant magnet to a heat treatment at 250.degree. C. to 400.degree. C., to thereby form a corrosion-resistant film containing zinc particles dispersed therein. 10. The production method as claimed in claim 8, characterized in that the dip spin coating is carried out by supporting plural rare earth metal-based permanent magnets on approximately the outer peripheral edge portion of a turn table which is rotatable around a vertical center axis that is used as the axis of rotation, immersion coating the rare earth metal-based permanent magnets with the aqueous treating fluid by immersing the turn table having the rare earth metal-based permanent magnets supported thereon in an aqueous treating fluid tank, and after taking out the resulting turn table from the liquid, rotating the turn table to centrifugally cut off the aqueous treating fluid that has adhered in excess to the rare earth metal-based permanent magnets.
Filed:	7,328,500	Assignee:	Method of manufacturing laminated polar anisotropic hybrid magnet

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April 28, 2004 Issued: February 12, 2008 Expires: April 2024		Jahwa Electronics Co., Ltd. (KOREA)	Abstract Disclosed is a method of manufacturing a laminated polar anisotropic hybrid magnet, which includes separately mixing first permanent magnet powders having low magnetic properties and second permanent magnet powders having high magnetic properties with a thermoplastic resin to prepare first and second compound pellets, respectively, and firstly injecting the first compound pellets by use of a first injection mold, to prepare a polar anisotropic and anisotropic resin magnet, which is then placed into a second injection mold having an outer diameter lager than that of the first mold, followed by secondly injecting in a magnetic field together with the second compound pellets. The manufacturing method of the current invention is advantageous in terms of exhibition of higher magnetic properties of the laminated polar anisotropic hybrid magnet, and reduction of the use of expensive materials, thus generating economic benefits. Further, a flux density wave of the magnet can be easily controlled on the magnet surface to be suitable for performances and characteristics of the motors, and temperature properties of the magnet can be enhanced. Thereby, the entire manufacturing method can be efficiently carried out, therefore increasing productivity and reliability in practical use thereof. What is claimed is: 1. A method of manufacturing a laminated polar anisotropic hybrid magnet ***[process/method]*** , comprising: mixing at least one first permanent magnet powder having first magnetic properties with a thermoplastic resin to prepare first compound pellets having magnetic properties, and mixing at least one second permanent magnet powder having magnetic properties which are higher than said first magnetic properties with a thermoplastic resin to prepare second compound pellets having high magnetic properties which are higher than said magnetic properties of said first compound pellets; injection molding the first compound pellets by use of a first polar anisotropic and anisotropic mold

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			having multi-poles and multi-cavities, to prepare a polar anisotropic and anisotropic resin magnet; and placing the polar anisotropic and anisotropic resin magnet into a second polar anisotropic mold having an outer diameter larger than that of said first polar anisotropic and anisotropic mold used for the firstly injection molding, thereby leaving a space between said polar anisotropic and anisotropic resin magnet and said second mold, injection molding in a magnetic field the second compound pellets into said space to manufacture a laminated polar anisotropic hybrid magnet with multi-poles and multi-layers. 3. A method according to claim 1 wherein the at least one first permanent magnet powder comprises at least one powder selected from the group consisting of ferrite (Ba, Sr and Pb) powders and mixtures thereof, alnico powders, Fe--Cr--Co powders, SmCo powders, Sm--Fe--N powders, Nd--Fe--B powders, and mixtures thereof.
Filed: June 29, 2001 Issued: January 8, 2008 Expires: June 2021	7,316,752	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	R-T-B-C based rare-earth magnetic powder and bonded magnet Abstract The step of preparing a rapidly solidified alloy by rapidly quenching a melt of an R-T-B-C based rare-earth alloy (where R is at least one of the rare-earth elements including Y, T is a transition metal including iron as its main ingredient, B is boron, and C is carbon) and the step of thermally treating and crystallizing the rapidly solidified alloy are included. The step of thermally treating results in producing a first compound phase with an R.sub.2Fe.sub.14B type crystal structure and a second compound phase having a diffraction peak at a site with an interplanar spacing d of 0.295 nm to 0.300 nm (i.e., where 2.theta.=30 degrees). An intensity ratio of the diffraction peak of the second compound phase to that of R.sub.2Fe.sub.14B type crystals representing a (410) plane is at least 10%. The present invention provides an R-T-B-C based rare-earth alloy magnetic material, including carbon (C) as an

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			indispensable element but exhibiting excellent magnetic properties, and makes it possible to recycle rare-earth magnets. The invention claimed is: 1. An R-T-B-C based rare-earth alloy magnetic material (where R is at least one of the rare-earth elements including Y, T is a transition metal including iron as its main ingredient, B is boron, and C is carbon, an amount of R being 25 wt % to 35 wt % of the overall magnetic material, a total amount of B and C being 0.9 wt % to 1.1 wt % of the magnetic material, the balance of the magnetic material being T) ***[composition of matter]*** comprising: a first compound phase with an R.sub.2Fe.sub.14B type crystal structure, and a second compound phase having a diffraction peak at a site with an interplanar spacing d of 0.295 nm to 0.300 nm, wherein the first compound phase is a main phase and an intensity ratio of the diffraction peak of the second compound phase to that of the first compound phase representing a (410) plane (and having an interplanar spacing of 0.214 nm) is at least 10%. 10. A method of making an R-T-B-C based rare-earth alloy magnetic material ***[process/method]*** , the method comprising the steps of: preparing a rapidly solidified alloy by rapidly quenching a melt of an R-T-B-C based rare-earth alloy (where R is at least one of the rare-earth elements including Y, T is a transition metal including iron as its main ingredient, B is boron, and C is carbon, an amount of R being 25 wt % to 35 wt % of the overall magnetic material, a total amount of B and C being 0.9 wt % to 1.1 wt % of the magnetic material, the balance of the magnetic material being T); and thermally treating and crystallizing the rapidly solidified alloy, wherein the step of thermally treating results in producing a first compound phase with an R.sub.2Fe.sub.14B type crystal structure and a second compound phase having a diffraction peak at a site with an interplanar spacing d of 0.295 nm to 0.300 nm, and wherein the first compound phase is a main phase and an intensity

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			ratio of the diffraction peak of the second compound phase to that of the first compound phase representing a (410) plane is at least 10%.
Filed: March 11, 2004 Issued: January 1, 2008 Expires: March 2024	7314531	Assignee: TDK Corporation (Tokyo, JAPAN)	R-T-B system rare earth permanent magnet Abstract A sintered body comprising a main phase consisting of an R.sub.2T.sub.14B phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y), and T represents one or more transition metal elements essentially containing Fe, or Fe and Co), and a grain boundary phase containing a higher amount of R than the main phase, wherein a platy or acicular product exists. This sintered body enables to inhibit the grain growth, while keeping a decrease in magnetic properties to a minimum, and to improve a suitable sintering temperature range. What is claimed is: 1. An R-T-B system rare earth permanent magnet ***[composition of matter]*** , comprising a sintered body comprising: a main phase consisting of an R.sub.2T.sub.14B phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y), and T represents one or more transition metal elements essentially containing Fe, or Fe and Co); and a grain boundary phase containing a higher total amount of R than said main phase, wherein a platy or acicular product exists, and wherein said sintered body has a composition consisting essentially of 28% to 33% by weight of R, 0.5% to 1.5% by weight of B, 0.03% to 0.3% by weight of Al, 0.3 or less by weight (excluding 0) of Cu, 0.05% to 0.2% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe.
Filed: September	7311788	Assignee:	R-T-B system rare earth permanent magnet

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29, 2003 Issued: December 25, 2007 Expires: Sept 2023		TDK Corporation (Tokyo, JAPAN)	Abstract A sintered body with a composition consisting of 25% to 35% by weight of R (wherein R represents one or more rare earth elements, provided that the rare earth elements include Y), 0.5% to 4.5% by weight of B, 0.02% to 0.6% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe. This sintered body has a coefficient of variation (CV value) showing the dispersion degree of Zr of 130 or less. In addition, this sintered body has a grain boundary phase comprising a region that is rich both in at least one element selected from a group consisting of Cu, Co and R, and in Zr. This sintered body enables to inhibit the grain growth, while keeping the decrease of magnetic properties to a minimum, and to improve the suitable sintering temperature range. What is claimed is: 1. An R-T-B system rare earth permanent magnet, comprising a main phase ***[composition of matter]*** consisting of an R.sub.2T.sub.14B.sub.1 phase (wherein R represents one or more rare earth elements (provided that the rare earth elements include Y), and T represents at least one transition metal element containing, as a main constituent, Fe, or Fe and Co), and a grain boundary phase containing a higher total amount of R than said main phase, said R-T-B system rare earth permanent magnet being a sintered body having a composition consisting essentially of 28% to 33% by weight of R, 0.5% to 1.5% by weight of B, 0.03% to 0.3% by weight of Al, 0.3% or less (excluding 0) by weight of Cu, 0.05% to 0.2% by weight of Zr, 4% or less by weight (excluding 0) of Co 0.2% or less by weight of oxygen, and the balance substantially being Fe, said sintered body containing a region that is rich both Cu and Zr. 2. An R-T-B system rare earth permanent magnet according to claim 1, wherein said rich region exists in said grain boundary phase.

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Filed: Dec 24, 2003 Issued: November 20, 2007 Expires: Dec 2023	7,297,213	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Permanent magnet including multiple ferromagnetic phases and method for producing the magnet Abstract An iron-based rare earth alloy magnet has a composition represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yM.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one rare earth element substantially excluding La and Ce; and M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti. In this formula, the mole fractions x, y, z and m meet the inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; and 0.ltoreq.m.ltoreq.0.5, respectively. What is claimed is: 1. A method for producing ***[process/method]*** an iron-based rare earth alloy nanocomposite magnet including a hard magnetic phase and a soft magnetic phase, comprising the steps of: preparing a melt of a material alloy, the material alloy having a composition represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yM.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one rare earth element substantially excluding La and Ce; and M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti, the mole fractions x, y, z and m meeting the inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; and 0.ltoreq.m.ltoreq.0.5, respectively; rapidly cooling the melt to make a rapidly solidified alloy comprising an R.sub.2Fe.sub.14B crystalline phase by: bringing the melt into contact with the surface of a rotating chill roller to

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			obtain a supercooled liquid alloy; and dissipating heat from the supercooled alloy into the ambient gas to grow the R.sub.2Fe.sub.14B phase after the supercooled alloy has left the chill roller; and thermally treating the rapidly solidified alloy to form a structure in which two or more ferromagnetic crystalline phases, including the hard and the soft magnetic phases, exist, an average grain size of the hard magnetic phase is equal to or greater than 10 nm and equal to or less than 200 nm, and an average grain size of the soft magnetic phase is equal to or greater than 1 nm and equal to or less than 100 nm ….
Filed: July 30, 2001 Issued: October 23, 2007 Expires: July 2021	7,285,338	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals*.	Anisotropic thin-film rare-earth permanent magnet Abstract An anisotropic thin-film rare-earth permanent magnet endowed with high magnetic characteristics by rendering a vapor-phase-grown thin film anisotropic in the layering direction. The atomic laminate units are formed by laminating a monoatomic layer of a rare earth element on a substrate of a non-magnetic material having, a flat smoothness and then by laminating an atomic laminate of a transition metal element having a plurality of monoatomic layers of a transition metal element, so that the atomic laminate units of a characteristic construction are laminated in a plurality of layers. As a result, each atomic laminate of the transition metal element has an easy magnetizable axis in the laminate direction of the monoatomic layers and which are sandwiched between a monoatomic layer of a rare-earth element so that an inverse magnetic domain is suppressed to establish a strong coercive force. Moreover, the content of the transition metal element to the rare-earth metal is raised to improve the residual magnetic flux density drastically. The invention claimed is: 1. An anisotropic thin-film rare-earth permanent magnet, comprising ***[composition of matter]*** at least one atomic layered unit that includes: a

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			plurality of monoatomic layers of a transition metal element directly disposed on each other and directly layered on a monoatomic layer of a rare-earth element which is directly layered on a substrate comprising a nonmagnetic material with a surface roughness of 1.0 .mu.m or less; and one or more monoatomic layers of the rare-earth element directly layered on an uppermost monoatomic layer of the plurality of monoatomic layers of the transition metal element, wherein the at least one atomic layered unit has an axis of easy magnetization in the layering direction, and the anisotropic thin-film rare-earth permanent magnet has a coercive force of 0.55 MA/m or higher and a residual magnetic flux density of 1.02 T or higher. … 3. The anisotropic thin-film rare-earth permanent magnet according to claim 1, wherein the rare-earth element is at least one element selected from Nd, Tb, and Dy; and the transition metal element is at least one element selected from Ti, V, Cr, Mn, Fe, Co, Ni, and Cu.
Filed: August 22, 2005 Issued: October 9, 2007 Expires: Aug 2025	7,279,053	Assignee: Nissan Motor Co., Ltd. (Yokohama, JAPAN); Horoshi Yamamoto (Tokyo, JAPAN)	Alloy thin ribbon for rare earth magnet, production method of the same, and alloy for rare earth magnet Abstract The present invention provides a rare earth magnet superior in magnetic properties and thermal stability. In an aspect of the present invention, a production method of an alloy thin ribbon for a rare earth magnet includes a step to obtain a quenched thin ribbon by feeding a molten alloy containing praseodymium (Pr), iron (Fe), cobalt (Co), titanium (Ti), boron (B), and silicon (Si) on a rotating roll and a step to apply heat treatment to the quenched thin ribbon at a heating rate within a range of 100.degree. to 150.degree. C./min to crystallize the quenched thin ribbon. The invention claimed is:

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			1. A production method of an alloy thin ribbon for a rare earth magnet ***[process/method]*** comprising: obtaining a quenched thin ribbon by feeding a molten alloy having a composition consisting essentially of Pr.sub.xFe.sub.90-x-zCo.sub.yTi.sub.1.5B.sub.zSi.sub.0.5 (x=10.0 to 13.0, y=8.0 to 12.0, and z=7.0 to 14.0) on a rotating roll; and applying heat treatment to said quenched thin ribbon at a heating rate within a range of 100.degree. to 150.degree. C./min to crystallize said quenched thin ribbon. 2. A production method according to claim 1, wherein a roll circumferential speed of said roll is 7.5 to 15 m/sec. 3. A production method according to claim 1, wherein a heat treatment temperature of said heat treatment is 550.degree. to 625.degree. C. 4. A production method according to claim 1, wherein a heat treatment time of said heat treatment is 3 to 7 minutes.
Filed: July 9, 2003 Issued: September 18, 2007 Expires: July 2023	7,270,714	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Surface treating apparatus Abstract A surface treating process according to the present invention, a vapor deposited film is formed from an easily oxidizable vapor-depositing material on the surface of a work by evaporating the vapor-depositing material in a state in which the vapor deposition controlling gas has been supplied to at least zones near a melting/evaporating source and the work within a treating chamber. Thus, the vapor deposited film can be formed stably on the surface of a desired work without requirement of a long time for providing a high degree of vacuum and without use of a special apparatus. In addition, the use of the surface treating process ensures that a corrosion resistance can be provided to a rare earth metal-based permanent magnet extremely liable to be oxidized, without degradation of a high magnetic characteristic of the magnet. A surface

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			treating apparatus according to the present invention includes a melting/evaporating source for melting and evaporating a wire-shaped vapor-depositing material containing a vapor deposition controlling gas, and a member for retaining a work on which the vapor-depositing material is deposited. The melting/evaporating source and the work retaining member are disposed in a treating chamber of the surface treating chamber. The apparatus further includes a vapor-depositing material supply means for supplying the wire-shaped vapor-depositing material containing the vapor deposition controlling gas to the melting-evaporating source. What is claimed is: 1. **A surface treating apparatus** comprising: a treating chamber connected to an evacuating system; a melting/evaporating source for melting and evaporating a wire-shaped vapor-depositing material containing a vapor deposition controlling gas, disposed in the treating chamber; a rotatable cage-shaped, work retaining member, disposed in the treating chamber, and spaced above the melting/evaporating source, for retaining a work on which the vapor depositing material is deposited; a supply of wire-shaped vapor-depositing material containing a predetermined amount of the vapor deposition controlling gas wound about a feed reel; a thermal resistant protective tube disposed between the feed reel and the melting/evaporating source; and the feed reel being mounted so as to rotate about a substantially vertical rotational axis, and disposed in the treating chamber below the melting/evaporating source; such that, as the wire-shaped vapor-depositing material containing the vapor deposition controlling gas is supplied from the feed reel to the melting/evaporating source, the wire-shaped vapor-depositing material containing the vapor deposition controlling gas has a horizontally disposed lower portion, a vertically disposed intermediate portion and a horizontally disposed upper portion, and the wire-shaped vapor-depositing material containing the vapor deposition controlling gas is protected by the thermal

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			resistant protective tube between the feed reel and the melting/evaporating source.
Filed: No v 19, 2002 Issued: August 28, 2007 Expires: Nov 2022	7,261,781	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Nanocomposite magnet Abstract A nanocomposite magnet has a composition represented by (Fe.sub.1-mT.sub.m).sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n, where T is at least one of Co and Ni, Q is at least one of B and C, R is at least one rare earth element that always includes at least one of Nd and Pr and optionally includes Dy and/or Tb, and M is at least one element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb. The mole fractions x, y, z, m and n satisfy 10 at %<x.ltoreq.20 at %, 6 at %.ltoreq.y<10 at %, 0.5 at %.ltoreq.z.ltoreq.12 at %, 0.ltoreq.m.ltoreq.0.5 and 0 at %.ltoreq.n.ltoreq.10 at %, respectively. The nanocomposite magnet has an oxygen content of at most about 1,500 ppm by mass. The invention claimed is: 1. A nanocomposite magnet having a composition ***[composition of matter]*** represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-z-nQ.sub.xR.sub.yTi.sub.zM.sub.n- , where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one rare earth element that always includes at least one of Nd and Pr and optionally includes Dy and/or Tb, wherein R includes La only in an amount due to inevitable impurities; and M is at least one element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, the mole fractions x, y, z, m and n satisfying the inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.5 at %.ltoreq.z.ltoreq.12 at %; 0.ltoreq.m.ltoreq.0.5; and 0 at %.ltoreq.n.ltoreq.10 at %, respectively, wherein the nanocomposite

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			magnet: has an oxygen content of about 20 ppm to about 1,500 ppm by mass; has a nitrogen content of about 10 ppm to about 400 ppm by mass; comprises at least two ferromagnetic crystalline phases including a hard magnetic phase including an R.sub.2Fe.sub.14B phase and a soft magnetic phase, wherein the volume percentage of the hard magnetic phase is 60 vol. % or more, and the soft magnetic phase is distributed on the grain boundaries of the hard magnetic phase; and exhibits hard magnetic properties including a remanence B.sub.r of at least about 0.7 T and a coercivity H.sub.cJ of at least about 480 kA/m.
Filed: June 19, 2002 Issued: August 21, 2007 Expires: June 2022	7,258,751	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare earth magnet and method for production thereof Abstract In a rare earth magnet, an added heavy rare earth element R.sub.H such as Dy is effectively used without any waste, so as to effectively improve the coercive force. First, a molten alloy of a material alloy for an R-T-Q rare earth magnet (R is a rare earth element, T is a transition metal element, and Q is at least one element selected from the group consisting of B, C, N, Al, Si, and P), the rare earth element R containing at least one kind of element R.sub.L selected from the group consisting of Nd and Pr and at least one kind of element R.sub.H selected from the group consisting of Dy Tb, and Ho is prepared. The molten alloy is quenched, so as to produce a solidified alloy. Thereafter, a thermal treatment in which the rapidly solidified alloy is held in a temperature range of 400.degree. C. or higher and lower than 800.degree. C. for a period of not shorter than 5 minutes nor longer than 12 hours is performed. By the thermal treatment, the element R.sub.H can be moved from the grain boundary phase to the main phase, so that the coercive force is increased. The invention claimed is: 1. A production method of a material alloy ***[process/method]*** for an R-T-Q rare earth sintered magnet comprising: a step of preparing a molten alloy of an

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			R-T-Q rare earth alloy (R is a rare earth element, T is a transition metal element, and Q is at least one element selected from the group consisting of B, C, N, Al, Si, and P), the rare earth element R containing at least one kind of element R.sub.L selected from the group consisting of Nd and Pr, and at least one kind of element R.sub.H selected from the group consisting of Dy, Tb, and Ho; a cooling step of rapidly solidifying the molten alloy, thereby producing a rapidly solidified alloy comprising an R.sub.2T.sub.14Q crystal phase; and a thermal treatment step of holding the rapidly solidified alloy in a temperature range of 400.degree. C. or higher and lower than 800.degree. C. for a period of not shorter than 5 minutes nor longer than 12 hours. … 9. A production method of a sintered magnet ***[process/method]*** comprising the steps of: preparing a molten alloy of an R-T-Q rare earth alloy (R is a rare earth element, T is a transition metal element, and Q is at least one element selected from the group consisting of B, C, N, Al, Si, and P), the rare earth element R containing at least one kind of element R.sub.L selected from the group consisting of Nd and Pr, and at least one kind of element R.sub.H selected from the group consisting of Dy, Tb, and Ho; a cooling step of rapidly solidifying the molten alloy, thereby producing a rapidly solidified alloy comprising an R.sub.2T.sub.14Q crystal phase; a thermal treatment step of holding the rapidly solidified alloy in a temperature range of 400.degree. C. or higher and lower than 800.degree. C. for a period of not shorter than 5 minutes nor longer than 12 hours to form a material alloy; embrittling the material alloy by a hydrogen decrepitation method; and pulverizing the embrittled material alloy to form a material alloy powder for the R-T-Q rare earth magnet; producing a compaction of the material alloy powder; and sintering the compaction
Filed: March 11, 2004	7,255,752	Assignee: TDK Corporation	Method for manufacturing R-T-B system rare earth permanent magnet Abstract

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Issued: August 14, 2007 Expires: March 2024		(Tokyo, JAPAN)	A method for manufacturing an R-T-B system rare earth permanent magnet that is a sintered body comprising a main phase consisting of an R.sub.2T.sub.14B phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y), and T represents one or more transition metal elements essentially containing Fe, or Fe and Co), and a grain boundary phase containing a higher amount of R than the above main phase, wherein a product that is rich in Zr exists in the above R.sub.2T.sub.14B phase, the above manufacturing method comprising the steps of: preparing an R-T-B alloy containing as a main component the R.sub.2T.sub.14B phase and also containing Zr, and an R-T alloy containing R and T as main components, wherein the amount of R is higher than that of the above R-T-B alloy; obtaining a mixture of the R-T-B alloy powder and the R-T alloy powder; preparing a compacted body with a certain form from the above mixture; and sintering the above compacted body, wherein, in the above sintering step, the above product is generated in the above R.sub.2T.sub.14B phase. What is claimed is: 1. A method for manufacturing an R-T-B system rare earth permanent magnet ***[process/method]*** comprising a sintered body having 0.03% to 0.25% by weight of Zr, wherein said sintered body comprises a main phase consisting of an R.sub.2T.sub.14B phase (wherein R represents one or more rare earth elements, providing that the rare earth elements include Y), and T represents one or more transition metal elements essentially containing Fe, or Fe and Co, and a grain boundary phase containing a higher amount of R than said main phase, wherein a product that is rich in Zr exists in said R.sub.2T.sub.14B phase, said manufacturing method comprising the steps of: preparing an R-T-B alloy containing as a main component said R.sub.2T.sub.14B phase and also containing the whole amount of Zr, and an R-T alloy containing R and T as main components, wherein the amount of R is higher than that of said R-T-B alloy; obtaining a mixture of a powder of said R-T-B alloy and a powder of

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			said R-T alloy; preparing a compacted body with a certain form from said mixture; and sintering said compacted body, wherein, in said sintering step, said product is generated in said R.sub.2T.sub.14B phase; and wherein said R-T-B alloy is prepared by the strip casting method under the condition that the peripheral velocity of a chill roll is 1.0 to 1.8 m/s
Filed: September 29, 2003 Issued: August 14, 2007 Expires: Sept 2023	7,255,751	Assignee: TDK Corporation (Tokyo, JAPAN)	Method for manufacturing R-T-B system rare earth permanent magnet Abstract When an R-T-B system rare earth permanent magnet is obtained by a mixing method to obtain a sintered body with a composition consisting essentially of 25% to 35% by weight of R (wherein R represents one or more rare earth elements, providing that the rare earth elements include Y), 0.5% to 4.5% by weight of B, 0.02% to 0.6% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe, wherein a coefficient of variation (CV) showing the dispersion of Zr is 130 or lower, Zr is contained in a low R alloy. This sintered body enables to inhibit the grain growth, while keeping the decrease of magnetic properties to a minimum, and to improve the suitable sintering temperature range. What is claimed is: 1. A method for manufacturing ***[process/method]*** an R-T-B system rare earth permanent magnet comprising a sintered body with a composition consisting essentially of 25% to 35% by weight of R (wherein R represents one or more rare earth elements, providing that the rare earth elements include Y), 0.5% to 4.5% by weight of B, 0.02% to 0.6% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe, said manufacturing method comprising the steps of: manufacturing a compacted body containing a low R alloy containing

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			a R.sub.2T.sub.14B compound as a main constituent and Zr, and a high R alloy containing, as main constituents, R and T (wherein T represents at least one transition metal element essentially containing Fe, or Fe and Co), wherein said high R alloy contains a higher amount of R than said low R alloy; and sintering the compacted body.
Filed: March 28, 2005 Issued: July 31, 2007 Expires: March 2025	7,250,840	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Layered product Abstract A layered product prepared by applying a surface treatment to an adherend having a surface with a low binding property with an anaerobic adhesive, which does not require a complex work, primer application, effected by accelerating an adhesive curing rate, and does not change surface conditions of the adherend. The layered product comprises an adherend, an uneven deposition comprising Cu, V, a Cu alloy or a V alloy and having a height of 500 nm or less on the surface of the adherend, and an adhesive layer formed at least on the uneven deposition. What is claimed is: 1. A layered product, which comprises ***[composition of matter]*** : an adherend; a Ni layer disposed on the surface of the adherend; an uneven deposition comprising Cu, V, a Cu alloy or a V alloy and having a height of from 10 to 200 nm on the surface of the Ni layer; and an anaerobic adhesive layer formed at least on the uneven deposition. … 4. The layered product according to claim 1 or 2, wherein the adherend is an R--Fe--B type permanent magnet.
Filed: January 22, 2002	7,244,318	Assignee: Neomax Co., Ltd.	Method for preparation of permanent magnet Abstract

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Issued: July 17, 2007 Expires: Jan 2022		(Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	A blended powder including a first powder containing an R.sub.2T.sub.14B phase as a main phase, and a second powder containing an R.sub.2T.sub.17 phase at 25 wt % or more of the whole is prepared. Herein, R is at least one element selected from the group consisting of all rare-earth elements and Y (yttrium), T is at least one element selected from the group consisting of all transition elements, and Q is at least one element selected from the group consisting of B (boron) and C (carbon). The blended powder is sintered, so as to manufacture a permanent magnet having a structure in which a rare-earth element included in the second powder is concentrated in a grain surface region of a main phase. The invention claimed is: 1. A method of producing a sintered permanent magnet ***[process/method]*** comprising the steps of: preparing a blended powder including a first powder and a second powder, the first powder containing an R.sub.2T.sub.14Q phase (R is at least one element selected from the group consisting of all rare-earth elements and Y (yttrium) excluding Dy and Tb, T is at least one element selected from the group consisting of all transition elements, and Q is at least one element selected from the group consisting of B (boron) and C (carbon)) as a main phase, the second powder containing an R1.sub.2T.sub.17 phase (R1 is at least one element selected from the group consisting of Dy and Tb) at 25wt % or more of the second powder; compacting the blended powder; and sintering the compacted powder to concentrate Dy and/or Tb in a surface portion of the R.sub.2T.sub.14Q phase, wherein the first powder is a powder of alloy represented by a composition formula of R.sub.xT.sub.100-x-yQ.sub.y, and x and y for defining molar fractions satisfy the following relationships, respectively: 12.5.ltoreq.x.ltoreq.18(at %); and 5.5.ltoreq.y.ltoreq.20 (at %), and the second powder is a powder of alloy represented by a composition formula of R1.sub.pCu.sub.rT.sub.100-p-r, and p and r for defining molar fractions satisfy the following relationships respectively:

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			10.ltoreq.p.ltoreq.20(at %); and 0.1.ltoreq.r.ltoreq.10(at %), and wherein the step of preparing the blended powder includes a step of performing a hydrogen embrittlement process to the alloy for the second powder, thereby obtaining an average particle diameter of the second powder of 100 .mu.m or less.
Filed: July 29, 2002 Issued: June 19, 2007 Expires: July 2022	7,232,495	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Method of magnetizing rare-earth magnet and rare-earth magnet Abstract The method of the present invention includes a step of preparing a rare earth magnet 22 disposed for forming a cylinder 22a, a first magnetizing step of applying a first external magnetic field H1 to the rare earth magnet 22, thereby forming a first region R1 magnetized from an inner side to an outer side of the cylinder 22a and a second region R2 magnetized from the outer side to the inner side, and a second magnetizing step of applying a second external magnetic field H2 so that an external magnetic field component forming an angle of more than 0.degree. and less than 50.degree. with a direction of the external magnetic field component applied in the first magnetizing step to a boundary between the first region R1 and the second region R2. The invention claimed is: 1. A magnetizing method ***[process/method]*** for a rare earth magnet comprising: preparing a rare earth magnet having a cylindrical shape; a first magnetizing step of applying a first external magnetic field to the rare earth magnet, thereby forming a first region magnetized from an inner side to an outer side of the cylinder and a second region magnetized from the outer side to the inner side; and a second magnetizing step of applying a second external magnetic field in such a manner that an external magnetic field component in a direction for forming an angle of more than 0.degree. and less than 50.degree. with respect to an external magnetic field component applied in the first magnetizing step is applied to a boundary between the first region and the second region

Filed: Aug 18, 2003 Issued: May 15, 2007 Expires: Aug 2023	7,217,328	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Compound for rare-earth bonded magnet and bonded magnet using the compound Abstract A compound for a rare-earth bonded magnet includes a rare-earth alloy powder and a binder. The rare-earth alloy powder includes at least about 2 mass % of Ti-containing nanocomposite magnet powder particles with a composition represented by (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yM.sub.z, where T is Co and/or Ni; Q is B with or without C; R is at least one rare-earth element substantially excluding La and Ce; M is at least one metal element selected from Ti, Zr and Hf and always includes Ti; and 10<x.ltoreq.20 at %; 6.ltoreq.y<10 at %; 0.1.ltoreq.z.ltoreq.12 at %; and 0.ltoreq.m.ltoreq.0.5. The particles include at least two ferromagnetic crystalline phases, in which hard magnetic phases have an average crystal grain size of about 10 nm to about 200 nm, soft magnetic phases have an average crystal grain size of about 1 nm to about 100 nm; and the average crystal grain size of the soft magnetic phases is smaller than that of the hard magnetic phases. What is claimed is: 1. A compound for a rare-earth bonded magnet, the compound comprising ***[composition of matter]*** a rare-earth alloy powder and a binder, wherein the rare-earth alloy powder includes at least about 2 mass % of Ti-containing nanocomposite magnet powder particles, and the Ti-containing nanocomposite magnet powder particles have a composition represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yM.sub.z where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C and always includes B; R is at least one rare-earth element substantially excluding La and Ce; M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti; and the mole fractions x, y, z and m satisfy the

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			inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; and 0.ltoreq.m.ltoreq.0.5, respectively, the Ti-containing nanocomposite magnet powder particles include at least two ferromagnetic crystalline phases, in which hard magnetic phases have an average crystal grain size of about 10 nm to about 200 nm, soft magnetic phases have an average crystal grain size of about 1 nm to about 100 nm, and the average crystal grain size of the soft magnetic phases is smaller than the average crystal grain size of the hard magnetic phases, the Ti-containing nanocomposite magnetic powder particles include an R.sub.2Fe.sub.14B compound phase at 60 volume % or more, and the soft magnetic phase of the Ti-containing nanocomposite magnetic powder particles includes an iron-based boride phase.
Filed: June 10, 2004 Issued: May 1, 2007 Expires: June 2024	7,211,157	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Rare-earth alloy, rare-earth sintered magnet, and methods of manufacturing Abstract A rare-earth alloy ingot is produced by melting an alloy composed of 20 30 wt % of a rare-earth constituent which is Sm alone or at least 50 wt % Sm in combination with at least one other rare-earth element, 10 45 wt % of Fe, 1 10 wt % of Cu and 0.5 5 wt % of Zr, with the balance being Co, and quenching the molten alloy in a strip casting process. The strip-cast alloy ingot has a content of 1 200 .mu.m size equiaxed crystal grains of at least 20 vol % and a thickness of 0.05 3 mm. Rare-earth sintered magnets made from such alloys exhibit excellent magnetic properties and can be manufactured under a broad optimal temperature range during sintering and solution treatment. The invention claimed is: 1. A method of manufacturing a rare-earth sintered magnet, comprising ***[process/method]*** the steps of: melting an alloy consisting essentially of 20 to 30 wt % of a rare-earth constituent R which is samarium alone or is at least 50 wt % samarium in combination with at least one other rare-earth element, 10 to

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			45 wt % of iron, 1 to 10 wt % of copper and 0.5 to 5 wt % of zirconium, with the balance being cobalt; quenching the molten alloy in a strip casting process so as to form a rare-earth alloy ingot which has a content of 1 to 200 .mu.m size equiaxed crystal grains of at least 20 vol % and a thickness of 0.05 to 3 mm; heat-treating the ingot in a non-oxidizing atmosphere at 1000 to 1300.degree. C. for 0.5 to 20 hours to form a rare-earth magnet alloy; milling the rare-earth magnet alloy; compression-molding the milled alloy in a magnetic field to form a compact; sintering the compact; subjecting the sintered compact to solution treatment; and carrying out aging treatment on the solution-treated compact.
Filed: January 10, 2005 Issued: April 24, 2007 Expires: Jan 2025	7,208,856	Assignee: Mitsubishi (Tokyo, JAPAN)	Electric rotating machine Abstract Claw-shaped magnetic poles are alternately disposed along the rotation plane of a rotor of an electric rotating machine, and a permanent magnet is disposed between the claw-shaped magnetic poles. Surface of the permanent magnet is coated with a coating layer. The coating layer is composed of a anticorrosive material performing sacrificial anticorrosion (metal flake in a coating film rusts prior to a matrix resulting in protection of the matrix) such as inorganic material containing zinc and a film of the anticorrosive material is formed by spraying. Ionization tendency of zinc is larger than that of iron composing the permanent magnet, and the permanent magnet is difficult to be rusted owing to the sacrificial anticorrosion. Consequently, anticorrosion of the permanent magnet disposed between the claw-shaped magnetic poles is improved. What is claimed is: 1. An electric rotating machine comprising ***[composition of matter]*** : a rotor provided with a rotor coil for generating magnetic flux; a pole core comprised of a first pole core and a second pole core respectively provided covering said

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			rotor coil and each having claw-shaped magnetic poles protruding in an alternate engagement with each other; and a permanent magnet disposed on two sides of said claw-shaped magnetic poles, and reducing leakage of magnetic flux between sides of said claw-shaped magnetic poles adjacent to each other; and a stator disposed oppositely to said rotor via a space; wherein said permanent magnet is coated with an anticorrosive material performing a sacrificial anticorrosion function and having a varnish layer coated over said anticorrosive material.
Filed: May 8, 2002 Issued: April 24, 2007 Expires: May 2022	7,208,097	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Iron-based rare earth alloy nanocomposite magnet and method for producing the same Abstract An iron-based rare earth alloy nanocomposite magnet has a composition represented by (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yTi.sub.z, where T is Co and/or Ni, Q is B and/or C and R is rare earth element(s) including substantially no La or Ce. x, y, z and m satisfy 10 at %<x.ltoreq.17 at %, 7 at %.ltoreq.y<10 at %, 0.5 at %.ltoreq.z.ltoreq.6 at % and 0.ltoreq.m.ltoreq.0.5, respectively. The magnet includes crystal grains of an R.sub.2T.sub.14Q type compound having an average grain size of 20 nm to 200 nm and a ferromagnetic iron-based boride that exists in a grain boundary between the crystal grains of the R.sub.2T.sub.14Q type compound. The boride is dispersed in, or present in the form of a film over, the grain boundary to cover at least partially the surface of the crystal grains of the R.sub.2T.sub.14Q type compound. The invention claimed is: 1. An iron-based rare earth alloy nanocomposite magnet having a composition ***[composition of matter]*** represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yTi.sub.z, where T is at least one

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			element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; and R is at least one rare earth element including no La or Ce, the mole fractions x, y, z and m satisfying the inequalities of: 10 at %<x.ltoreq.17 at %; 7 at %.ltoreq.y<10 at %; 0.5 at %.ltoreq.z.ltoreq.6 at %; and 0.ltoreq.m.ltoreq.0.5, respectively; wherein crystal grains of an R.sub.2T.sub.14Q type compound have an average grain size of about 20 nm to about 200 nm; crystal grains of a ferromagnetic iron-based boride have an average crystal grain size smaller than the crystal grain size of the crystal grains of the R.sub.2T.sub.14Q type compound; and the ferromagnetic iron-based boride is a soft magnetic phase and is dispersed in the grain boundary or present in the form of a film over the grain boundary to cover at least partially the surfaces of the crystal grains of the R.sub.2T.sub.14Q type compound.
Filed: January 31, 2005 Issued: April 24, 2007 Expires: Jan 2025	7,208,056	Assignee: TDK Corporation (Tokyo, JAPAN)	Rare earth sintered magnet, and method for improving mechanical strength and corrosion resistance thereof Abstract An R-T-B system rare earth sintered magnet having a high mechanical strength and excellent corrosion resistance is provided. The R-T-B system rare earth sintered magnet of the present invention comprises a sintered body comprising a main phase consisting of an R.sub.2T.sub.14B phase where R represents one or more rare earth elements and T represents one or more transition metal elements essentially containing Fe, or Fe and Co, and a grain boundary phase containing a higher amount of R than the above described main phase, wherein the surface of the above described sintered body is partially covered with a carbon compound layer. In the R-T-B system rare earth sintered magnet of the present invention, the area ratio of the partial surface of the above described sintered body covered with the above described carbon compound layer to the entire surface thereof is preferably between 10% and 90%.

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			What is claimed is: 1. A rare earth sintered magnet comprising ***[composition of matter]*** a sintered body, in which said sintered body comprises: a main phase consisting of an R.sub.2T.sub.14B phase where R represents one or more rare earth elements and T represents one or more transition metal elements essentially containing Fe, or Fe and Co; and a grain boundary phase containing a higher amount of R than said main phase, wherein the surface of said sintered body is partially covered with a carbon compound layer comprising RC.sub.0.4 and the area ratio of the partial surface of said sintered body covered with said carbon compound layer to the entire surface thereof is between 10% and 90%. 8. A method ***[process/method]*** for improving the mechanical strength and corrosion resistance of a rare earth sintered magnet, in which the rare earth sintered magnet comprises a sintered body comprising: a main phase consisting of an R.sub.2T.sub.14B phase where R represents one or more rare earth elements and T represents one or more transition metal elements essentially containing Fe, or Fe and Co; and a grain boundary phase containing a higher amount of R than said main phase, wherein said method comprises: preparing a compacted body by compacting allay powders with a predetermined composition in a magnetic field; and sintering said compacted body into a sintered body in a state where a carbon-containing compound is placed in a sintering atmosphere for sintering the compacted body.
Filed: March 29, 2002 Issued: April 10,	7,201,810	Assignee: Neomax Co., Ltd. (Osaka-shi, JAPAN) *Originally Sumitomo*	Rare earth alloy sintered compact and method of making the same Abstract A rare earth alloy sintered compact includes a main phase represented by (LR.sub.1-xHR.sub.x).sub.2T.sub.14A, where including respective main phases having different HR mole fractions, mixing the alloy materials so that the sintered compact will include sintering a main phase having an average

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2007 Expires: March 2022		*Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	composition represented by (LR.sub.1-xHR.sub.x).sub.2T.sub.14A, thereby obtaining a mixed powder, and the mixed powder. The alloy materials include first and second rare earth alloy materials represented by (LR.sub.1-uHR.sub.u).sub.2T.sub.14A (where 0.ltoreq..mu.<x) and (LR.sub.1-vHR.sub.V).sub.2T.sub.14A (where x<v.ltoreq.1) and including a rare earth element R(=LR+HR) at R1 and R2 (at%), respectively. .DELTA.=|R1-R2| is about 20% or less of (R1+R2)/2.T is Fe with or without non-Fe transition metal element(s); A is boron with or without carbon; LR is a light rare earth element; HR is a heavy rare earth element; and 0<x<1. The sintered compact is produced by preparing multiple types of rare earth alloy materials. The invention claimed is: 1. A rare earth alloy sintered compact ***[composition of matter]*** comprising a main phase that has an average composition represented by the general formula: (LR.sub.1-xHR.sub.x).sub.2T.sub.14A, where T is either Fe alone or a mixture of Fe and at least one transition metal element other than Fe; A is either boron alone or a mixture of boron and carbon; LR is at least one light rare earth element; HR is at least one heavy rare earth element; and 0<x<1; wherein the rare earth alloy sintered compact includes crystal grains, each including at least one main phase of a first type and a plurality of main phases of a second type, or each including a plurality of main phases of a first type and at least one main phase of a second type, each of the main phases of the first type having a composition represented by (LR.sub.1-pHR.sub.p).sub.2T.sub.14A (where 0.ltoreq.p<x), each of the main phases of the second type having a composition represented by (LR.sub.1-qHR.sub.q).sub.2T.sub.14A (where x<q.ltoreq.1).
Filed: March 24, 2004	7199690	Assignee: TDK Corporation	R-T-B system rare earth permanent magnet Abstract An R-T-B system rare earth permanent is provided, which comprises a sintered

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Issued: April 3, 2007 Expires: March 2024		(Tokyo, JAPAN)	body comprising: an R.sub.2T.sub.14B phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y) and T represents one or more transition metal elements essentially containing Fe, or Fe and Co) as a main phase; and a grain boundary phase containing a higher amount of R than the above main phase, wherein, when Pc (permeance coefficient) is 2, if a total flux is defined as f1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field=an applied magnetic field-a demagnetizing field, and each value of them is absolute value), if a total flux is defined as f2 under the application of an effective magnetic field of 800 kA/m, and if a total flux is defined as f3 under the application of an effective magnetic field of 2,000 kA/m, a magnetization rate a (=f1/f3.times.100) is 40% or more, and a magnetization rate b (=f2/f3.times.100) is 90% or more. What is claimed is: 1. An R-T-B system rare earth permanent magnet, which comprises ***[composition of matter]*** a sintered body comprising: an R.sub.2T.sub.14B phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y) and T represents one or more transition metal elements essentially containing Fe, or Fe and Co) as a main phase; and a grain boundary phase containing a higher amount of R than said main phase, wherein, when Pc (permeance coefficient) is 2, if a total flux is defined as f1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field=an applied magnetic field-a demagnetizing field, and each value of them is absolute value), if a total flux is defined as f2 under the application of an effective magnetic field, of 800 kA/m, and if a total flux is defined as f3 under the application of an effective magnetic field of 2000 kA/m, a magnetization rate a (=f1/f3.times.100) is 40% or more, and a magnetization rate b (=f2/f3.times.100) is 90% or more.
Filed: Feb	7,195,661	Assignee:	Magnetic material

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24, 2003 Issued: March 27, 2007 Expires; Feb 2023		Pioneer Metals and Technology, Inc. (Boston, MA, USA)	Abstract Magnetic materials having a coercivity not less than about 1000 Oersted are prepared in a single step procedure. A molten mixture of a desired composition having a relatively high boron content is cooled at a rate slower than about 10.sup.5 degrees Celsius per second. Preferably, the molten mixture is cooled by depositing it on a chilled surface such that it forms a layer between about 120 and about 300, and preferably between about 120 and about 150, microns thick. What is claimed is: 1. The method of producing a magnetic material ***[process/method]*** having a coercivity greater than 1000 Oersted comprising the steps of: providing a molten mixture including boron, one or more rare earths and one or more transition metals; and cooling said mixture at a rate slower than about 10.sup.5 degrees Celsius per second at a pressure of about 100 kPa, the molten mixture containing not less than about ten atomic percent boron, not less than about 60 atomic percent transition metals, and not more than about 10 atomic percent rare earths, wherein at least about 90 percent by weight of said rare earths comprise Nd, Pr, or a mixture thereof.
Filed: September 29, 2003 Issued: March 20, 2007 Expires: Sept 2023	7,192,493	Assignee: TDK Corporation (Tokyo, JAPAN)	R-T-B system rare earth permanent magnet and compound for magnet Abstract A sintered body with a composition consisting of 25% to 35% by weight of R (wherein R represents one or more rare earth elements, providing that the rare earth elements include Y), 0.5% to 4.5% by weight of B, 0.02% to 0.6% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe, wherein a coefficient of variation (CV) showing the dispersion of Zr is 130 or lower. This sintered body enables to inhibit the grain growth, while keeping the decrease of

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			magnetic properties to a minimum, and to improve the suitable sintering. What is claimed is: 1. An R-T-B system rare earth permanent magnet comprising a ***[composition of matter]*** sintered body with a composition consisting essentially of 25% to 35% by weight of R (wherein R represents one or more rare earth elements, providing that the rare earth elements include Y), 0.5% to 4.5% by weight of B, 0.02% to 0.6% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe, wherein a coefficient of variation (CV value) showing the dispersion degree of Zr in said sintered body is 130 or less and said magnet satisfies the condition that, with regard to a residual magnetic flux density (Br) and a coercive force (HcJ), Br+0.1.times.HcJ (dimensionless) is 15.2 or greater
Filed: June 22, 2005 Issued: February 20, 2007 Expires: June 2025	7,179,340	Assignee: Hitachi, Ltd. (Tokyo, JAPAN)	Rare-earth magnet and manufacturing method thereof and magnet motor Abstract The object of the present invention is to provide a rare earth magnet which enables to achieve a good balance between high coercive force and high residual magnetic flux density, and its manufacturing method. The present invention provides a rare earth magnet in which a layered grain boundary phase is formed on a surface or a potion of a grain boundary of Nd.sub.2Fe.sub.14B which is a main phase of an R--Fe--B (R is a rare-earth element) based magnet, and wherein the grain boundary phase contains a fluoride compound, and wherein a thickness of the fluoride compound is 10 .mu.m or less, or a thickness of the fluoride compound is from 0.1 .mu.m to 10 .mu.m, and wherein the coverage of the fluoride compound over a main phase particle is 50% or more on average. Moreover, after layering fluoride compound powder, which is formed in plate-like shape, in the grain boundary phase, the rare earth magnet is manufactured by quenching the layered compound after melting it at a vacuum atmosphere at a predetermined

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			temperature, or by heating and pressing the main phase and the fluoride compound to make the fluoride compound into a layered fluoride compound along the grain boundary phase. The invention claimed is: 1. A rare-earth magnet in which ***[composition of matter]*** a layered grain boundary phase is formed on a surface or a portion of a grain boundary of Nd.sub.2Fe.sub.14B which is a main phase of an R--Fe--B (R; rare-earth element) based magnet, wherein the grain boundary phase includes a fluoride compound, and wherein a thickness of the fluoride compound is from 0.1 .mu.m to 10 .mu.m, and wherein the coverage of the fluoride compound over a main phase particle is 50% or more on average. 6. The rare-earth magnet according to claim 1, wherein the fluoride compound ***[composition of matter]*** contained in the grain boundary phase is BaF.sub.2, OaF.sub.2, MgF.sub.2, SrF.sub.2, LiE, LaF.sub.3, NdF.sub.3, PrF.sub.3, SmF.sub.3, EuF.sub.3, GdF.sub.3, TbF.sub.3, DyF.sub.3, CeF.sub.3, HoF.sub.3, ErF.sub.3, TinE.sub.3, YbF.sub.3, LuF.sub.3, LaF.sub.2, NdF.sub.2, PrF.sub.2, SmF.sub.2, EuF.sub.2, GdF.sub.2, TbF.sub.2, DyF.sub.2, CeF.sub.2, HoE.sub.2, ErF.sub.2, TmF.sub.2, YbF.sub.2, LuF.sub.2, YF.sub.3, ScF.sub.3, CrF.sub.3, MnF.sub.2, MnF.sub.3, FeE.sub.2, FeF.sub.3, CoF.sub.2, CoF.sub.3, NiF.sub.2, ZnF.sub.2, AgF, PbF.sub.4, A1F.sub.3, GaF.sub.3, SnF.sub.2, SnF.sub.4, lnF.sub.3, PbF.sub.2, or BiF.sub.3.
Filed: June 19, 2001 Issued: February	[7,175,718](#)	Assignee: Mitsubishi (Tokyo, JAPAN)	Rare earth element permanent magnet material Abstract A material for a rare earth permanent magnet having a high magnetic coercive force and a high residual magnetic flux density. 28 to 35% by weight of at least one rare earth element selected from the group consisting of neodymium,

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13, 2007 Expires: June 2021			praseodymium, dysprosium, terbium, and holmium, 0.9 to 1.3% by weight of boron, 0.25 to 3% by weight of phosphorus, iron, and inevitable impurities. It can further comprise 0.1 to 3.6% by weight of cobalt and 0.02 to 0.25% by weight of copper. The invention claimed is: 1. A rare earth permanent magnet material comprising ***[composition of matter]*** 28 to 35% by weight of at least one rare earth element selected from the group consisting of neodymium, praseodymium, dysprosium, terbium, and holmium, 0.9 to 1.3% by weight of boron, 0.25 to 3% by weight of phosphorus, and iron, having a residual magnetic flux density of 11 to 18 kG, a magnetic coercive force of 14 to 21 kOe at 25.degree. C., and produced by sintering at a temperature in a range from 1,0000.degree. C. to l,4000.degree. C. 9. A rare earth permanent magnet material consisting ***[composition of matter]*** essentially of 28 to 35% by weight of at least one rare earth element selected from the group consisting of neodymium, praseodymium, dysprosium, terbium, and holmium, 0.9 to 1.3% by weight of boron, 0.25 to 3% by weight of phosphorus, 58 to 80% by weight of iron, 0.1 to 3.6% by weight of cobalt, and 0.02 to 0.25% by weight of copper, and having a residual magnetic flux density of 11 to 18 kG, a magnetic coercive force of 14 to 21 kOe at 25.degree.C.
Filed: June 24, 2002 Issued: February 6, 2007	7,172,659	Assignee: Neomax Co., Ltd. (Osaka, JAPAN)	Method for producing quenched R-T-B--C alloy magnet Abstract The present invention is a production method of an R-T-B--C rare earth alloy (R is at least one element selected from the group consisting of rare earth elements and yttrium, T is a transition metal including iron as a main component, B is boron, and C is carbon). An R-T-B bonded magnet containing

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Expires: June 2022		*Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	a resin component, or an R-T-B sintered magnet with a resin film formed on the surface thereof is prepared, and a solvent alloy containing a rare earth element R and a transition metal element T is prepared. Thereafter, the R-T-B bonded magnet is molten together with the solvent alloy. In this way, a rare earth alloy can be recovered from a spent bonded magnet or a defective one generated in a production process stage, and a rapidly quenched alloy magnet can be obtained. As a result, magnet powder is recovered from the R-T-B magnet, and the recycling of a magnet including a resin component can be realized. The invention claimed is: 1. A production method ***[process/method]*** of an R-T-B--C rare earth alloy (R is at least one element selected from the group consisting of rare earth elements and yttrium, T is a transition metal including iron as a main component, B is boron, and C is carbon) comprising the steps of: preparing an R-T-B magnet containing a resin component; preparing a solvent alloy containing a rare earth element R and a transition metal element T, ratio of said transition metal clement T being between 50 percent and 95 percent by weight, inclusive; and melting the R-T-B magnet together with the solvent alloy; wherein said R-T-B magnet and said solvent alloy are mixed at a ratio of 5:95 to 80:20, inclusive, by weight.
Filed: August 20, 2004 Issued: January 30, 2007 Expires:	7,170,378	Assignee: NEC Tokin Corporation (Sendai, JAPAN) Inoue; Akihisa	Magnetic core for high frequency and inductive component using same Abstract A high-frequency core is a molded body obtained by molding a mixture of a soft magnetic metallic glass powder and a binder in an amount of 10% or less in mass ratio. The powder has an alloy composition represented by a general formula (Fe.sub.1-a-bNi.sub.aCo.sub.b).sub.100-x-y-z(M.sub.1-pM'.sub.p).sub.xT.su- b.yB.sub.z (where 0.ltoreq.a.ltoreq.0.30, 0.ltoreq.b.ltoreq.0.50, 0.ltoreq.a+b.ltoreq.0.50, 0.ltoreq.p.ltoreq.0.5, 1 atomic

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Aug 2024		(Sendai, JAPAN)	%.ltoreq.x.ltoreq.5 atomic %, 1 atomic %.ltoreq.y.ltoreq.12 atomic %, 12 atomic %.ltoreq.z.ltoreq.25 atomic %, 22.ltoreq.(x+y+z).ltoreq.32, M being at least one selected from Zr, Nb, Ta, Hf, Mo, Ti, V, Cr, and W, M' being at least one selected from Zn, Sn, R (R being at least one element selected from rare earth metals including Y), T being at least one selected from Al, Si, C, and P). An inductance component includes the high-frequency core and at least one turn of winding wound around the core. The invention claimed is: 1. A high-frequency core comprising ***[composition of matter]*** a molded body obtained by molding a mixture of a soft magnetic metallic glass powder and a binder in an amount of 10% or less in mass ratio with respect to the soft magnetic metallic glass powder, said soft magnetic metallic glass powder having an alloy composition represented by a general formula (Fe.sub.1-a-bNi.sub.aCo.sub.b).sub.100-x-y-z(M.sub.1-pM'.sub.p).sub.xT.su- b.yB.sub.z (where 0.ltoreq.a.ltoreq.0.30, 0.ltoreq.b.ltoreq.0.50, 0.ltoreq.a+b.ltoreq.0.50, 0.ltoreq.p.ltoreq.0.5, 1 atomic %.ltoreq.x.ltoreq.5 atomic %, 1 atomic %.ltoreq.y.ltoreq.12 atomic %, 12 atomic %.ltoreq.z.ltoreq.25 atomic %, 22.ltoreq.(x+y+z).ltoreq.32, M being at least one selected from Zr, Nb, Ta, Hf, Mo, Ti, V, Cr, and W, M' being at least one selected from Zn, Sn, R ,where R is at least one element selected from rare earth metals including Y, and T is at least one selected from Al, Si, C, and P).
Filed: Oct 18, 1999 Issued: January 30, 2007	[7,169,468](https://cmi.ameslab.gov/resources/magnet-table)	Assignee: Minebea Co., Ltd (Nagano-Ken, JAPAN)	Resin bonded rare earth magnet Abstract A resin bonded rare earth magnet, compression molded from rare earth-transition alloy powder and thermosetting resin, having a magnet 1 comprising a mixture of thermosetting resin and rare earth-transition alloy powder with a particle size of between 20 and 300 microns, a filling material 3 with particle

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Expires: Oct 2019			size between 0.1 and 15 microns which is used to fill in the depressions 2 on the surface of said magnet 1 and is then fixed with said thermosetting resin, and a corrosion inhibiting coat 4 made from synthetic resin applied to the surface of said magnet 1 which has been rendered smooth by the application of said filling material into the depressions on its surface. What is claimed is: 1. A resin bonded rare earth magnet ***[composition of matter]*** comprising: (a) a magnet body formed by compression molding a mixture of a first thermosetting resin and a rare earth-transition metal alloy powder having a particle size of between 20 and 300 microns such that the magnet body comprises powdered magnetic particles comprising the rare earth-transition metal alloy powder, said magnet body comprising a surface having depressions and projections; (b) a filling material with a particle size of between 0.1 and 15 microns selectively fixed by a second thermosetting resin to the surface of the magnet body only in the depressions so as to cause the surface of the magnet body with the filling material to be smoother than the surface of the magnet body without the filling material, the surface of the magnet body with the filling material having a surface roughness of less than 3 microns; and (c) a corrosion inhibiting coat comprising a synthetic resin covering the surface of the magnet body with first portions of the corrosion inhibiting coat in contact with the powdered magnetic particles and second portions of the corrosion inhibiting coat in contact with the filling material.
Filed: October 14, 2004 Issued: January 30, 2007	7,169,319	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo*	Anisotropic, sintered ferrite magnet and method for producing the same Abstract A ferrite magnet having a basic composition represented by the following general formula: (A.sub.1-xR.sub.x)O.n[(Fe.sub.1-yM.sub.y).sub.2O.sub.3] by atomic ratio, wherein A is Sr and/or Ba, R is at least one of rare earth elements including Y, M is at least one element selected from the group consisting of

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Expires: Oct 2024		*Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Co, Mn, Ni and Zn, and x, y and n are numbers meeting the conditions of 0.01.ltoreq.x.ltoreq.0.4, [x/(2.6n)].ltoreq.y.ltoreq.[x/(1.6n)], and 5.ltoreq.n.ltoreq.6, and substantially having a magnetoplumbite-type crystal structure, is obtained by uniformly mixing a compound of Sr and/or Ba with an iron compound; calcining the resultant uniform mixture; adding a compound of the R element and/or the M element to the resultant calcined powder at a pulverization step thereof; and sintering the resultant mixture. The compound of the R element and/or the M element may be added at a percentage of more than 0 atomic % and 80 atomic % or less, on an element basis, at a mixing step before calcination. What is claimed is: 1. A method for producing ***[process/method]*** an anisotropic, sintered ferrite magnet having a basic composition represented by the following general formula: (A.sub.1-xR.sub.x)O.n[(Fe.sub.1-yM.sub.y).sub.2O.sub.3] by atomic ratio, wherein A is Sr or (Sr+Ba), R is at least one rare earth element including Y, the M element is Co, and x, y and n are numbers meeting the following conditions: 0.01.ltoreq.x.ltoreq.0.4, 0.005.ltoreq.y.ltoreq.0.04, and 5.ltoreq.n.ltoreq.6, said anisotropic, sintered ferrite magnet having a magnetoplumbite crystal structure, and a magnetization-temperature curve of said anisotropic, sintered ferrite magnet having a concavely curved portion relative to a tangent on said magnetization-temperature curve when said tangent is drawn on said magnetization-temperature curve in the direction of the axis of abscissas(magnetization=0), said method comprising the steps of adding a compound of the R element and/or the M element at a step of uniformly mixing a compound of Sror (Sr+Ba) with an iron compound; calcining the resultant mixture; adding the remaining amount of said compound of the R element and/or the M element to the resultant calcined powder at a pulverization step thereof to form a finely pulverized powder; molding the resultant finely pulverized powder in a magnetic field; and

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			sintering the resultant green body, wherein R is added as a hydroxide or R, and wherein said finely pulverized powder is finely pulverized in a wet state and an average diameter of said finely pulverized powder is 0.7 0.9 .mu.m.
Filed: December 12, 2003 Issued: January 16, 2007 Expires: Dec 2023	7,163,591	Assignee: Jahwa Electronics Co., Ltd. (KOREA)	Method of preparing micro-structured powder for bonded magnets having high coercivity and magnet powder prepared by the same Abstract Disclosed is a method of preparing a micro-structured powder for bonded magnets having high coercivity, which is advantageous in terms of low preparation costs by recycling magnet scraps, simplified mass production, minimal environmental contamination by such a recycling process, and the preparation of stable anisotropic powders having high coercivity. Further, a magnet powder prepared by the above method is provided. The current method is characterized in that R--Fe--B type anisotropic sintered magnets or scraps thereof are crushed to prepare 50 500 .mu.m sized magnet powders, which are then mixed with 1 10 wt % of rare earth fluoride (RF.sub.3) powders and thermally treated at high temperatures (500 1100.degree. C.) in a vacuum or an inert gas, to cause the change of matrix-near surface and grain boundary of the powders. Thus obtained powders include a matrix phase having R.sub.2Fe.sub.14B crystal structure, a R-rich grain boundary phase containing rare earth fluoride, and other phases, in which the matrix phase has an average grain size of 1 20 .mu.m, and the powders have an average size of 50 500 .mu.m with superior magnetic characteristics of (BH)max.gtoreq.20 MGOe and iHc.gtoreq.5 kOe. What is claimed is: 1. A method of preparing ***[process/method]*** a micro-structured powder for bonded magnets having high coercivity, comprising: (a) mechanically crushing or hydrogen decrepitating a R--Fe--B type anisotropic sintered magnet or scraps thereof, to prepare R--Fe--B type anisotropic permanent magnet

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			powders having an average size of 50 500 .mu.m; (b) mixing the R--Fe--B type anisotropic permanent magnet powders with 1 10 wt % of rare earth fluoride (RF.sub.3) powders having a size of 0.1 50 .mu.m, to obtain mixed powders; and (c) thermally treating the mixed powders at 500 1100.degree. C. in a vacuum or an inert gas atmosphere, to prepare R--Fe--B type anisotropic permanent magnet powders.
Filed: June 27, 2003 Issued: January 9, 2007 Expires: June 2023	7,160,398	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Method of making rapidly solidified alloy for magnet Abstract A melt of an alloy, represented (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yM.sub.z, where T is Co and/or Ni, Q is B and/or C, R is at least one rare-earth element, M is selected from Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb; 10 at %.ltoreq.x.ltoreq.35 at %; 2 at %.ltoreq.y.ltoreq.10 at %; 0 at %.ltoreq.z.ltoreq.10 at %; and 0.ltoreq.m.ltoreq.0.5, is prepared. Next, the melt is brought into contact with, and rapidly cooled and solidified by, the surface of a rotating chill roller. The melt is teemed onto a guide member, of which the guide surface defines a tilt angle with a horizontal plane, runs down on the guide surface, and then is fed through at least one tubular hole onto a contact area on the surface of the chill roller. What is claimed is: 1. A method of making ***[process/method]*** a rapidly solidified alloy for a nanocomposite magnet, the method comprising the steps of: preparing a melt of an alloy having a composition represented by the general formula: (Fe.sub.1-mT.sub.m).sub.100-x-y-zQ.sub.xR.sub.yM.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C and always includes B; R is at least one rare-earth element; and M is at least one metal element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb,

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			Mo, Ag, Hf, Ta, W, Pt, Au and Pb, the mole fractions x, y, z and m satisfying the inequalities of: 10 at %.ltoreq.x.ltoreq.35 at %; 2 at %.ltoreq.y.ltoreq.10 at %; 0 at %.ltoreq.z.ltoreq.10 at %; and 0.ltoreq.m.ltoreq.0.5, respectively, and forming the rapidly solidified alloy by bringing the melt into contact with the surface of a rotating chill roller; wherein the step of forming the rapidly solidified alloy includes the steps of: arranging a guide member such that a guide surface thereof defines a tilt angle of about 5 degrees to about 70 degrees with respect to a horizontal plane, the guide member having a plurality of tubular holes with at least one of the plurality of tubular holes having a length of about 0.5 mm to about 50 mm and an opening area of about 0.02 cm.sup.2 to about 0.5 cm.sup.2; teeming the melt onto the guide surface of the guide member, and then feeding the melt, running down on the guide surface, through the plurality of tubular holes of the guide member directly adjacent to the guide surface and onto a contact area on the surface of the chill roller; and splitting the melt into a number of melt flows by way of the plurality of tubular holes and then bringing the melt flows into contact with the chill roller.
Filed: November 14, 2002 Issued: January 2, 2007 Expires: Nov 2022	7,156,928	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Corrosion-resistant rare earth element magnet Abstract A corrosion resistant rare earth magnet is characterized by comprising a rare earth permanent magnet represented by R-T-M-B wherein R is at least one rare earth element inclusive of Y, T is Fe or Fe and Co, M is at least one element selected from among Ti, Nb, Al, V, Mn, Sn, Ca, Mg, Pb, Sb, Zn, Si, Zr, Cr, Ni, Cu, Ga, Mo, W, and Ta, the contents of the respective elements are 5 wt %.ltoreq.R.ltoreq.40 wt %, 50 wt %.ltoreq.T.ltoreq.90 wt %, 0 wt %.ltoreq.M.ltoreq.8 wt %, and 0.2 wt %.ltoreq.B.ltoreq.8 wt %, and a coating on a surface of the permanent magnet comprising a silicone resin, a flake metal fine powder, and a complexing agent. The invention claimed is:

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			1. A corrosion resistant rare earth magnet characterized by comprising ***[composition of matter]*** a rare earth permanent magnet represented by R-T-M-B wherein R is at least one rare earth element inclusive of yttrium, T is iron or iron and cobalt, and M is at least one element selected from the group consisting of Ti, Nb, Al, V, Mn, Sn, Ca, Mg, Pb, Sb, Zn, Si, Zr, Cr, Ni, Cu, Ga, Mo, W, and Ta, the contents of the respective elements are 5 wt %.ltoreq.R.ltoreq.40 wt %, 50 wt %.ltoreq.T.ltoreq.90 wt %, 0 wt %.ltoreq.M.ltoreq.8 wt %, and 0.2 wt %.ltoreq.B.ltoreq.8 wt %, and a coating on a surface of the permanent magnet comprising a silicone resin, a flake metal fine powder of at least one metal selected from the group consisting of Al, Mg, Ca, Zn, Si and Mn and/or an alloy thereof, and at least one complexing agent selected from the group consisting of salts of boric acid, oxalic acid, phosphoric acid, phosphorous acid, hypophosphorous acid, silicic acid, phosphonic acid, phytic acid, molybdic acid, and phosphomolybdic acid.
Filed: June 23, 2003 Issued: December 12, 2006 Expires: June 2023	7,147,686	Assignee: Nissan Motor Co., Ltd. (Kanagawa, JAPAN)	Rare earth magnet, method for manufacturing the same, and motor using rare earth magnet Abstract A rare earth magnet comprises rare earth magnet particles and a rare earth oxide being present between the rare earth magnet particles. The rare earth oxide is represented by a following general formula (I): R.sub.2O.sub.3 (I) where R is any one of terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. What is claimed is: 1. A method of manufacturing ***[process/method]*** a rare earth magnet, comprising: forming a rare earth magnet particle constituted by a cluster of numerous crystal grains, preparing a mixture including the rare earth magnet particle and a rare earth oxide being represented by a following general

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			formula (I); R.sub.2O.sub.3 (I) where R is any one of terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium; filling the mixture in a molding die; and molding the mixture at a temperature of 600.degree. C. to 850.degree. C. 6. A rare earth magnet,***[composition of matter]*** comprising: a sintered body including: rare earth magnet particles; and a rare earth oxide being present only between the rare earth magnet particles, the rare earth oxide being represented by a following general formula (I): R.sub.2O.sub.3 (I) where R is any one of terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium, wherein the rare earth magnet particle is constituted by a cluster of numerous crystal grains.
Filed: September 6, 2005 Issued: December 5, 2006 Expires: Sept 2025	7,144,463	Assignee: Magnequench, Inc. (Singapore)	Highly quenchable Fe-based rare earth materials for ferrite replacement Abstract The present invention relates to highly quenchable Fe-based rare earth magnetic materials that are made by rapid solidification process and exhibit good magnetic properties and thermal stability. More specifically, the invention relates to isotropic Nd--Fe--B type magnetic materials made from a rapid solidification process with a lower optimal wheel speed and a broader optimal wheel speed window than those used in producing conventional magnetic materials. The materials exhibit remanence (B.sub.r) and intrinsic coercivity (H.sub.ci) values of between 7.0 to 8.5 kG and 6.5 to 9.9 kOe, respectively, at room temperature. The invention also relates to process of making the materials and to bonded magnets made from the magnetic materials, which are suitable for direct replacement of anisotropic sintered ferrites in many applications. What is claimed is: 1. A method of making ***[process/method]*** a magnetic material comprising:

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			forming a melt comprising the composition, in atomic percentage, of (R.sub.1-aR'.sub.a).sub.uFe.sub.100-u-v-w-x-yCo.sub.vM.sub.wT.sub.xB.sub.- y rapidly solidifying the melt to obtain a magnetic powder; thermally annealing the magnetic powder at a temperature range of about 350.degree. C. to about 800.degree. C. for about 0.5 minutes to about 120 minutes; wherein R is Nd, Pr, Didymium (a nature mixture of Nd and Pr at composition of Nd.sub.0.75Pr.sub.0.25), or a combination thereof; R' is La, Ce, Y, or a combination thereof; M is one or more of Zr, Nb, Ti, Cr, V, Mo, W, and Hf; and T is one or more of Al, Mn, Cu, and Si, wherein 0.01.ltoreq.a.ltoreq.0.8, 7.ltoreq.u.ltoreq.13, 0.ltoreq.v.ltoreq.20, 0.01.ltoreq.w.ltoreq.1, 0.1.ltoreq.x.ltoreq.5, and 4.ltoreq.y.ltoreq.12, and wherein the magnetic material exhibits a remanence (B.sub.r) value of from about 6.5 kG to about 8.5 kG and an intrinsic coercivity (H.sub.ci) value of from about 6.0 kOe to about 9.9 kOe.
Filed: Feb 6, 2002 Issued: December 5, 2006 Expires: Feb 2022	7,144,642	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Permanent magnet and method for preparation thereof Abstract A ferrite magnet obtained by adding a ferrite having a hexagonal W-type magnetoplumbite structure to a ferrite having a hexagonal M-type magnetoplumbite structure, in which a portion of Sr, Ba, Pb or Ca is replaced with at least one element that is selected from the group consisting of the rare-earth elements (including Y) and Bi and that always includes La, during the fine pulverization process thereof. By adding a small amount of the element such as Co, Ni, Mn or Zn to the ferrite already having the hexagonal M-type magnetoplumbite structure during the fine pulverization process thereof, the magnetic properties can be improved. The invention claimed is: 1. An oxide magnetic material ***[composition of matter]*** including a ferrite having a hexagonal M-type magnetoplumbite structure as a main phase, the

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			material comprising: A, which is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R, which is at least one element selected from the group consisting of the rare-earth elements (including Y) and Bi and which always includes La; and Fe, wherein the ratio of the constituents A, R and Fe of the oxide magnetic material is represented by (1-x)AO.(x/2)R.sub.2O.sub.3.nFe.sub.2O.sub.3, Formula 1: where 0.05.ltoreq.x.ltoreq.0.3, and 5.0.ltoreq.n.ltoreq.6.5, and wherein another oxide magnetic material, including a ferrite having a hexagonal W-type magnetoplumbite structure as a main phase, is added at 0.6 wt % to 20.8 wt % to the oxide magnet material including the ferrite having the hexagonal M-type magnetoplumbite structure as its main phase, the oxide magnetic material to be added being represented by: AO.2MO.8Fe.sub.2O.sub.3(AM.sub.2Fe.sub.16O.sub.27) Formula 2: where M is at least one element selected from the group consisting of Co, Ni, Mn and Zn. 3. A method of making ***[process/method]*** a ferrite calcined body, the method comprising the steps of: preparing a material powder mixture by mixing: a material powder of at least one compound that is selected from the group consisting of SrCO.sub.3, BaCO.sub.3, PbO and CaCO.sub.3; an oxide material powder of at least one element to be selected from the group consisting of the rare-earth elements (including Y) and Bi, the oxide material powder always including La.sub.2O.sub.3; and a material powder of Fe.sub.2O.sub.3; calcining the material powder mixture at a temperature of 1,100.degree. C. to 1,450.degree. C., thereby forming a ferrite calcined body having an M-type magnetoplumbite structure and a composition represented by the general formula: (1-x)AO.(x/2)R.sub.2O.sub.3.nFe.sub.2O.sub.3 where A is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R is at least one element selected from the group consisting of the rare-earth elements (including Y) and Bi and always includes La; 0.05.ltoreq.x.ltoreq.0.3; and 5.0.ltoreq.n.ltoreq.6.5; preparing another material powder mixture by

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			mixing: a material powder of at least one compound that is selected from the group consisting of SrCO.sub.3, BaCO.sub.3, PbO and CaCO.sub.3; an oxide material powder of at least one element selected from the group consisting of Co, Ni, Mn and Zn; and a material powder of Fe.sub.2O.sub.3; calcining the material powder mixture at a temperature of 1,100.degree. C. to 1,450.degree. C., thereby forming a ferrite calcined body having a W-type magnetoplumbite structure and a composition represented by the general formula: AO.2MO.8Fe.sub.2O.sub.3 where A is at least one element selected from the group consisting of Sr, Ba, Pb and Ca and M is at least one element selected from the group consisting of Co, Ni, Mn and Zn; and preparing a calcined body mixed powder by adding the ferrite calcined body having the W-type magnetoplumbite structure at 0.6 wt % to 20.8 wt % to the ferrite calcined body having the M-type magnetoplumbite structure.
Filed: Sept 6, 2005 Issued: December 5, 2006 Expires: Sept 2025	7144463	Assignee: Magnequench, Inc. (Singapore)	Highly quenchable Fe-based rare earth materials for ferrite replacement Abstract The present invention relates to highly quenchable Fe-based rare earth magnetic materials that are made by rapid solidification process and exhibit good magnetic properties and thermal stability. More specifically, the invention relates to isotropic Nd--Fe--B type magnetic materials made from a rapid solidification process with a lower optimal wheel speed and a broader optimal wheel speed window than those used in producing conventional magnetic materials. The materials exhibit remanence (B.sub.r) and intrinsic coercivity (H.sub.ci) values of between 7.0 to 8.5 kG and 6.5 to 9.9 kOe, respectively, at room temperature. The invention also relates to process of making the materials and to bonded magnets made from the magnetic materials, which are suitable for direct replacement of anisotropic sintered ferrites in many applications. What is claimed is:

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			1. A method of making ***[process/method]*** a magnetic material comprising: forming a melt comprising the composition, in atomic percentage, of (R.sub.1-aR'.sub.a).sub.uFe.sub.100-u-v-w-x-yCo.sub.vM.sub.wT.sub.xB.sub.- y rapidly solidifying the melt to obtain a magnetic powder; thermally annealing the magnetic powder at a temperature range of about 350.degree. C. to about 800.degree. C. for about 0.5 minutes to about 120 minutes; wherein R is Nd, Pr, Didymium (a nature mixture of Nd and Pr at composition of Nd.sub.0.75Pr.sub.0.25), or a combination thereof; R' is La, Ce, Y, or a combination thereof; M is one or more of Zr, Nb, Ti, Cr, V, Mo, W, and Hf; and T is one or more of Al, Mn, Cu, and Si, wherein 0.01.ltoreq.a.ltoreq.0.8, 7.ltoreq.u.ltoreq.13, 0.ltoreq.v.ltoreq.20, 0.01.ltoreq.w.ltoreq.1, 0.1.ltoreq.x.ltoreq.5, and 4.ltoreq.y.ltoreq.12, and wherein the magnetic material exhibits a remanence (B.sub.r) value of from about 6.5 kG to about 8.5 kG and an intrinsic coercivity (H.sub.ci) value of from about 6.0 kOe to about 9.9 kOe.
Filed: June 22, 2004 Issued: November 28, 2006 Expires: June 2024	7,141,126	Assignee: Neomax Co., Ltd. (JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare earth magnet and method for manufacturing the same Abstract Rare earth alloy powder having an oxygen content of 50 to 4000 wt. ppm and a nitrogen content of 150 to 1500 wt. ppm is compacted by dry pressing to produce a compact. The compact is impregnated with an oil agent and then sintered. The sintering process includes a first step of retaining the compact at a temperature of 700.degree. C. to less than 1000.degree. C. for a period of time of 10 to 420 minutes and a second step of permitting proceeding of sintering at a temperature of 1000.degree. C. to 1200.degree. C. The average crystal grain size of the rare earth magnet after the sintering is controlled to be 3 .mu.m to 9 .mu.m. What is claimed is:

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			1. A method for manufacturing ***[process/method]*** an R--Fe--B rare earth magnet, comprising the steps of: preparing a rare earth alloy powder having an oxygen content in a range of 50 wt. ppm to 4000 wt. ppm and a nitrogen content in a range of 150 wt. ppm to 1500 wt. ppm and embrittling an R--Fe--B rare earth alloy by hydrogen occlusion and milling the embrittled alloy; compacting the rare earth alloy powder by dry pressing to produce a compact; and, sintering the compact, wherein the step of sintering the compact includes: a first step of retaining the compact at a temperature in a range of 700.degree. C. to less than 1000.degree. C. for a period of time in a range of 10 minutes to 420 minutes and releasing hydrogen outside the compact so that the amount of hydrogen contained in sintered magnet is in a range of 10 wt. ppm to 100 wt. ppm; and a second step of permitting the proceeding of sintering at a temperature in a range of 1000.degree. C. to 1200.degree. C., and the average crystal grain size of the rare earth magnet after the sintering is in a range of 3 .mu.m to 9 .mu.m.
Filed: May 27, 2003 Issued: November 21, 2006 Expires: May 2023	7,138,070	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic material manufacturing method, ribbon-shaped magnetic materials, powdered magnetic material and bonded magnets Abstract A magnetic material manufacturing method, a ribbon-shaped magnetic material manufactured by the method, a powdered magnetic material formed from the ribbon-shaped magnetic material and a bonded magnet manufactured using the powdered magnet material are disclosed. The method and the magnetic materials can provide magnets having excellent magnetic properties and reliability. A melt spinning apparatus 1 is provided with a tube 2 having a nozzle 3 at the bottom thereof, a coil 4 for heating the tube and a cooling roll 5 having a circumferential surface 53 on which dimple correcting means is provided. A melt spun ribbon 8 is formed by injecting the molten alloy 6 from the nozzle 3 so as to be collided with the circumferential surface 53 of the cooling roll 5 in an inert gas atmosphere (ambient gas) such as helium gas, so that the molten alloy 6 is cooled and then solidified. In this process, dimples to

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			be produced on a roll contact surface of the melt spun ribbon are divided by the dimple correcting means, thereby preventing formation of huge dimples. What is claimed is: 1. A ribbon-shaped magnetic material which is manufactured by ***[process/method]*** colliding a molten alloy to a circumferential surface of a cooling roll so as to cool and then solidify it, the ribbon-shaped magnetic material having an alloy composition represented by the formula of R.sub.x(Fe.sub.1-yCo.sub.y).sub.100-x-y-zB.sub.z(where R is at least one rare-earth element, x is 10 15 at %, y is 0 0.30 and z is 4 10 at %), wherein the circumferential surface of the cooling roll has dimple correcting means for dividing dimples to be produced on a roll contact surface of the ribbon-shaped magnetic material which is in contact with the circumferential surface of the cooling roll, the dimple correcting means comprising a plurality of grooves or ridges formed in the circumferential surface of the cooling roll in which the average pitch of the grooves or ridges is in the range of 7.5 to 40.0 .mu.m, and the average height of the ridges or the average depth of the grooves is in the range of 0.5 to 20 .mu.m; the roll contact surface of the ribbon-shaped magnetic material is formed with ridges or grooves which correspond to the grooves or ridges of the dimple correcting means and which are formed by transfer of the ridges or grooves of the circumferential surface of the cooling roll to the roll contact surface of the ribbon-shaped magnetic material; and the dimples produced on the roll contact surface of the ribbon-shaped magnetic material upon solidification thereof include dimples each having an area equal to or greater than 2000 .mu.m.sup.2, a ratio of the area of the roll contact surface occupied by the thus produced dimples with respect to the total area of the roll contact surface of the ribbon-shaped magnetic material being equal to or less than 10% due to the ridges or grooves formed by the transfer. 3. A powdered magnetic material which is obtained by ***[process/method]***

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			milling the ribbon-shaped magnetic material of claim 1.
Filed: January 15, 2004 Issued: November 21, 2006 Expires: Jan 2024	7,138,018	Assignee: Aichi Steel Corporation (Aichi-ken, JAPAN)	Process for producing anisotropic magnet powder Abstract A method for manufacturing an anisotropic magnet powder includes a high-temperature hydrogenation process of holding an RFeB-based alloy containing rare earth elements (R), B and Fe as main ingredients in a treating atmosphere under a first treating pressure (P1) of which a hydrogen partial pressure ranges from 10 to 100 kPa and at a first treating temperature (T1) which ranges from 953 to 1133 K, a structure stabilization process of holding the RFeB-based alloy after the high-temperature hydrogenation process under a second treating pressure (P2) of which a hydrogen partial pressure is 10 or more and at a second treating temperature (T2) which ranges from 1033 to 1213 K such that the condition T2>T1 or P2>P1 is satisfied, a controlled evacuation process of holding the RFeB-based alloy after the structure stabilization process in a treating atmosphere under a third treating pressure (P3) of which a hydrogen partial pressure ranges from 0.1 to 10 kPa and at a third treating temperature (T3) which ranges from 1033 to 1213 K, and a forced evacuation process of removing residual hydrogen (H) from the RFeB-based alloy after the controlled evacuation process. With this method, the magnetic properties of the anisotropic magnet powder can be improved. The invention claimed is: 1. A method for manufacturing ***[process/method]*** an anisotropic magnet powder characterized in that the method comprises: a high-temperature hydrogenation process of holding an RFeB-based alloy containing a rare earth element (hereinafter referred to as "R"), boron (B) and iron (Fe) as main ingredients in a treating atmosphere under a first treating pressure (hereinafter referred to as "P1") of which a hydrogen partial pressure ranges from 10 to 100 kPa and at a first treating temperature (hereinafter referred to as "T1") which

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			ranges from 953 to 1133 K; a structure stabilization process of holding said RFeB-based alloy after said high-temperature hydrogenation process in a treating atmosphere under a second treating pressure (hereinafter referred to as "P2") of which a hydrogen partial pressure is 10 kPa or more and at a second treating temperature (hereinafter referred to as "T2") which ranges from 1033 to 1213 K such that one of condition T2>T1 and P2>P1 is satisfied; a controlled evacuation process of holding said RFeB-based alloy after said structure stabilization process in a treating atmosphere and carrying out dehydrogenation under a third treating pressure (hereinafter referred to as "P3") of which a hydrogen partial pressure ranges from 0.1 to 10 kPa and at a third treating temperature (hereinafter referred to as "T3") which ranges from 1033 to 1213 K such that the condition P3<P2 is satisfied, and a forced evacuation process of removing residual hydrogen (H) from said RFeB-based alloy after said controlled evacuation process.
Filed: August 21, 2003 Issued: November 21, 2006 Expires: Aug 2023	7,138,017	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare earth magnet and method for producing the magnet Abstract A method of making an alloy powder for an R--Fe--B-type rare earth magnet includes the steps of preparing a material alloy that is to be used for forming the R--Fe--B-type rare earth magnet and that has a chilled structure that constitutes about 2 volume percent to about 20 volume percent of the material alloy, coarsely pulverizing the material alloy for the R--Fe--B-type rare earth magnet by utilizing a hydrogen occlusion phenomenon to obtain a coarsely pulverized powder, finely pulverizing the coarsely pulverized powder and removing at least some of fine powder particles having particle sizes of about 1.0 .mu.m or less from the finely pulverized powder, thereby reducing the volume fraction of the fine powder particles with the particle sizes of about 1.0 .mu.m or less, and covering the surface of remaining ones of the powder particles with a lubricant after the step of removing has been performed. What is claimed is:

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			1. A method of making an alloy powder for an R--Fe--B-type rare earth magnet ***[process/method]*** , the method comprising the steps of: a) preparing a material alloy that is to be used to form the R--Fe--B-type rare earth magnet and that includes a chilled structure that constitutes about 2 volume percent to about 20 volume percent of the material alloy; b) coarsely pulverizing the material alloy for the R--Fe--B-type rare earth magnet by utilizing a hydrogen occlusion phenomenon to obtain a coarsely pulverized powder; c) finely pulverizing the coarsely pulverized powder and removing at least some of fine powder particles having particle sizes of about 1.0 pm or less from the finely pulverized powder, thereby reducing the volume fraction of the fine powder particles having the particle sizes of about 1.0 pm or less; and d) covering the surface of remaining ones of the powder particles with a lubricant after the step c) has been performed.
Filed: November 21, 2001 Issued: October 31, 2006 Expires: Nov 2021	7,128,798	Assignee: MagaetNotes, Ltd. (Toledo, OH, USA)	Magnetic substrates, composition and method for making the same Abstract A process of making a magnetic assembly having at least one magnetic layer and at least one printable substrate layer including the steps of providing a magnetic composition comprising about 70 wt-% to about 95 wt-% of at least one magnetic material and about 5 wt-% to about 30 wt-% of at least one thermoplastic binder, forming the magnetic composition into a magnetic layer, and directly applying the magnetic composition at an elevated temperature in molten form to a printable substrate layer, and to the magnetic composition and any articles made therefrom. The invention claimed is: 1. A unitary process ***[process/method]*** of forming a magnetic assembly having at least one magnetic layer having dimensions of thickness, width and

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			length, and at least one printable substrate layer having dimensions of thickness, width and length, comprising the steps of: a) providing a magnetic hot melt composition at an elevated temperature with an extruder, said magnetic hot melt composition comprising about 75 wt-% to about 95 wt-% of at least one magnetic material and about 5 wt-% to about 25 wt-% of at least one thermoplastic polymer; b) directly applying said magnetic hot melt composition with a slot die head at an elevated temperature when it is pliable to a printable substrate layer to form a magnetic layer having a thickness of about 50 microns to about 305 microns, the printable substrate layer formed of paper, paper products or paste board; and c) subjecting said magnetic assembly to a strong magnetic field sufficient to result in a permanent magnetic effect in the assembly.
Filed: June 17, 2003 Issued: August 15, 2006 Expires: June 2023	7,090,733	Assignee: The Regents of the University of California (Oakland, CA, USA)	Metallic glasses with crystalline dispersions formed by electric currents Abstract Metallic glasses of superior mechanical and magnetic properties are manufactured by annealing the glasses under the influence of an electric current to convert the glass to a composite that includes crystallites, preferably nanocrystallites, dispersed through an amorphous matrix. What is claimed is: 1. A method for the manufacture of a composite metallic material ***[process/method]*** comprising a matrix of metallic glass with metallic crystallites dispersed therein, from an alloy composition that can be cooled from a melt at a cooling rate sufficient to form a glass, said method comprising annealing a bulk metallic glass of said alloy composition that will form a glass upon cooling from a melt at a cooling rate of less than about 1,000 degrees Celsius per second, while passing an electric current through said glass at a current density of at least about 300 A/cm.sup.2 for at least one hour to cause the formation of crystallite dispersions of about 50 microns or less in diameter

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			in said glass.
Filed: November 13, 2003 Issued: August 15, 2006 Expires: Nov 2023	7,090,730	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	R-Fe-B sintered magnet Abstract An R--Fe--B base sintered magnet having a composition of 12 17 at % of R (wherein R stands for at least two of yttrium and rare earth elements and essentially contains Nd and Pr), 0.1 3 at % of Si, 5 5.9 at % of B, 0 10 at % of Co, and the balance of Fe, containing a R.sub.2(Fe,(Co),Si).sub.14B intermetallic compound primary phase and at least 1% by volume of an R--Fe(Co)--Si grain boundary phase, and being free of a B-rich phase exhibits a coercive force of at least 10 kOe despite a reduced content of heavy rare earth. The invention claimed is: 1. An R--Fe--B base sintered magnet of a composition ***[composition of matter]*** consisting essentially of, in atom percent, 12 to 17% of R which stands for at least two of yttrium and rare earth elements and essentially contains Nd and Pr, 0.1 to 3% of Si, 5 to 5.9% of B, up to 10% of Co, and the balance of Fe, containing a primary phase of R.sub.2(Fe,(Co),Si).sub.14B intermetallic compound, and having a coercive force iHc of at least 10 kOe, characterized in that the magnet is free of a B-rich phase and contains at least 1% by volume based on the entire magnet of an R--Fe(Co)--Si grain boundary phase consisting essentially of, in atom percent, 25 to 35% of R, 2 to 8% of Si, up to 8% of Co, and the balance of Fe.
Filed: March 10, 2003 Issued:	7,087,185	Assignee: Seiko Epson Corporation	Magnetic powder and isotropic bonded magnetMagnetic powder and isotropic bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a magnet having a

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August 8, 2006 Expires: March 2023		(JAPAN)	high magnetic flux density and excellent magnetizability and reliability especially excellent heat resisting property (heat stability). The magnetic powder is composed of an alloy composition represented by R.sub.x(Fe.sub.1-yCo.sub.y).sub.100-x-z-wB.sub.zAl.sub.w (where R is at least one kind of rare-earth element, x is 8.1 9.4 at %, y is 0 0.30, z is 4.6 6.8 at %, and w is 0.02 1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein the magnetic powder has characteristics in which, when the magnetic powder is formed into an isotropic bonded magnet by mixing with a binding resin and then molding it, the irreversible susceptibility (.chi..sub.irr) which is measured by using an intersectioning point of a demagnetization curve in the J-H diagram representing the magnetic characteristics at the room temperature and a straight line which passes the origin in the J-H diagram and has a gradient (J/H) of -3.8.times.10-.sup.6 H/m as a starting point is less than 5.0.times.10-.sup.7 H/m, and the intrinsic coercive force (H.sub.CJ) of the magnet at the room temperature is in the range of 406 717 kA/m. What is claimed is: 1. An isotropic rare-earth bonded magnet comprising ***[composition of matter]*** : a magnetic powder having an alloy composition represented by Rx(Fe.sub.1-yCo.sub.y).sub.100-x-z-wB.sub.zAl.sub.w (where R is at least one rare-earth element, x is 8.1 9.4 at %, y is 0.0 0.30 at %, z is 4.6 6.8 at %, and w is 0.02 1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and hard magnetic phase; and a binding resin; wherein the soft magnetic phase and the hard magnetic phase have a mean crystal grain size in the range of 1 100 nm; and the isotropic rare-earth bonded magnet is characterized in that the irreversible susceptibility (.chi..sub.irr), which is measured by using an intersectioning point of a demagnetization curve in a J-H diagram representing magnetic characteristics at room temperature and a straight line which passes an origin in the J-H diagram and

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			has a gradient (J/H) of -3.8.times.10.sup.-6 H/m as a starting point is less than 5.0.times.10-.sup.7 H/m, and the intrinsic coercive force (H.sub.CJ) of the magnet at the room temperature is in the range of 406 717 kA/m. 2. The isotropic bonded magnet as claimed in claim 1, wherein the magnetic powder includes at least one element which is selected from the group comprising Cu, Si, Ga, Ti, V, Ta, Zr, Nb, Mo, Hf, Ag, Zn, P, Ge and Cr.
Filed: May 28, 2002 Issued: June 6, 2006 Expires: May 2022	7,056,393	Assignee: Neomax, Co., Ltd. (Osaka, JAPAN)	Method of making sintered compact for rare earth magnet Abstract A method of making a sintered body for a rare earth magnet includes the steps of (a) preparing a first coarse powder by coarsely pulverizing a rare earth alloy sintered body by a hydrogen pulverization process, (b) preparing a first fine powder by finely pulverizing the first coarse powder, (c) preparing a second fine powder by pulverizing an alloy block of a rare earth alloy material, and (d) sintering a mixed powder including the first and second fine powders. The first and second fine powders each includes a main phase represented by (LR.sub.1-xHR.sub.x).sub.2T.sub.14A, where T is Fe and/or at least one non-Fe transition metal element; A is boron and/or carbon; LR is at least one light rare earth element; HR is at least one heavy rare earth element; and 0.ltoreq.x<1. The invention claimed is: 1. A method of making ***[process/method]*** a sintered body for a rare earth magnet, the method comprising the steps of: (a) preparing a first coarse powder by coarsely pulverizing a rare earth alloy sintered body by a hydrogen pulverization process; (b) preparing a first fine powder by finely pulverizing the first coarse powder; (c) preparing a second fine powder by pulverizing an alloy block of a rare earth alloy material; and (d) sintering a mixed powder

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			including the first and second fine powders; wherein each of the first and second fine powders includes a main phase having a composition represented by the general formula: (LR.sub.1-xHR.sub.x).sub.2T.sub.14A, where T is either Fe alone or a mixture of Fe and at least one transition metal element other than Fe; A is either boron alone or a mixture of boron and carbon; LR is at least one light rare earth element; HR is at least one heavy rare earth element; and 0.ltoreq.x<1. 2. The method ***[process/method]*** of claim 1, wherein the steps (b) and (c) respectively include the steps of preparing the first and second fine powders each including about 25 mass % to about 40 mass % of rare earth element(s) R (where R=LR.sub.1-xHR.sub.x) and about 0.6 mass % to about 1.6 mass % of A.
Filed: February 11, 2002 Issued: May 30, 2006 Expires: Feb 2022	7,053,745	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare earth metal-based permanent magnet, and process for producing the same Abstract A rare earth metal-based permanent magnet has a film layer formed substantially of only a fine metal powder on a metal forming the surface of the magnet. The rare earth metal-based permanent magnet having the film layer on its surface is produced in the following manner: A rare earth metal-based permanent magnet and a fine metal powder forming material are placed into a treating vessel, where both of them are vibrated and/or agitated, whereby a film layer made of a fine metal powder produced from the fine metal powder producing material is formed on a metal forming the surface of the magnet. Thus, the formation of a corrosion-resistant film such as plated film can be achieved at a high thickness accuracy by forming an electrically conductive layer uniformly and firmly on the entire surface of the magnet without use of a third component such as a resin and a coupling agent What is claimed is:

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			1. A rare earth metal-based permanent magnet which has a film layer made substantially of ***[composition of matter]*** only a fine metal powder formed directly on a metal surface of the magnet, particles of the fine metal powder having a longest diameter in a range of 0.001 .mu.m to 5 .mu.m, wherein said permanent magnet is a sintered magnet or a bonded magnet. 2. A rare earth metal-based permanent magnet according to claim 1, wherein said fine metal powder contains ***[composition of matter]*** at least one metal component selected from copper (Cu), iron (Fe), cobalt (Co), nickel (Ni) and chromium (Cr).
Filed: October 1, 2001 Issued: May 23, 2006 Expires: Oct 2021	7,048,808	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare-earth sintered magnet and method of producing the same Abstract The present invention provides a rare-earth sintered magnet exhibiting desirable magnetic properties in which the amount of Nd and/or Pr forming a non-magnetic phase in a grain boundary phase is reduced. Specifically, the present invention provides a rare-earth sintered magnet having a composition of (R1.sub.x+R2.sub.y)T.sub.100-x-y-zQ.sub.z where R1 is at least one element selected from the group consisting of all rare-earth elements excluding La (lanthanum), Y (yttrium) and Sc (scandium); R2 is at least one element selected from the group consisting of La, Y and Sc; T is at least one element selected from the group consisting of all transition elements; Q is at least one element selected from the group consisting of B and C, and including, as a main phase, a crystal grain of an Nd.sub.2Fe.sub.14B crystalline structure, wherein: molar fractions x, y and z satisfy 8.ltoreq.x.ltoreq.18 at %, 0.1.ltoreq.y.ltoreq.3.5 at % and 3.ltoreq.z.ltoreq.20 at %, respectively; and a concentration of R2 is higher in at least a part of a grain boundary phase than in the main phase crystal grains.

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			What is claimed is: 1. A rare-earth sintered magnet of a composition ***[composition of matter]*** of (R1.sub.x+R2.sub.y)T.sub.100-x-y-zQ.sub.z, where R1 is at least one element selected from the group consisting of all rare-earth elements excluding La, Y and Sc, R2 is Y and may optionally include La and/or Sc, T is at least one element selected from the group consisting of all transition elements, and Q is B and may optionally include C, and comprising a crystal grain of an Nd.sub.2Fe.sub.14B type compound as a main phase, wherein: molar fractions x, y and z satisfy 8.ltoreq.x.ltoreq.18 at %, 0.1.ltoreq.y.ltoreq.3.5 at % and 3.ltoreq.z.ltoreq.20 at %, respectively; and a concentration of R2 is higher in at least a part of a grain boundary phase than in the crystal grain, and wherein an amount of oxygen is in a range of 2000 ppm to 8000 ppm by weight. 3. A method of producing a rare-earth sintered magnet, ***[process/method]*** comprising the steps of: preparing a powder of a rare-earth alloy having a composition of (R1.sub.x+R2.sub.y)T.sub.100-x-y-zQ.sub.z where R1 is at least one element selected from the group consisting of all rare-earth elements excluding La, Y and Sc; R2 is Y and may optionally include La and/or Sc; T is at least one element selected from the group consisting of all transition elements; and Q is B and may optionally include C, wherein molar fractions x, y and z satisfy 8.ltoreq.x.ltoreq.18 at %, 0.1.ltoreq.y.ltoreq.3.5 at % and 3.ltoreq.z.ltoreq.20 at %, respectively, and wherein an amount of oxygen included in the rare-earth alloy powder is in a range of 2000 ppm by weight to 8000 ppm by weight; and sintering the rare-earth alloy powder, wherein R2 existing in a main phase crystal grain of an Nd.sub.2Fe.sub.14B crystalline structure in the rare-earth alloy before sintering is diffused into a grain boundary phase in the sintering step, whereby a concentration of R2 is higher in at least a part of the grain boundary phase than in the crystal grain.
Filed:	7,022,252	Assignee:	Permanent magnetic alloy and bonded magnet

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Nov8, 2002 Issued: April 4, 2006 Expires: Nov 2022		Hitachi Metals, Ltd. (Tokyo, JAPAN)	Abstract The permanent magnetic alloy of the present invention comprises an R--Fe--B alloy wherein R is at least one element selected from rare earth elements including Y. The R--Fe--B alloy has a composition mainly comprising Fe, substantially containing no N, and containing 4 at. % or more of B. The permanent magnetic alloy substantially comprises a TbCu.sub.7 hard magnetic phase (main phase) and a fine crystal having an average crystal grain size of less than 5 nm and/or an amorphous phase, and has high magnetic properties. What is claimed is: 1. A permanent magnetic alloy comprising ***[composition of matter]*** an R--Fe--B alloy wherein R is at least one element selected from rare earth elements including Y, the R--Fe--B alloy having a composition mainly comprising Fe, containing N in an amount of more than 0.0001 at. % but 0.01 at. % or less and containing 4 at. % or more of B; the R--Fe--B alloy substantially comprising a TbCu.sub.7 hard magnetic phase (main phase) and a fine crystal having an average crystal grain size of less than 5 nm and/or an amorphous phase; and the R--Fe--B alloy being produced by quenching a hot melt of said R--Fe--B alloy by a cooling roll method at a peripheral speed of the cooling roll within 5 to 28 m/s. .
Filed: June 25, 2002 Issued: March 28, 2006	7,018,485	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co.,*	Apparatus for subjecting rare earth alloy to hydrogenation process and method for producing rare earth sintered magnet using the apparatus Abstract An apparatus for subjecting a rare earth alloy block to a hydrogenation process includes a casing, gas inlet and outlet ports, a member arranged to produce a gaseous flow, and a windbreak plate. The casing defines an inner space for receiving a container. The container includes an upper opening and stores the

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Expires: June 2022		*Ltd., now a 100% subsisidiary of Hitachi Metals.*	rare earth alloy block therein. A hydrogen gas and an inert gas are introduced into the inner space through the gas inlet port, and are exhausted from the inner space through the gas outlet port. The gaseous flow is produced by a fan, for example, in the inner space. The windbreak plate is disposed upstream with respect to the gaseous flow that has been produced inside the inner space. Also, the windbreak plate reduces a flow rate of the gaseous flow that has been produced near the upper opening of the container. The invention claimed is: 1. **An apparatus** for subjecting a rare earth alloy block to a hydrogenation process, the apparatus comprising: a casing that defines an inner space for receiving a container, the container including an upper opening and arranged to store the rare earth alloy block therein; a gas inlet port for introducing a hydrogen gas and an inert gas into the inner space of the casing; a gas outlet port for exhausting the gases from the inner space of the casing; a member arranged to produce a gaseous flow inside the inner space; and a windbreak plate, which is disposed upstream with respect to the gaseous flow that has been produced inside the inner space and which reduces a flow rate of the gaseous flow that has been produced near the upper opening of the container. 8. A method ***[process/method]*** for producing a rare earth sintered magnet, the method comprising the steps of: (a) preparing a container, which includes an upper opening and which stores a rare earth alloy block therein; (b) pulverizing the rare earth alloy block into a coarse powder by performing a hydrogen pulverization process using the apparatus as recited in claim 1; (c) making a fine powder from the coarse powder; and (d) compacting the fine powder to obtain a green compact and sintering the green compact.
Filed: Jun	7,014,811	Assignee:	Method for producing rare earth sintered magnets

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e 25, 2002 Issued: March 21, 2006 Expires: March 2022		Neomax Co., Ltd. (Osaka, JAPAN) …. *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Abstract A method for producing rare earth sintered magnets includes the steps of pressing and compacting an alloy powder for the rare earth sintered magnets, thereby preparing a plurality of green compacts, arranging the green compacts on a receiving plane in a direction in which a projection area of each of the green compacts onto the receiving plane is not maximized, and heating the green compacts, thereby sintering the green compacts and obtaining a plurality of sintered bodies. The invention claimed is: 1. A method for producing rare earth sintered magnets ***[process/method]*** , the method comprising the steps of: (a) pressing and compacting an alloy powder for the rare earth sintered magnets, thereby preparing a plurality of green compacts; (b) arranging the green compacts on a receiving plane in a direction in which a projection area of each said green compact onto the receiving plane is not maximized; and (c) heating the green compacts within a reduced-pressure atmosphere, thereby sintering the green compacts and obtaining a plurality of sintered bodies; wherein step (b) includes the step of arranging the green compacts on the receiving plane so that the green compacts are in contact with each other in a horizontal direction; and step (b) includes the step of applying an anti-fusing agent composed of a slurry in which a Y.sub.2O.sub.3 powder is dispersed in an organic solvent to at least portions of the green compacts and arranging the green compacts on the receiving plane so that the green compacts are in contact with each other via the anti-fusing agent. 3. The method of claim 1, wherein the step (a) includes the step of preparing a plurality of green compacts each having at least one curved surface, and wherein the step (b) includes the step of arranging the green compacts on the receiving plane so that the at least one curved surface of each said green compact crosses the receiving plane substantially at right angles.

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			8. The method of claim 1, wherein the Y.sub.2O.sub.3 powder has a mean particle size of about 1 .mu.m to about 10 .mu.m. 9. A method for producing rare earth sintered magnets, the method comprising the steps of: (a) pressing and compacting an alloy powder for the rare earth sintered magnets, thereby preparing a plurality of green compacts; (b) arranging the green compacts on a receiving plane in a direction in which a projection area of each said green compact onto the receiving plane is not maximized; (c) heating the green compacts within a reduced-pressure atmosphere, thereby sintering the green compacts and obtaining a plurality of sintered bodies; and (d) removing a portion of each said sintered bodies, which portion has been in contact with the receiving plane, and a surrounding portion thereof.
Filed: September 3, 2002 Issued: March 21, 2006 Expires: Sept 2022	7,014,718	Assignee: Showa Denko K.K. (Tokyo, JAPAN)	Rare earth magnet alloy ingot, manufacturing method for the same, R-T-B type magnet alloy ingot, R-T-B type magnet, R-T-B type bonded magnet, R-T-B type exchange spring magnet alloy ingot, R-T-B type exchange spring magnet, and R-T-B type exchange spring bonded magnet Abstract One object of the present invention is to provide a rare earth magnet alloy ingot, which has improved magnetic properties. In order to achieve the object, the present invention provides a rare earth magnet alloy ingot, wherein the rare earth magnet alloy ingot comprises an R-T-B type magnet alloy (R represents at least one element selected from among rare earth elements, including Y; and T represents a substance predominantly comprising Fe, with a portion of Fe atoms being optionally substituted by Co, Ni, Cu, Al, Ga, Cr, and Mn.) containing at least one element selected from among Nd, Pr, and Dy in a total amount of 11.8 to 16.5% by atom and B in an amount of 5.6 to 9.1% by atom; and wherein as determined in an as-cast state of the alloy ingot, R-rich phase that measures 100 .mu.m or more is substantially absent on a cross section.

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			What is claimed is: 1. A rare earth magnet alloy ingot, wherein the rare earth magnet alloy ingot comprises ***[composition of matter]*** an R-T-B magnet alloy (R represents at least one element selected from among rare earth elements, including Y; and T represents a substance predominantly comprising Fe, with a portion of Fe atoms being optionally substituted by Co, Ni, Cu, Al, Ga, Cr, and Mn) containing at least one element selected from among Nd, Pr, and Dy in a total amount of 11.8 to 16.5% by atom and B in an amount of 5.6 to 9.1% by atom; and wherein as determined in an as-cast state of the alloy ingot, the as-cast state contains an R-rich phase that has a maximum width of 50 .mu.m, and the area occupied by the R-rich phase accounts for at least 50% of the cross section of the as-cast state. 2. A rare earth magnet alloy ingot according to claim 1, wherein the rare earth magnet alloy ingot contains crystal grains ***[composition of matter]*** having a diameter of at least 1,000 .mu.m as measured along the major axis occupy an area percentage of at least 5%, and has an average R-rich phase spacing of 10 .mu.m or less. 4. A rare earth magnet alloy ingot according to claim 1, wherein the rare earth magnet alloy ingot is cast ***[process/method]*** through centrifugal casting comprising receiving molten metal by means of a rotary body; sprinkling the molten metal by the effect of rotation of the rotary body; and causing the sprinkled molten metal to be deposited and solidify on an inner surface of a rotating cylindrical mold; and wherein the inner surface including a non-smooth surface. 7. A rare earth magnetic alloy ingot according to claim 1, wherein a portion of Fe atoms is optionally substituted with at least one of Co, Ni, Cu and Al.

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			[composition of matter]
Filed: June 12, 2003 Issued: March 21, 2006 Expires: June 2023	7,014,440	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Method of manufacturing rare earth magnet and powder compacting apparatus Abstract A method and apparatus for manufacturing a rare earth magnet is disclosed. In a first step, a compact is produced by compacting rare earth alloy powder in a predetermined space in an orienting magnetic field. Next, a demagnetizing process is performed for the compact, and the compact is ejected from the predetermined space. Then, a additional demagnetizing process is performed for magnetic powder adhering to a surface of the compact by applying an magnetic field to the compact after the compact is ejected. What is claimed is: 1. **A powder compacting apparatus** comprising: means for producing a compact by compacting rare earth alloy powder in an orienting magnetic field; first means for performing a demagnetizing process for the compact by applying a first magnetic field to the compact; and second means for performing a demagnetizing process for magnetic powder adhering to a surface of the compact by applying a second magnetic field to the compact along a route for moving the compact from a first position in which compaction of the rare earth alloy powder is performed to a second position
Filed: Sep t 25, 2001 Issued: February 28, 2006 Expires:	7,004,228	Assignee: Santoku Corporation (Kobe, JAPAN); Neomax Co., Ltd.	Process for producing, through strip casting, raw alloy for nanocomposite type permanent magnet Abstract To make a raw alloy, consisting mostly of element selected from Pr, Nd, Dy and Tb; Q is B and/or C; M is at least one element selected from Co, Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo, Ag, Pt, Au and Pb; and 1 at %.ltoreq.x<6 at %, 15 at %.ltoreq.y.ltoreq.30 at % and 0 at %.ltoreq.z.ltoreq.7 at %) is prepared. This molten alloy is rapidly cooled by a strip casting process in

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Sept 2021		(Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	which the alloy is fed onto a chill roller, rotating at a peripheral velocity of 3 m/s to less than 20 m/s, at a feeding rate per unit contact width of 0.2 kg/min/cm to 5.2 kg/min/cm. In this manner, an alloy including at least 60 volume percent of amorphous phase can be obtained. What is claimed is: 1. A method of making a raw alloy ***[process/method]*** for a magnet, the method comprising the steps of: preparing a molten alloy represented by Fe.sub.100-x-y-zR.sub.xQ.sub.yM.sub.z where R is at least one element selected from the group consisting of Pr, Nd, Dy and Tb; Q is B and/or C; M is at least one element selected from the group consisting of Co, Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo, Ag, Pt, Au and Pb; and x, y and z satisfy 1 at %.ltoreq.x<6 at %, 15 at %.ltoreq.y.ltoreq.30 at % and 0 at %.ltoreq.z.ltoreq.10 at %; and obtaining a thin-strip alloy, including an amorphous structure, by a strip casting process, in which the molten alloy is brought into contact with a chill roller within a vacuum or in a reduced pressure atmosphere so as to have a predetermined contact width in an axial direction of the chill roller and in which the molten alloy is moved along an outer circumference of the chill roller and cooled by rotating the chill roller; wherein the chill roller is rotated at a peripheral velocity of 3 m/s to less than 20 m/s, and wherein the molten alloy is continuously fed onto the chill roller at a feeding rate per unit contact width of 0.2 kg/min/cm to 5.2 kg/min/cm. 7. A magnet raw alloy prepared by the method of claim 1, wherein the raw alloy has a coercivity H.sub.cJ of at most 10 kA/m before being heated and crystallized. 8. The raw alloy of claim 7, wherein the raw alloy has a thickness of 70 .mu.m to 250 .mu.m.

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Filed: January 6, 2005 Issued: February 7, 2006 Expires: Jan 2025	6,995,643	Assignee: NEC Tokin Corporation (Miyagi, JAPAN)	Magnetically biasing bond magnet for improving DC superposition characteristics of magnetic coil Abstract In order to provide an inductance part having excellent DC superposition characteristic and core-loss, a magnetically biasing magnet, which is disposed in a magnetic gap of a magnetic core, is a bond magnet comprising magnetic powder and plastic resin with the content of the resin being 20% or more on the base of volumetric ratio and which has a specific resistance of 0.1.OMEGA.cm or more. The magnetic powder used is rare-earth magnetic powder having an intrinsic coercive force of 5 kOe or more, Curie point of 300.degree. C. or more, and an average particle size of 2.0 50 .mu.m. A magnetically biasing magnet used in an inductance part that is treated by the reflow soldering method has a resin content of 30% or more and the magnetic powder used therein is Sm--Co magnetic powder having an intrinsic coercive force of 10 kOe or more, Curie point of 500.degree. C. or more, and an average particle size of 2.5 50 .mu.m. A thin magnet having a thickness of 500 .mu.m or less can be realized for a small-sized inductance part. What is claimed is: 1. An inductance part comprising ***[composition of matter]*** a magnetic core formed with a magnetic gap having a gap length of about 50 10,000 .mu.m at least one position in a magnetic path thereof, a magnetically biasing magnet disposed in the vicinity of the magnetic gap for supplying a magnetic bias from both ends of the magnetic gap, and a coil winding wound on the magnetic core by at least one turn, wherein: said magnetically biasing magnet is a bond magnet comprising a plastic resin and magnetic powder dispersed in the plastic resin and has a specific resistance of 1.OMEGA.cm or more; said magnetic powder being a rare-earth magnetic powder which has an intrinsic coercive force of 5 kOe or more, a Curie Point Tc of 300.degree. C. or more, the

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			maximum particle size equal to or less than 150 .mu.m, and an average particle size of 2 50 .mu.m, said rare-earth magnetic powder being one selected from a group of Sm--Co magnetic powder, Nd--Fe--B magnetic powder, and Sm--Fe--N magnetic powder.
Filed: Feb 6, 2002 Issued: Feb 7, 2006 Expires: Feb 2022	6,994,797	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Permanent magnet and method for preparation thereof Abstract A ferrite magnet obtained by adding at least one element selected from the group consisting of Co, Ni, Mn and Zn to a ferrite having a hexagonal M-type magnetoplumbite structure, in which a portion of Sr, Ba, Pb or Ca is replaced with at least one element that is selected from the group consisting of the rare-earth elements (including Y) and Bi and that always includes La, during the fine pulverization process thereof, and then subjecting the mixture to re-calcining and/or sintering process(es). By adding a small amount of the element such as Co, Ni, Mn or Zn to the ferrite already having the hexagonal M-type magnetoplumbite structure during the fine pulverization process thereof, the magnetic properties can be improved. What is claimed is: 1. An oxide magnetic material ***[composition of matter]*** including, as a main phase, a ferrite having a hexagonal M-type magnetoplumbite structure, the material comprising: A, which is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R, which is at least one element selected from the group consisting of the rare-earth elements (including Y) and Bi and which always includes La; and Fe, wherein the ratio of the constituents A, R and Fe of the oxide magnetic material is represented by (1-x)AO.(x/2)R.sub.2O.sub.3.nFe.sub.2O.sub.3, Formula 1: where 0.05.ltoreq.x.ltoreq.0.3, and 6.0<n.ltoreq.6.7, and wherein an oxide of at least one element M selected from the group consisting of Co, Ni, Mn and Zn is added at 0.05 wt % to 2.0 wt % to the oxide magnetic material.

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			2. A ferrite magnet powder comprising the oxide magnetic material of claim 1. 3. A method of making a ferrite calcined body ***[process/method]*** , the method comprising the steps of: preparing a material powder mixture by mixing: a material powder of at least one compound that is selected from the group consisting of SrCO.sub.3, BaCO.sub.3, PbO and CaCO.sub.3; an oxide material powder of at least one element to be selected from the group consisting of the rare-earth elements (including Y) and Bi, the oxide material powder always including La.sub.2O.sub.3; and a material powder of Fe.sub.2O.sub.3; calcining the material powder mixture at a temperature of 1,100.degree. C. to 1,450.degree. C., thereby forming a ferrite calcined body having a composition represented by: (1-x)AO.(x/2)R.sub.2O.sub.3.nFe.sub.2O.sub.3 where A is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R is at least one element selected from the group consisting of the rare-earth elements (including Y) and Bi and always includes La; 0.05.ltoreq.x.ltoreq.0.3; and 6.0<n.ltoreq.6.7; and preparing a calcined body by adding an oxide material powder of at least one element M, selected from the group consisting of Co, Ni, Mn and Zn, to the ferrite calcined body.
Filed: November 13, 2002 Issued: February 7, 2006 Expires: Nov 2022	6,994,755	Assignee: University of Dayton (Dayton, OH, USA) Electron Energy Corporation (Landisville, PA, USA)	Method of improving toughness of sintered RE-Fe-B-type, rare earth permanent magnets Abstract Disclosed are methods for producing compositionally modified sintered RE--Fe--B-based rare earth permanent magnets, by the addition of small amounts of Nd, Cu, Ti, Nb, or other transition metals, and mixtures thereof, to maximize fracture toughness with corresponding improved machinability, while maintaining maximum energy product, said method comprising the steps of: (a) prepare a magnetic composition; (b) melt the composition and form powders with an average particle size smaller than 5 microns from the same;

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			(c) press the powder under a magnetic field to obtain green compacts, which are then sintered at from about 1030.degree. C. to 1130.degree. C., and heat treating the sintered material at from about 570.degree. C. to 900.degree. C. What is claimed is: 1. A method of improving ***[process/method]*** the room temperature fracture toughness of sintered RE--Fe--B permanent magnets comprising: a) providing an RE--Fe--B magnet composition where RE is Nd; b) modifying said magnet composition by increasing the amount of Nd to provide from 18 to 22% by weight Nd and c) sintering said magnet; wherein said magnet has a room temperature fracture toughness of 13.3 ft-lbs/in.sup.2 to 22.1 ft-lbs/in.sup.2. 2. A method of imparting improved fracture toughness ***[process/method]*** to a class of sintered rare earth permanent magnets comprising modifying the composition of an RE--Fe--B permanent magnet to produce the formula: (a) Nd.sub.wFe.sub.94-wB.sub.6 wherein: w has a value between 18 and 22; wherein said rare earth permanent magnet has a maximum energy product of at least about 30 MGOe and a room temperature fracture toughness of 13.3 ft-lbs/in.sup.2 to 22.1 ft-lbs/in.sup.2.
Filed: March 26, 2004 Issued: January 10, 2006 Expires: March	6,984,271	Assignee: Nissan Motor Co., Ltd. (Yokohama, JAPAN)	Rare earth magnet, process for producing same, and motor using rare earth magnet Abstract A rare earth magnet to be used in a motor. The rare earth magnet comprises rare earth magnet particles. Additionally, a rare earth oxide is present among the rare earth magnet particles, the rare earth oxide being represented by the following general formula (I): R.sub.2xR'.sub.2(1-x)O.sub.3 (I) where each of R and R' is one element selected from the group consisting of yttrium (Y), lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium

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2024			(Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu), and 0<x<1. What is claimed is: 1. A rare earth magnet comprising ***[composition of matter]*** : rare earth magnet particles; and a rare earth oxide which is present among the rare earth magnet particles, the rare earth oxide being represented by the following general formula (I): R.sub.2xR'.sub.2(1-x)O.sub.3 (I) where each of R and R' is one element selected from the group consisting of yttrium (Y), lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu), and 0<x<1, wherein R and R' refer to different elements and wherein the rare earth magnet particles and the rare earth oxide are physically or chemically bound together. 14. A process for producing ***[process/method]*** a rare earth magnet, comprising: preparing a mixture containing rare earth magnet powder and rare earth oxide powder whose rare earth oxide is represented by the following general formula (I): R.sub.2xR'.sub.2(1-x)O.sub.3 (I) where each of R and R' is an element selected from the group consisting of yttrium (Y), lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu), and 0<x<1; charging a forming die with the mixture; and forming the mixture; wherein R and R' refer to different elements and wherein the step of forming the mixture comprises physically or chemically bonding together the rare earth magnet powder and the rare earth oxide powder.
Filed:	6,984,270	Assignee:	Radial anisotropic sintered magnet and its production method, magnet rotor

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October 31, 2002 Issued: January 10, 2006 Expires: Jan 2026		Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	using sintered magnet, and motor using magnet rotor Abstract A radial anisotropic sintered magnet formed into a cylindrical shape includes a portion oriented in directions tilted at an angle of 30.degree. or more from radial directions, the portion being contained in the magnet at a volume ratio in a range of 2% or more and 50% or less, and a portion oriented in radial directions or in directions tilted at an angle less than 30.degree. from radial directions, the portion being the rest of the total volume of the magnet. The radial anisotropic sintered magnet has excellent magnet characteristics without occurrence of cracks in the steps of sintering and cooling for aging, even if the magnet has a shape of a small ratio between an inner diameter and an outer diameter. What is claimed is: 1. A method of producing a radial anisotropic magnet ***[process/method]*** , comprising the steps of: preparing a metal mold having a core including, in at least part thereof, a ferromagnetic body having a saturated magnetic flux density of 5 kG or more; packing a magnet powder in a cavity of the metal mold; and molding the magnet powder while applying an orientation magnetic field to the magnet powder by a horizontal-field vertical molding process.
Filed: February 6, 2003 Issued: December 27, 2005	6,979,409	Assignee: Magnequench, Inc. (Singapore)	Highly quenchable Fe-based rare earth materials for ferrite replacement. Abstract The present invention relates to highly quenchable Fe-based rare earth magnetic materials that are made by rapid solidification process and exhibit good magnetic properties and thermal stability. More specifically, the invention relates to isotropic Nd--Fe--B type magnetic materials made from a rapid solidification process with a lower optimal wheel speed and a broader

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Expires February, 2023			optimal wheel speed window than those used in producing conventional magnetic materials. The materials exhibit remanence (B.sub.r) and intrinsic coercivity (H.sub.ci) values of between 7.0 to 8.5 kG and 6.5 to 9.9 kOe, respectively, at room temperature. The invention also relates to process of making the materials and to bonded magnets made from the magnetic materials, which are suitable for direct replacement of anisotropic sintered ferrites in many applications. What is claimed is: 1. A magnetic material ***[composition of matter]*** having been prepared by a rapid solidification process ***[process/method]*** , followed by a thermal annealing process, said magnetic material having the composition, in atomic percentage, of $(R_{1-a}R'_{a})_uFe_{100-u-v-w-x-y}Co_vM_wT_xB_y$ wherein R is Nd, Pr, Didymium (a nature mixture of Nd and Pr at composition of $Nd_{0.75}Pr_{0.25}$), or a combination thereof; R′ is La, Ce, Y, or a combination thereof; M is one or more of Zr, Nb, Ti, Cr, V, Mo, W, and Hf; and T is one or more of Al, Mn, Cu, and Si, wherein 0.01≦a≦0.8, 7≦u≦13, 0≦v≦20, 0.01≦w≦1, 0.1≦x≦5, and 4≦y≦12, and wherein the magnetic material exhibits a remanence (B_r) value of from about 6.5 kG to about 8.5 kG and an intrinsic coercivity (H_{ci}) value of from about 6.0 kOe to about 9.9 kOe. 2. The magnetic material of claim 1, wherein the rapid solidification process is a melt-spinning or jet-casting process with a nominal wheel speed of from about 10 meter/second to about 60 meter/second.
Filed: May 31, 2001	6,979,374	Assignee: Seiko Epson	Magnetic powder, manufacturing method of magnetic powder and bonded magnets Abstract

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Issued: December 27, 2005 Expires: May 2021		Corporation (JAPAN)	Disclosed herein is a magnetic powder which can provide magnets having excellent magnetic properties and having excellent reliability especially excellent heat stability. The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-a Co.sub.a).sub.100-x-y-z B.sub.y M.sub.z (where R is at least one kind of rare-earth element excepting Dy, M is at least one kind of element selected from Ti, Cr, Nb, Mo, Hf, W, Mn, Zr and Dy, x is 7.1-9.9 at %, y is 4.6-8.0 at %, z is 0.1-3.0 at %, and a is 0-0.30, and the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein when the magnetic powder is mixed with a binding resin and then the mixture is subjected to compaction molding to form a bonded magnet having a density .rho.[Mg/m.sup.3], the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at a room temperature satisfies the relationship represented by the formula (BH).sub.max /.rho..sup.2 [.times.10.sup.-9 Jm.sup.3 /g.sup.2] 2.40, and the intrinsic coercive force H.sub.CJ of the bonded magnet at a room temperature is in the range of 400-750 kA/m. What is claimed is: 1. Magnetic powder composed of ***[composition of matter]*** an alloy composition represented by R.sub.x (Fe.sub.1-a Co.sub.a).sub.100-x-y-z B.sub.y M.sub.z (where R is at least one kind of rare-earth element excepting Dy, M is at least one kind of element selected from Ti, Cr, Nb, V, Mo, Hf, W, Mn, Zr and Dy, x is 7.1-9.9 at %, y is 4.6-8.0 at %, z is 0.1-3.0 at %, and a is 0-0.30), and the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein when the magnetic powder is mixed with a binding resin and then the mixture is subjected to injection molding or extrusion molding to form a bonded magnet having a density p[Mg/m.sup.3], a maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at room temperature

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			satisfies a relationship represented by the formula of (BH).sub.max /.rho..sup.2 [x10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.10, and an intrinsic coercive force H.sub.CJ of the bonded magnet at room temperature is in a range of 400-760 kA/m.
Filed: May 21, 2002 Issued: December 27, 2005 Expires: May 2022	6,978,533	Assignee: Matsushita Electric Industrial Co., Ltd. (Osaka, JAPAN)	Method of manufacturing rare earth-iron bond magnet Abstract A powder molded magnet manufactured by a method comprising the steps of: (1) forming a granular compound of diameter of not more than 250 .mu.m with a rare earth-iron rapid-quenched flake, which has not more than 150 .mu.m in diameter, being coarsely ground if necessary, and a binder, (2) dry-blending the granular compound with fatty acid metallic soap powder, (3) forming compressed powder from the granular compound dry-blended with the fatty acid metallic soap powder, by powder molding, and (4) heat-treating the compressed powder to a temperature higher than a thermally dissociating temperature of stabilized isocyanate. What is claimed is: 1. A method for manufacturing ***[process/method]*** an arc-shaped rare earth-iron bond magnet having a weight of not more than 0.5 g and a thickness of less than 1 mm, the method comprising the steps of: (1) grinding rare earth-iron melt-spun flakes to a diameter not greater than 150 .mu.m; (2) forming a granular compound by blending the rare earth-iron melt-spun flakes not greater than 150 .mu.m in diameter with an epoxy oligomer and a stabilized isocyanate curing agent; (3) grinding and classifying the granular compound to have a particle diameter of less than 250 .mu.m; (4) dry blending the granular compound having a particle diameter of less than 250 .mu.m with fatty acid metallic soap powder; (5) compressing a powder comprising the blend of the granular compound and the fatty acid metallic soap powder in a an arc-shaped

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			mold to form a compressed powder; and (6) heat-treating the compressed powder to form the arc-shaped rare earth-iron bond magnet having a weight of not more than 0.5 g and a thickness of less than 1 mm.
Filed: November 13, 2002 Issued: November 22, 2005 Expires: Nov 2022	6,966,953	Assignee: University of Dayton (Dayton, OH, USA) Electron Energy Corporation (Landisville, PA,USA)	Modified sintered RE-Fe-B-type, rare earth permanent magnets with improved toughness Abstract Compositionally modified, sintered RE-Fe--B-based rare earth permanent magnets demonstrate the optimum combination of mechanical and magnetic properties, thereby maximizing fracture toughness with corresponding improved machinability, while maintaining the maximum energy product (BH).sub.max. What is claimed is: 1. A class of sintered rare earth permanent magnets having improved fracture toughness, said magnets having the general formula ***[composition of matter]*** : (a) Nd.sub.w Fe.sub.94-w B.sub.6, wherein: w has a value between 18 and 22; said class of magnets having a maximum energy product of at least about 30 MGOe and a room temperature fracture toughness from 13.3 ft-lbs/in.sup.2 to 22.1 ft-lbs/in.sup.2. 2. Rare earth permanent magnets according to claim 1, wherein said magnets represented by Nd.sub.w Fe.sub.94-w B.sub.6 are selected from the group consisting of: Nd.sub.18 Fe.sub.76 B.sub.6, Nd.sub.19 Fe.sub.75 B.sub.6, Nd.sub.20 Fe.sub.74 B.sub.6, Nd.sub.21 Fe.sub.73 B.sub.6, and Nd.sub.22 Fe.sub.72 B.sub.6.
Filed: July 22, 2003	6,955,768	Assignee: Neomax Co., Ltd.	Permanent magnet and method for preparation thereof Abstract

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Issued: October 18, 2005 Expires: July 2023		(Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	A ferrite magnet obtained by adding a ferrite having a spinel-type structure to a ferrite having a hexagonal M-type magnetoplumbite structure, in which a portion of Sr, Ba, Pb or Ca is replaced with at least one element that is selected from the group consisting of the rare-earth elements (including Y) and Bi and that always includes La, during the fine pulverization process thereof. By adding a small amount of the element such as Co, Ni, Mn or Zn to the ferrite already having the hexagonal M-type magnetoplumbite structure during the fine pulverization process thereof, the magnetic properties can be improved. What is claimed is: 1. A method of making ***[process/method]*** a ferrite calcined body, the method comprising the steps of: preparing a material powder mixture by mixing: a material powder of at least one compound that is selected from the group consisting of $SrCO_3$, $BaCO_3$, PbO and $CaCO_3$; an oxide material powder of at least one element to be selected from the group consisting of the rare-earth elements (including Y) and Bi, the oxide material powder always including La_2O_3; and a material powder of Fe_2O_3; calcining the material powder mixture at a temperature of 1,100° C. to 1,450° C., thereby forming a ferrite calcined body having an M-type magnetoplumbite structure and a composition represented by the general formula: $(1-x)AO.(x/2)R_2O_3 .n\ Fe_2O_3$ where A is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R is at least one element selected from the group consisting of the rare-earth elements (including Y) and Bi and always includes La; $0.05 \leqq x < 0.3$; and $5.0 \leqq n \leqq 6.5$; preparing another material powder mixture by mixing an oxide material powder of at least one element selected from the group consisting of Co, Ni, Mn and Zn and a material powder of Fe_2O_3; calcining the material powder mixture at a temperature of 700° C. to 1,450° C., thereby forming a ferrite calcined body having a spinel-type structure and a composition represented by the general formula: $MO.Fe_2O_3$ where M is at least one element selected from the group consisting of Co, Ni, Mn and Zn; and preparing a calcined body by adding the ferrite calcined body

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			having the spinel-type structure at 0.2 wt % to 6.2 wt % to the ferrite calcined body having the M-type magnetoplumbite structure.
Filed: January 27, 2003 Issued: October 18, 2005 Expires: Jan 2023	6,955,729	Assignee: Aichi Steel Corporation (Tokai, JAPAN)	Alloy for bonded magnets, isotropic magnet powder and anisotropic magnet powder and their production method, and bonded magnet Abstract An alloy for bonded magnets of the present invention includes at least a main component of iron (Fe), 12-16 atomic % (at %) of rare-earth elements (R) including yttrium (Y), and 10.8-15 at % of boron (B), and is subjected to a hydrogen treatment method as HDDR process or d-HDDR process. Using the magnet powder obtained from carrying out d-HDDR processing, etc. on this magnet alloy, pellets with superior insertion characteristics into bonded magnet molding dies can be obtained, and bonded magnets with superior magnetic properties and showing low cost can be obtained. What is claimed is: 1. An alloy comprising ***[composition of matter]*** a main component of iron (Fe); 12-16 atomic % of R, where R is at least one selected from the group consisting of rare-earth elements and yttrium (Y), and 0.01-1.0 atomic % of lanthanum (La) is included in the 12-16 atomic % of R; and 10.8-15 atomic % of boron (B). 3. The alloy according to claim 1, further comprising 0.1-6 atomic % of cobalt (Co). 4. The alloy according to claim 1, further comprising at least one of gallium (Ga), zirconium (Zr), vanadium (V), aluminum (Al), titanium (Ti), hafnium (Hf) and copper (Cu) in a total amount of 0.1-2 atomic %; and at least one of niobium (Nb), tantalum (Ta) and nickel (Ni) in a total amount of 0.1-2 atomic

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			%. 5. The alloy according to claim 1, wherein 0.01-0.7 atomic % of La is included in the 12-16 atomic % of R. 6. An isotropic magnet powder made by a HDDR process comprising ***[process/method]*** a hydrogenation step where an alloy comprising a main composition of Fe; 12-16 atomic % of R, where R is at least one selected from the group consisting of rare-earth elements and yttrium (Y), and 0.01-1.0 atomic % of lanthanum (La) is included in the 12-16 atomic % of R; and 10.8-15 atomic % of B is maintained in a hydrogen gas atmosphere at 1023-1173 K, and after said hydrogenation step, a desorption step where hydrogen is removed from the alloy.
Filed: August 25, 2000 Issued: February 7, 2006 Expires: Aug 2020	6,995,488	Assignee: Matsushita Electric Industrial Co., Ltd. (Osaka, JAPAN)	Permanent magnet field small DC motor Abstract A permanent magnet field small DC motor includes an arc-shaped rare earth magnet of maximum thickness 1 mm or less fabricated by compression molding from rare earth iron based melt-spun flakes and a binder. The magnet is provided with a certain specific portion at both ends in the circumferential direction, which has no back yoke when the magnet is press-fit in a soft-magnetic frame. The arc-shaped rare earth magnet fabricated by compression molding from a material containing more rare earth iron based melt-spun flakes exhibits simultaneous increase of both a remanence as a function of magnetizing field and coercivity; and hence, exhibits a well-balanced demagnetization curve even in an unsaturated magnetized state. What is claimed is: 1. A permanent magnet field small DC motor comprising ***[composition of matter]*** : a soft-magnetic frame; and an arc-shaped permanent magnet fixed in

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			said soft-magnetic frame, wherein an outer surface of said arc-shaped permanent magnet has a pair of end portions and a middle portion therebetween in a thrust direction, said end portions fit along an inner surface of said soft-magnetic frame, and said middle portion has a pair of recessed sections that are recessed on outer middle portion regions of said middle portion with respect to said end portions.
Filed: November 13, 2002 Issued: February 7, 2006 Expires: Nov 2022	6,994,755	Assignee: University of Dayton (Dayton, OH, USA) Electron Energy Corporation (Landisville, PA,USA)	Method of improving toughness of sintered RE-Fe-B-type, rare earth permanent magnets Abstract Disclosed are methods for producing compositionally modified sintered RE--Fe--B-based rare earth permanent magnets, by the addition of small amounts of Nd, Cu, Ti, Nb, or other transition metals, and mixtures thereof, to maximize fracture toughness with corresponding improved machinability, while maintaining maximum energy product, said method comprising the steps of: (a) prepare a magnetic composition; (b) melt the composition and form powders with an average particle size smaller than 5 microns from the same; (c) press the powder under a magnetic field to obtain green compacts, which are then sintered at from about 1030.degree. C. to 1130.degree. C., and heat treating the sintered material at from about 570.degree. C. to 900.degree. C. What is claimed is: 1. A method of improving ***[process/method]*** the room temperature fracture toughness of sintered RE--Fe--B permanent magnets comprising: a) providing an RE--Fe--B magnet composition where RE is Nd; b) modifying said magnet composition by increasing the amount of Nd to provide from 18 to 22% by weight Nd and c) sintering said magnet; wherein said magnet has a room temperature fracture toughness of 13.3 ft-lbs/in.sup.2 to 22.1 ft-lbs/in.sup.2. 2. A method of imparting improved fracture toughness ***[process/method]*** to a class of sintered rare earth permanent magnets comprising modifying the

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			composition of an RE--Fe--B permanent magnet to produce the formula: (a) Nd.sub.wFe.sub.94-wB.sub.6 wherein: w has a value between 18 and 22; wherein said rare earth permanent magnet has a maximum energy product of at least about 30 MGOe and a room temperature fracture toughness of 13.3 ft-lbs/in.sup.2 to 22.1 ft-lbs/in.sup.2.
Filed: November 13, 2002 Issued: November 22, 2005 Expires: Nov 2022	6,966,953	Assignee: University of Dayton (Dayton, OH, USA) Electron Energy Corporation (Landisville, PA,USA)	Modified sintered RE-Fe-B-type, rare earth permanent magnets with improved toughness Abstract Compositionally modified, sintered RE-Fe--B-based rare earth permanent magnets demonstrate the optimum combination of mechanical and magnetic properties, thereby maximizing fracture toughness with corresponding improved machinability, while maintaining the maximum energy product (BH).sub.max. What is claimed is: 1. A class of sintered rare earth permanent magnets ***[composition of matter]*** having improved fracture toughness, said magnets having the general formula: (a) Nd.sub.w Fe.sub.94-w B.sub.6, wherein: w has a value between 18 and 22; said class of magnets having a maximum energy product of at least about 30 MGOe and a room temperature fracture toughness from 13.3 ft-lbs/in.sup.2 to 22.1 ft-lbs/in.sup.2. 2. Rare earth permanent magnets according to claim 1, wherein said magnets ***[composition of matter]*** represented by Nd.sub.w Fe.sub.94-w B.sub.6 are selected from the group consisting of: Nd.sub.18 Fe.sub.76 B.sub.6, Nd.sub.19 Fe.sub.75 B.sub.6, Nd.sub.20 Fe.sub.74 B.sub.6, Nd.sub.21 Fe.sub.73 B.sub.6, and Nd.sub.22 Fe.sub.72 B.sub.6.

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Filed: February 6, 2003 Issued: December 27, 2005 Expires: February 2023	6,979,409	Assignee: Magnequench, Inc. (Singapore, SG)	Highly quenchable Fe-based rare earth materials for ferrite replacement Abstract The present invention relates to highly quenchable Fe-based rare earth magnetic materials that are made by rapid solidification process and exhibit good magnetic properties and thermal stability. More specifically, the invention relates to isotropic Nd--Fe--B type magnetic materials made from a rapid solidification process with a lower optimal wheel speed and a broader optimal wheel speed window than those used in producing conventional magnetic materials. The materials exhibit remanence (B.sub.r) and intrinsic coercivity (H.sub.ci) values of between 7.0 to 8.5 kG and 6.5 to 9.9 kOe, respectively, at room temperature. The invention also relates to process of making the materials and to bonded magnets made from the magnetic materials, which are suitable for direct replacement of anisotropic sintered ferrites in many applications. CLAIMS 1. A magnetic material having been prepared by a rapid solidification process, followed by a thermal annealing process, said magnetic material having the composition, in atomic percentage, of (R1-aR′a)uFe100-u-v-w-x-yCovMwTxBy wherein R is Nd, Pr, Didymium (a nature mixture of Nd and Pr at composition of Nd0.75Pr0.25), or a combination thereof; R′ is La, Ce, Y, or a combination thereof; M is one or more of Zr, Nb, Ti, Cr, V, Mo, W, and Hf; and T is one or more of Al, Mn, Cu, and Si, wherein 0.01≦a≦0.8, 7≦u≦13, 0≦v≦20, 0.01≦w≦1, 0.1≦x≦5, and 4≦y≦12, and wherein the magnetic material exhibits a remanence (Br) value of from about 6.5 kG to about 8.5 kG and an intrinsic coercivity (Hci) value of from about 6.0 kOe to about 9.9 kOe.

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Filed: January 7, 2003 Issued: October 4, 2005 Expires: Jan 2023	6,951,625	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and isotropic bonded magnet Abstract Disclosed herein is a magnetic powder which can provide magnet having excellent magnetic properties and having excellent reliability especially excellent heat stability. The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-a Co.sub.a).sub.100-x-y-z-w B.sub.y M.sub.z (where R is at least one kind of rare-earth element excepting Dy, M is at least one kind of element selected from Ti, Cr, Nb, V, Mo, Hf, W, Mn, Zr and Dy, x is 7.1-9.9at%, y is 4.6-8.0at%, z is 0.1-3.0at%, and a is 0-0.30), and the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein when the magnetic powder is mixed with a binding resin and then the mixture is subjected to injection molding or extrusion molding to form a bonded magnet having a density .rho.[Mg/m.sup.3], the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at a room temperature satisfies the relationship represented by the formula (BH).sub.max/.rho..sup.2 [x10.sup.-9 J.multidot.m.sup.3/g.sup.2] .gtoreq. 2.10, and the intrinsic coercive force H.sub.CJ of the bonded magnet at the room temperature is in the range of 400-760 kA/m. What is claimed is: 1. An isotropic bonded magnet formed by ***[composition of matter]*** binding a magnetic powder containing Al with a binding resin, wherein the isotropic bonded magnet is characterized in that: the magnetic powder is composed of an alloy composition resented by R.sub.x (Fe.sub.1-x Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one rare-earth element, x is 7.1-9.9 at %, v is 0-0.30, z is 4.6-6.9 at %, and w is 0.02-1.5 at %), when the density of the isotropic bonded magnet is defined as .rho.[Mg/m.sup.3], the remanent magnetic flux density Br[T] at room temperature satisfies the relationship

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			represented by the formula of Br/.rho.[.times.10.sup.-6 T.multidot.m.sup.3 /g]>0.125; the irreversible susceptibility (.chi..sub.irr) of the isotropic bonded magnet which is measured by using an intersectioning point of a demagnetization curve in the J-H diagram representing point of a demagnetization curve in the J-H diagram representing the magnetic properties at the room temperature and a straight line which passes the origin in the J-H diagram and has a gradient (J/H) of -3.8.times.10.sup.-6 H/m as a starting point is less than 5.0.times.10.sup.-7 H/m; and the intrinsic coercive force (H.sub.CJ) of the isotropic bonded magnet at the room temperature is in the range of 320-720 kA/m.
Filed: March 7, 2003 Issued: September 13, 2005 Expires: March 2023	6,942,930	Assignee: Seiko Epson Corporation (JAPAN	Cooling roll, ribbon-shaped magnetic materials, magnetic powders and bonded magnets Abstract Disclosed herein is a cooling roll which can provide bonded a magnet having excellent magnetic properties and having excellent reliability. A melt spinning apparatus 1 is provided with a tube 2 having a nozzle 3 at the bottom thereof, a coil 4 for heating the tube and a cooling roll 5 having a circumferential surface 53 in which gas expelling grooves 54 are formed. A melt spun ribbon 8 is formed by injecting the molten alloy 6 from the nozzle 6 so as to be collided with the circumferential surface 53 of the cooling roll 5, so that the molten alloy 6 is cooled and then solidified. In this process, gas is likely to enter between a puddle 7 of the molten alloy 6 and the circumferential surface 53, but such gas is expelled by means of the gas expelling grooves 54. What is claimed is: 1. A ribbon-shaped magnetic material ***[composition of matter]*** , which is manufactured by colliding a molten alloy to a circumferential surface of a cooling roll so as to cool and then solidify the molten alloy, comprising: a roll

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			contact surface; and a free surface, the free surface being opposite the roll contact surface; wherein the roll contact surface is devoid of dimples; and the cooling roll has gas expelling means defined by at least one spiral-shaped groove with an average width of 0.5-90 .mu.m provided in the circumferential surface of the cooling roll, the gas expelling means for expelling gas entered between the circumferential surface and a puddle of the molten alloy, and preventing the molten alloy from entering the spiral-shaped groove. 2. A magnetic powder which is obtained by milling the ribbon-shaped magnetic material described in claim 1.
Filed: June 13, 2003 Issued: August 16, 2005 Expires: June 2023	6,929,758	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Permanent magnet and method for preparation thereof Abstract A ferrite magnet obtained by adding either an oxide of Mn or oxides of Mn and Co to a ferrite having a hexagonal M-type magnetoplumbite structure, in which a portion of Sr, Ba, Pb or Ca is replaced with at least one element that is selected from the group consisting of the rare earth elements (including Y) and Bi and that always includes La, during the fine pulverization process thereof, and then subjecting the mixture to re-calcining and/or sintering process(es). By adding a small amount of the element Mn or elements Mn and Co to the ferrite already having the hexagonal M-type magnetoplumbite structure during the fine pulverization process thereof, the magnetic properties can be improved. What is claimed is: 1. An oxide magnetic material ***[composition of matter]*** including, as a main phase, a ferrite having a hexagonal M-type magnetoplumbite structure, the material comprising: A, which is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R, which is at least one element selected from the group consisting of the rare

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			earth elements (including Y) and Bi and which always includes La; and Fe, wherein the ratio of the constituents A, R and Fe of the oxide magnetic material is represented by $(1-x)AO.(x/2)R_2O_3 .nFe_2O_3$, (Formula 1): where 0.05≦x≦0.35, and 5.0≦n≦6.7, and wherein either an oxide of Mn or oxides of Mn and Co is added at 0.3 wt % to 2.8 wt % to the oxide magnetic material. 5. A method of making ***[process/method]*** a ferrite calcined body, the method comprising the steps of preparing a material powder mixture by mixing: a material powder of at least one compound that is selected from the group consisting of $SrCO_3$, $BaCO_3$, PbO and $CaCO_3$; a material powder of at least one oxide that is selected from the group consisting of oxides of the rare earth elements (including Y) and Bi_2O_3 and that always includes La_2O_3; and a material powder of Fe_2O_3, calcining the material powder mixture at a temperature of 1,100° C. to 1,450° C., thereby forming a ferrite calcined body having a composition represented by: $(1-x)AO.(x/2)R_2O_3 .nFe_2O_3$ where A is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R is at least one element selected from the group consisting of the rare earth elements (including Y) and Bi and always includes La; 0.05≦x≦0.35; and 5.0≦n≦6.7, and preparing a calcined body by adding a material powder of an oxide of Mn or a material powder of oxides of Mn and Co to the ferrite calcined body.
Filed: September 27, 2001 Issued: August 9, 2005	6,926,963	Assignee: Sumitomo Metal Mining Co., Ltd. (Tokyo, JAPAN)	Highly weather-resistant magnet powder and magnet produced by using the same Abstract The objects of the present invention are to provide a highly weather-resistant iron-based magnet powder containing a rare-earth element, characterized by high coercive force in a practically important humid atmosphere, resin

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Expires: Sept 2021			composition containing the same powder for bonded magnets, and bonded and compacted magnets containing the same powder. The present invention provides the above-described products by optimizing the functions and types of the phosphate coating film, uniformly formed over the surfaces of the iron-based magnet powder particles containing a rare-earth element. We claim: 1. A highly weather-resistant magnet powder ***[composition of matter]*** comprising iron and a rare-earth element, wherein said magnet powder is an alloy powder selected from the group consisting of Nd--Fe--B and Sm--Fe--N; wherein particles of said magnet powder comprise uniform coating with a phosphate film to a thickness of 5 to 100 nm on the average; and wherein said particles of said magnet powder are prepared by crushing an alloy magnet powder in an organic solvent having added thereto phosphoric acid 7. A resin composition ***[composition of matter]*** for bonded magnets, comprising, as the ingredient present in the largest amount by weight, a highly weather-resistant magnet powder comprising a rare-earth element, wherein particles of said magnet powder comprise uniform coating with a phosphate film to a thickness of 5 to 100 nm on the average; and wherein said particles of said magnet powder are prepared by crushing an alloy magnet powder in an organic solvent having added thereto phosphoric acid.
Filed: March 24, 2003 Issued: June 7, 2005	6,902,685	Assignee: Neomax Co., Ltd. (Osaka, JAPAN *Originally Sumitomo*	Oxide magnetic material Abstract A ferrite magnet powder and a ferrite magnet exhibiting improved magnetic properties are provided at a reduced manufacturing cost. An application product and manufacturing methods thereof are also provided. An oxide magnetic material includes, as a main phase, a ferrite having a hexagonal M-

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Expires: March 2023		*Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	type magnetoplumbite structure. The material includes: A, which is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R, which is at least one element selected from the group consisting of Y (yttrium), the rare earth elements and Bi; Fe; and B (boron). The constituents A, R, Fe and B of the material satisfy the inequalities of 7.04 at %.ltoreq.A.ltoreq.8.68 at %, 0.07 at %.ltoreq.R.ltoreq.0.44 at %, 90.4 at %.ltoreq.Fe.ltoreq.92.5 at % and 0.015 at %.ltoreq.B.ltoreq.0.87 at % to the sum of the elements A, R, Fe and B. What is claimed is: 1. An oxide magnetic material ***[composition of matter]*** including, as a main phase, a ferrite having a hexagonal M-type magnetoplumbite structure, the material comprising: A, which is at least one element that is selected from the group consisting of Sr, Ba, Pb and Ca; R, which is at least one element that is selected from the group consisting of Y (yttrium), the rare earth elements and Bi; Fe; and B (boron), wherein the constituents A, R, Fe and B of the oxide magnetic material satisfy the inequalities of: 7.04 at %≦A≦8.68 at %; 0.07 at %≦R≦0.44 at %; 90.4 at %≦Fe≦92.5 at %; and 0.015 at %≦B≦0.87 at % with respect to the sum of the elements A, R, Fe and B; and wherein the material is represented by the general formula: $(1-x)AO.(x/2)R_2O_3.n(Fe_2O_3).y(B_2O_3)$ where 0.01≦x≦0.05, 0.001≦y≦0.05, and 5.2≦n≦6.2. 4. A method of making ***[process/method]*** a ferrite calcined body, the method comprising the steps of: preparing a material powder mixture by mixing: a material powder of at least one compound that is selected from the group consisting of $SrCO_3$, $BaCO_3$, PbO and $CaCO_3$; a material powder of at

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			least one oxide that is selected from the group consisting of an oxide of Y, oxides of the rare earth elements and Bi_2O_3; a material powder of Fe_2O_3 (iron oxide); and a material powder of B_2O_3 or H_3BO_3; and calcining the material powder mixture at a temperature of 1,100° C. to 1,300° C., thereby forming a ferrite calcined body having a composition represented by the general formula: $(1-x)AO.(x/2)R_2O_3.n(Fe_2O_3).y(B_2O_3)$ where A is at least one element selected from the group consisting of Sr, Ba, Pb and Ca; R is at least one element selected from the group consisting of the rare earth elements, including Y, and Bi; $0.01 \leqq x \leqq 0.05$; $0.001 \leqq y \leqq 0.05$; and $5.2 \leqq n \leqq 6.2$.
Filed: June 6, 2001 Issued: May 24, 2005 Expires: June 2021	6,896,745	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder, manufacturing method of magnetic powder and bonded magnets Abstract Disclosed herein is a magnetic powder which can provide magnets having excellent magnetic properties and having excellent reliability especially excellent heat stability. The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-a Co.sub.a).sub.100-x-y-z B.sub.y M.sub.z (where R is at least one kind of rare-earth element excepting Dy, M is at least one kind of element selected from Ti, Cr, Nb, V, Mo, Hf, W, Mn, Zr and Dy, x is 7.1-9.9 at %, y is 4.6-8.0 at %, z is 0.1-3.0 at %, and a is 0-0.30), and the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein when the magnetic powder is mixed with a binding resin and then the mixture is subjected to injection molding or extrusion molding to form a bonded magnet having a density .rho.[Mg/m.sup.3], the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at a room temperature satisfies the relationship represented by the formula (BH).sub.max/.rho..sup.2 [.times.10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.10, and the intrinsic

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			coercive force H.sub.CJ of the bonded magnet at a room temperature is in the range of 400-760 kA/m. What is claimed is: 1. A magnetic powder comprising ***[composition of matter]*** : an alloy composition represented by R.sub.x (Fe.sub.1-a Co.sub.a).sub.100-x-y-z B.sub.y M.sub.z (where R is at least one rare-earth element selected from the group consisting of Nd and Pr, a ratio of Pr with respect to a total mass of R is in the range of 20-60%, M is at least one element selected from Ti, Cr, Nb, V, Mo, Hf, W, Mn, and Zr, x is 7.1-9.9 at %, y is 4.6-8.0 at %, z is 0.1-3.0 at %, and a is 0-0.30); wherein the magnetic powder further comprises a composite structure having a soft magnetic phase and a hard magnetic phase; an average particle size of the magnetic powder is 1-50 .mu.m; and when the magnetic powder is mixed with a binding resin and then the mixture is subjected to injection molding or extrusion molding to form a bonded magnet having a density .rho.[Mg/m.sup.3], a maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at room temperature satisfies a relationship represented by a formula of (BH).sub.max/.rho..sup.2 [.times.10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.10, and an intrinsic coercive force H.sub.CJ of the bonded magnet at room temperature is in a range of 430-760 kA/m.
Filed: Aug 19, 2002 Issued: May 10, 2005 Expires:	6,890,392	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100%*	Nanocomposite magnet and method for producing same Abstract A method of making a material alloy for an iron-based rare earth magnet includes the step of forming a melt of an alloy with a composition of (Fe.sub.1-m T.sub.m).sub.100-x-y-z-n (B.sub.1-p C.sub.p).sub.x R.sub.y Ti.sub.2 M.sub.n. T is Co and/or Ni; R is at least one element selected from Y (yttrium) and the rare earth elements; and M is at least one element selected from Al, Si, V, Cr, Mn, Ni, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, wherein

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Aug 2022		*subsisidiary of Hitachi Metals.*	the following inequalities are satisfied: 10<x.ltoreq.25 at %, *6.ltoreq.y<10 at %, 0.5.ltoreq.z.ltoreq.12 at %, 0.ltoreq.m.ltoreq.0.5, 0.ltoreq.n.ltoreq.10 at % and 0.ltoreq.p.ltoreq.0.25. Next, the melt is fed onto a shoot with a guide surface tilted at about 1 degree to about 80 degrees with respect to a horizontal plane, thereby moving the melt onto a melt/roller contact region. The melt is then rapidly cooled using a chill roller to make a rapidly solidified alloy including an R.sub.2 Fe.sub.14 B phase. What is claimed is: 1. A method of making a material alloy ***[process/method]*** for an iron-based rare earth magnet, the method comprising the steps of: preparing a melt of an iron-based rare earth material alloy, the material alloy having a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100-x-y-z-n (B.sub.1-p C.sub.p).sub.x R.sub.y Ti.sub.2 M.sub.n, where T is at least one element selected from the group consisting of Co and Ni; R is at least one element selected from the group consisting of Y (yttrium) and the rare earth elements; and M is at least one element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, the mole fractions x, y, z, m, n and p satisfying the inequalities of: 10 at %<x.ltoreq.25 at %; 6 at %.ltoreq.y<10 at %; 0.5 at %.ltoreq.z.ltoreq.12 at %; 0.ltoreq.m.ltoreq.0.5; 0 at %.ltoreq.n.ltoreq.10 at %; and 0.ltoreq.p.ltoreq.0.25, respectively; feeding the melt of the material alloy onto a guide having a guide surface that defines an angle of about 1 degree to about 80 degrees with respect to a horizontal plane so as to move the melt onto a region where the melt comes into contact with a chill roller; and rapidly cooling the melt using the chill roller to make a rapidly solidified alloy comprising an R.sub.2 Fe.sub.14 B phase at about 60 volume percent or more and an iron-based boride phase, said iron-based borlde phase having ferromagnetic properties and existing around a grain boundary or sub-boundary of the R.sub.2 Fe.sub.4 B phase.

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Filed: August 9, 2001 Issued: April 26, 2005 Expires: Aug 2021	6,884,513	Assignee: Neomax Co. Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare earth metal-based permanent magnet having corrosion-resistant film and method for producing the same Abstract The chemical conversion film containing, at least as the constituent components thereof, (a) at least one of the metals selected from molybdenum, zirconium, vanadium, and tungsten; (b) a rare earth metal constituting the magnet; and (c) oxygen, which is formed on the surface of a rare earth metal-based permanent magnet according to the present invention, contains a composite metal oxide provided on the surface of the R-rich phase having a lower oxidation-reduction potential through a preferential reaction of the metallic ions that are present in the form of complex ions or oxide ions, such as of molybdenum, contained in the treatment solution, with the rare earth metals that elute from the magnet. Thus formed composite metal oxide reduces the difference in corrosion potential as to realize a uniform surface potential, and effectively suppresses the corrosion based on potential difference. Furthermore, the chemical conversion film thus formed exhibits excellent corrosion resistance even if it is provided as a thin film. The production method thereof can be implemented at low cost and by a simple process comprising treating the surface of the magnet by using a treatment solution containing a molybdate and the like. What is claimed is: 1. A permanent magnet comprising ***[composition of matter]*** : a rare earth metal-based permanent magnet; and a chemical conversion film provided directly on a surface of said magnet, said chemical conversion film containing, at least as the constituent components thereof, (a) at least one metal selected from the group consisting of molybdenum, zirconium, vanadium, and tungsten; (b) a rare earth metal from the rare earth metal-based permanent magnet; and (c) oxygen; and (d) phosphorous.

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Filed: October 8, 2002 Issued: April 12, 2005 Expires: Oct 2022	6,878,217	Assignee: Neomax Co. Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Rare earth metal-based permanent magnet having corrosion-resistant film and method for producing the same Abstract The chemical conversion film containing, at least as the constituent components thereof, (a) at least one of the metals selected from molybdenum, zirconium, vanadium, and tungsten; (b) a rare earth metal constituting the magnet; and (c) oxygen, which is formed on the surface of a rare earth metal-based permanent magnet according to the present invention, contains a composite metal oxide provided on the surface of the R-rich phase having a lower oxidation-reduction potential through a preferential reaction of the metallic ions that are present in the form of complex ions or oxide ions, such as of molybdenum, contained in the treatment solution, with the rare earth metals that elute from the magnet. Thus formed composite metal oxide reduces the difference in corrosion potential as to realize a uniform surface potential, and effectively suppresses the corrosion based on potential difference. Furthermore, the chemical conversion film thus formed exhibits excellent corrosion resistance even if it is provided as a thin film. The production method thereof can be implemented at low cost and by a simple process comprising treating the surface of the magnet by using a treatment solution containing a molybdate and the like. What is claimed is: 1. A method for producing a permanent magnet ***[process/method]*** comprising a rare earth metal-based permanent magnet having provided directly on the surface thereof a chemical conversion film containing, at least as the constituent components thereof, (a) at least one metal selected from the group consisting of molybdenum, zirconium, vanadium, and tungsten; (b) a rare earth metal from the rare earth metal-based permanent magnet; (c)

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			oxygen; and (d) phosphorous, said method comprising: directly treating the surface of a rare earth metal-based permanent magnet with a treatment solution containing at least one selected from the group consisting of a molybdic acid or a salt thereof, a molybdenum oxide, a molybdophosphoric acid or a salt thereof, a zirconic acid or a salt thereof, a zirconium oxide, a vanadic acid or a salt thereof, a vanadium oxide, a tungstic acid or a salt thereof, a tungsten oxide, wherein said treatment solution further contains a phosphoric acid or a salt thereof and/or a phosphorous acid or a salt thereof, wherein the treating causes a reaction between metallic ions in the treatment solution and the rare earth metals that elute from the magnet.
Filed: February 25, 2003 Issued: March 29, 2005 Expires: Feb 2023	6,872,326	Assignee: Seiko Epson Corporation (JAPAN)	Method of manufacturing magnetic powder, magnetic powder and bonded magnets Abstract A method of manufacturing magnetic powder is disclosed. This method can provide magnetic powder from which a bonded magnet having excellent magnetic properties and reliability can be manufactured. A melt spinning apparatus 1 is provided with a tube 2 having a nozzle 3 at the bottom thereof, a coil 4 for heating the tube and a cooling roll 5. The cooling roll 5 is constructed from a roll base 51 and a circumferential surface 53 in which gas flow passages 54 for expelling gas are formed. A melt spun ribbon 8 is formed by injecting the molten alloy 6 from the nozzle 3 so as to be collided with the circumferential surface 53 of the cooling roll 5, so that the molten alloy 6 is cooled and then solidified. In this process, gas is likely to enter between a puddle 7 of the molten alloy 6 and the circumferential surface 53, but such gas is expelled by means of the gas flow passages 54. The magnetic powder is obtained by milling thus formed melt spun ribbon 8. In this method, when the average pitch of these gas flow passages 54 is defined as P.mu.m and the average particle size of the magnetic powder is defined as D.mu.m, the relationship represented by the formula P<D is satisfied.

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			What is claimed is: 1. A magnetic powder which is manufactured by ***[process/method]*** milling a ribbon-shaped magnetic material which has been obtained by colliding a molten alloy of a magnetic material to a circumferential surface of a rotating cooling roll so as to cool and then solidify it, comprising: a plurality of particles, each particle including: an average particle size D.mu.m in the range of 10-20 .mu.m; a plurality of ridges and recesses, each ridge and recess having an average pitch in the range of 3-50 .mu.m, a length of D/30 .mu.m and an average depth or height in the range of 0.3-.mu.m; and a composite structure composed of a hard magnetic phase and a soft magnetic phase, each of the hard and soft magnetic phases having an average crystal grain size in the range of 1-100 mn; wherein the cooling roll is formed with gas flow passages as gas expelling means defined by a plurality of grooves for expelling gas entered between the circumferential surface and a puddle of the molten alloy in the circumferential surface thereof, a width of the grooves preventing the molten alloy from fully entering the grooves; and when an average pitch of these gas flow passages is defined as P.mu.m and the average particle size of the magnetic powder is defined as D.mu.m, a relationship represented by a formula P<D is satisfied.
Filed: September 9, 2002 Issued: March 15, 2005 Expires:	6,866,765	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Electrolytic copper-plated R-T-B magnet and plating method thereof Abstract An R-T-B magnet (R is at least one kind of rare-earth elements including Y, and T is Fe or Fe and Co) has an electrolytic copper-plating film where the ratio [I(200)/I(111)] of the X-ray diffraction peak intensity I(200) from the (200) plane to the X-ray diffraction peak intensity I(111) from the (111) plane is 0.1-0.45 in the X-ray diffraction by CuKal rays. This electrolytic copper-plating film is formed by an electrolytic copper-plating method using an

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Sept 2022			electrolytic copper-plating solution which contains 20-150 g/L of copper sulphate and 30-250 g/L of chelating agent and contains no agent for reducing copper ions and has a pH adjusted to 10.5-13.5. What is claimed is: 1. A method for forming an electrolytic copper plating ***[process/method]*** on an R-T-B magnet, wherein R is at least one of rare earth elements including Y, and T is Fe or Fe and Co, comprising using an electrolytic copper plating solution containing 20-150 g/L of copper sulfate and 30-250 g/L of a chelating agent without containing an agent for reducing a copper ion, the pH of said electrolytic copper plating solution being controlled to 10.5-13.5. 11. An R-T-B magnet ***[composition of matter]*** with a plating layer, wherein R is at least one of rare earth elements including Y, and T is Fe or Fe and Co, wherein said plating layer comprises an electrolytic copper plating layer and an electrolytic or electroless nickel plating layer in this order from the magnet side; wherein a ratio of I(200)/I(111), wherein I(200) is an X-ray diffraction peak intensity of a (200) face, and I(111) is an X-ray diffraction peak intensity of a (111) face, is 0.1-0.45 in the X-ray diffraction of said peak intensity of a (200) face, and I(111) is an X-ray diffraction peak intensity of a (111) face, is 0.1-0.45 in the X-ray diffraction of said electrolytic copper plating layer obtained with a CuK.alpha.1 line, and wherein said electrolytic copper plating layer is formed by an electrolytic copper plating method using an electrolytic copper plating solution containing 20-150 g/L of copper sulfate and 30-250 g/L of a chelating agent without containing an agent for reducing a copper ion, the pH of said electrolytic copper plating solution being controlled to 10.5-13.5.
Filed: July 12, 2002	6,863,839	Assignee: Sumitomo Metal	Composition for resin-bonded magnet, and resin-bonded magnet using the same

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Issued: March 8, 2005 Expires: July 2022		Mining Co., Ltd. (Tokyo, JAPAN)	Abstract A composition for resin-bonded magnets. The resin-bonded magnets using the composition of the resin have excellent service lives in industry, excellent magnetic characteristics and excellent mechanical strength. A composition for resin-bonded magnets contains a magnetic powder and resin binder. The magnetic powder contains a transition metal element as one of the constituent elements. The binder contains, as the major ingredient, a thermosetting resin containing an organic peroxide and having radical-polymerization reactivity, and is further incorporated with an N-oxyl compound. Also disclosed is a composition including magnetic powder, thermosetting resin having radical-polymerization reactivity and organic oxide as the major ingredients, and a resin-bonded magnet using the same. What is claimed is: 1. A composition ***[composition of matter]*** for resin-bonded magnets, comprising a magnetic powder (A) and resin binder (B), the former containing a transition metal element as one of the constituent elements, wherein the binder (B) comprises, as the major ingredient, a thermosetting resin (B-1) containing an organic peroxide(B-2) and having radical-polymerization reactivity, and is further incorporated with an N-oxyl compound (C), wherein the N-oxyl compound (C) is incorporated at 0.1 to 10 part by weight per 100 parts by weight of the thermosetting resin (B-1) having radical-polymerization reactivity.
Filed: March 14, 2002 Issued: March 8,	6,863,742	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Bulk anisotropic rare earth permanent magnet and preparation method Abstract A bulk anisotropic rare earth permanent magnet consists essentially of R, Fe or Fe and Co, and N, wherein R is selected from rare earth elements inclusive of Y and contains Sm as a main component, and has a primary phase of Th.sub.2

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2005 Expires: March 2022			Zn.sub.17 type rhombohedral crystal structure, a density of at least 90% of the true density, and unidirectionally oriented C-axis. By electric conduction hot pressing of SmFeN base powder under rapid heating and rapid cooling conditions, the powder can be worked into the anisotropic bulk magnet without decomposing the 2-17 phase. What is claimed is: 1. A method for preparing ***[process/method]*** a bulk anisotropic rare earth permanent magnet, comprising the steps of: placing in a magnetic field of at least 800 kA/m a rare earth magnet powder consisting essentially of R, Fe or Fe and Co, and N, wherein R is selected from rare earth elements inclusive of Y and contains Sm as a main component, and having a primary phase of Th.sub.2 Zn.sub.17 crystal structure, so that C-axis is oriented in the magnetic field direction, and monoaxially hot pressing the powder into a bulk body while heating the powder to the highest temperature within a time of 2 seconds to 5 minutes to provide a heated bulk body; and cooling the heated bulk body to below 300.degree. C. within a time of 5 seconds to 10 minutes, thereby obtaining a bulk anisotropic rare earth permanent magnet consisting essentially of R, Fe or Fe and Co, and N, wherein R is selected from the rare earth elements inclusive of Y and contains Sm as a main component and having a primary phase of Th.sub.2 Zn.sub.17 crystal structure, a density of at least 90% of the true density and unidirectionally oriented C-axis.
Filed: January 7, 2003 Issued: March 1, 2005	6,861,089	Assignee: Neomax Co. Ltd. (Osaka, JAPAN) *Originally Sumitomo*	Method of inhibiting production of projections in metal deposited-film Abstract A method of inhibiting production of projections in a metal deposited-film according to the present invention is characterized by using a vapor deposition apparatus comprising, in a vacuum-treating chamber, an evaporating section for a depositing material, and an accommodating member and/or a holding

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Expires: Jan 2023		*Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	member for accommodation and/or hold of work pieces, respectively, and, in depositing a metal depositing material on each of the surface of the work pieces with the accommodating member and/or the holding member being made rotated about the horizontal rotational axis thereof, carrying out vapor deposition with a Vickers hardness of a film formed on each of the surface of the work pieces maintained at 25 or more. According to the present invention, production of projections in a metal deposited-film can be effectively inhibited when forming the metal deposited-film of aluminum, zinc or the like on the surface of a work piece such as a rare earth metal-based permanent magnet**.** What is claimed is: 1. A method ***[process/method]*** of inhibiting production of projections in a metal deposited-film characterized by using a vapor deposition apparatus comprising, in a vacuum-treating chamber, an evaporating section for a depositing material, and an accommodating member and/or a holding member for accommodation and/or hold of work pieces, respectively, and, in depositing a metal depositing material on each of the surface of said work pieces with said accommodating member and/or said holding member being made rotated about the horizontal rotational axis thereof, carrying out vapor deposition with a Vickers hardness of a film formed on each of the surface of said work pieces maintained at 25 or more. said accommodating member and/or a holding member for accommodation and/or hold of work pieces is a tubular barrel for accommodation of said work pieces, said tubular barrel is formed of a mesh net having an open area ratio of 50 to 85%, said tubular barrel is revolvably supported circumferentially outside a horizontal rotational axis of a support member made rotatable about the rotational axis, for revolution about the rotational axis of said support member by rotating said support member, said tubular barrel revolves about the rotational axis of said support member, whereby vapor deposition is carried out under a condition that said work pieces collide with and rub against one another in said tubular barrel, a plurality of

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			said tubular barrels are supported in an annular shape circumferentially outside the rotational axis of said support member, and said work piece is a rare earth metal-based permanent magnet.
Filed: January 16, 2003 Issued: February 22, 2005 Expires: Jan 2023	6,858,156	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Ferrite magnet and both rotor and magnet roll comprising the same Abstract A ferrite magnet having a basic composition represented by the following general formula: (A.sub.1-x R.sub.x)O.n[(Fe.sub.1-y M.sub.y).sub.2 O.sub.3] by atomic ratio, wherein A is Sr and/or Ba, R is at least one of rare earth elements including Y, M is at least one element selected from the group consisting of Co, Mn, Ni and Zn, and x, y and n are numbers meeting the conditions of 0.01.ltoreq.x.ltoreq.0.4, [x/(2.6n)].ltoreq.y.ltoreq.[x/(1.6n)], and 5.ltoreq.n.ltoreq.6, and substantially having a magnetoplumbite crystal structure, is obtained by uniformly mixing a compound of Sr and/or Ba with an iron compound; calcining the resultant uniform mixture; adding a compound of the R element and/or the M element to the resultant calcined powder at a pulverization step thereof; and sintering the resultant mixture. The compound of the R element and/or the M element may be added at a percentage of more than 0 atomic % and 80 atomic % or less, on an element basis, at a mixing step before calcination. What is claimed is: 1. A ferrite magnet having a basic composition ***[composition of matter]*** represented by the following general formula: wherein A is Sr and/or Ba, R is at least one rare earth element including Y, M is at least one element selected from the group consisting of Co, Mn, Ni and Zn, and x, y and n are numbers meeting the following conditions:

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			0.01.ltoreq.x.ltoreq.0.4, 0.005.ltoreq.y.ltoreq.0.04, and 5.ltoreq.n.ltoreq.6, said ferrite magnet having a magnetoplumbite crystal structure, wherein the concentration of said R element and/or said M element is higher in crystal grain boundaries than in magnetoplumbite crystal grains.
Filed: September 10, 2001 Issued: February 15, 2005 Expires: Sept 2021	6,856,231	Assignee: NEC Tokin Corporaton (Miyagi, JAPAN)	Magnetically biasing bond magnet for improving DC superposition characteristics of magnetic coil Abstract In order to provide an inductance part having excellent DC superposition characteristic and core-loss, a magnetically biasing magnet, which is disposed in a magnetic gap of a magnetic core, is a bond magnet comprising magnetic powder and plastic resin with the content of the resin being 20% or more on the base of volumetric ratio and which has a specific resistance of 0.1.OMEGA..cndot.cm or more. The magnetic powder used is rare-earth magnetic powder having an intrinsic coercive force of 5 kOe or more, Curie point of 300.degree. C. or more, and an average particle size of 2.0-50 .mu.m. A magnetically biasing magnet used in an inductance part that is treated by the reflow soldering method has a resin content of 30% or more and the magnetic powder used therein is Sm--Co magnetic powder having an intrinsic coercive force of 10 kOe or more, Curie point of 500.degree. C. or more, and an average particle size of 2.5-50 .mu.m. A thin magnet having a thickness of 500 .mu.m or less can be realized for a small-sized inductance part. What is claimed is: 1. A permanent magnet which is a bond magnet comprising ***[composition of matter]*** a plastic resin and magnetic powder dispersed in the plastic resin without any inorganic glass, wherein said magnet has a specific resistance of 0.1 .OMEGA..cndot.cm or more and said magnetic powder has an intrinsic

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			coercive force of 5 kOe or more, a Curie point Tc of 300.degree. C. or more, and the maximum particle size which is equal to or less than 150 .mu.m.
Filed: February 24, 2003 Issued: February 15, 2005 Expires: Feb 2023	6,855,265	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and isotropic bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a bonded magnet having excellent magnetic properties and having excellent reliability especially excellent heat stability. The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one kind of rare-earth element, x is 7.1-9.9 at %, y is 0-0.30, z is 4.6-6.9 at %, and w is 0.02-1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein the magnetic powder has magnetic properties in which, when the magnetic powder is formed into an isotropic bonded magnet having a density .rho.[Mg/m.sup.3] by mixing with a binding resin and then molding it, the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at the room temperature satisfies the relationship represented by the formula (BH).sub.max /.rho..sup.2 [.times.10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.1, and the intrinsic coercive force (H.sub.CJ) of the bonded magnet at the room temperature is in the range of 320-720 kA/m. What is claimed is: 1. An isotropic bonded magnet ***[composition of matter]*** formed by binding a magnetic powder containing Al with a binding resin, wherein the isotropic bonded magnet is characterized in that, the magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one rare-earth element, x is 7.1-9.9 at %, y is 0-0.30, z is 4.6-6.9 at %, and W is 0.02-1.5 at %) when the density of the

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			isotropic bonded magnet is .rho.[Mg/m.sup.3], the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] at room temperature satisfies the relationship represented by the formula (BH).sub.max.rho..sup.2 [.times.10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.1, and the intrinsic coercive force (H.sub.CJ) of the bonded magnet at the room temperature is in the range of 320-720 kA/m.
Filed: October 8, 2002 Issued: February 8, 2005 Expires: Oct 2022	6,852,246	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and isotropic bonded magnet Abstract Disclosed herein is magnetic powder which can provide a magnet having a high magnetic flux density and excellent magnetizability and reliability especially excellent heat resistance property (heat stability). The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Si.sub.w (where R is at least one kind of rare-earth element, x is 8.1-9.4 at %, y is 0-0.30, z is 4.6-6.8 at %, and w is 0.2-3.0 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein the magnetic powder has characteristics in which, when the magnetic powder is formed into an isotropic bonded magnet by mixing with a binding resin and then molding it, the irreversible susceptibility (.chi..sub.irr which is measured by using an intersection of a demagnetization curve in the J-H diagram representing the magnetic characteristics at the room temperature and a straight line which passes the origin in the J-H diagram and has a gradient .times.J/H of -3.8.times.10.sup.-6 H/m as a starting point is less than 5.0.times.10.sup.-7 H/m, and the intrinsic coercive force (H.sub.CJ) of the magnet at the room temperature is in the range of 406-717 kA/m. What is claimed is: 1. An isotropic rare-earth bonded magnet comprising ***[composition of matter]***

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			: a magnetic powder having a composition consisting of R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Si.sub.w (where R is at least one rare-earth element, x is 8.1-9.4 at %, y is 0-0.30, z is 4.6-6.8 at %, and w is 0.2-3.0 at %), the magnetic powder having a composite structure including a soft magnetic phase and a hard magnetic phase; and a binding resin, wherein the isotropic rare-earth bonded magnet is characterized in that an irreversible susceptibility (.chi..sub.irr) is equal to or less than 5.0.times.10.sup.-7 H/m; the irreversible susceptibility is measured by using a point where a demagnetization curve in a J-H diagram and a straight line that passes through the origin in the J-H diagram intersect; the demagnetization curve represents the magnetic characteristics at room temperature, and the straight line has a gradient (J/H) of -3.8.times.10.sup.-6 ; and the intrinsic coercive force (H.sub.CJ) of the magnet at the room temperature is in the range of 406-717 kA/m.
Filed: September 10, 2003 Issued: February 1, 2005 Expires: Sept 2023	6,850,140	Assignee: Magnetic Technologies Corporation (Rochester, NY, USA)	Layered magnets and methods for producing same Abstract The present invention is directed to layered magnets, magnetic rolls made therefrom, methods for increasing the magnetic field strength of a ferritic magnet, methods for increasing the magnetic field strength of a magnetic roll, methods for increasing the magnetic field uniformity of a rare earth magnet, and methods for increasing the magnetic field uniformity of a magnetic roll. Layered magnets include a rare earth magnet having a magnetic field, and superposed upon the rare earth magnet, a layer of ferritic magnet bonded thereto. Layered magnets exhibit greater magnetic field strength and a substantially more uniform magnetic field. What is claimed: 1. A magnetic roll comprising ***[composition of matter]*** a cylindrical core adapted for use with a reprographics apparatus, superposed upon the

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			cylindrical core, at least one layered magnet; the layered magnet comprising a rare earth magnet having a magnetic field, and superposed upon the rare earth magnet, a layer of ferritic magnetic material bonded thereto; the magnetic field of the layered magnet in the direction outward from and normal to the layer of ferritic magnet being substantially more uniform than the magnetic field in said direction exhibited by the rare earth magnet alone.
Filed: May 27, 2003 Issued: January 4, 2005 Expires: May 2023	6,838,014	Assignee: Seiko Epson Corporation (JAPAN)	Cooling roll, ribbon-shaped magnetic materials, magnetic powders and bonded magnets Abstract Disclosed herein is a cooling roll which can provide bonded a magnet having excellent magnetic properties and having excellent reliability. A melt spinning apparatus is provided with a tube 2 having a nozzle 3 at the bottom thereof, a coil 4 for heating the tube and cooling roll 5 having a circumferential surface 53 in which dimple correcting means is provided. A melt spun ribbon 8 is formed by injecting the molten alloy 6 from the nozzle 3 so as to be collided with the circumferential surface 53 of the cooling roll 5 in an inert gas atmosphere (ambient gas) such as helium gas, so that the molten alloy 6 is cooled and then solidified. In this process, dimples to be produced on a roll contact surface of the melt spun ribbon are divided by the dimple correcting means, thereby preventing formation of huge dimples. What is claimed: 1. A ribbon-shaped magnetic material ***[composition of matter]*** which is manufactured by colliding a molten alloy to a circumferential surface of a cooling roll so as to cool and then solidify it, comprising: a plurality of ridges and grooves formed on a roll contact surface of the ribbon-shaped magnetic material, said grooves having a width in the range of 1-50 μm: wherein the plurality of ridges and grooves are transferred to the roll contact surface of the ribbon-shaped magnetic material from the circumferential surface of the cooling roll by dimple correcting means formed on the

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			circumferential surface of the cooling roll for dividing dimples that are produced on the roll contact surface of the ribbon-shaped magnetic material which is in contact with the circumferential surface of the cooling roll, the dimple correcting means defined by a plurality of ridges provided by forming a plurality of grooves with an average width of 1-50 µm, the width of the grooves enabling the expelling of a gas that is entered between the molten alloy and the circumferential surface of the cooling roll. 6. A magnetic powder ***[composition of matter]*** , which is obtained by milling a ribbon-shaped magnetic material which is manufacturing by colliding a molten alloy to a circumferential surface of a cooling roll so as to a cool and then solidify it, comprising: a composite structure composed of a hard magnetic phase and a soft magnetic phase, an average crystal grain size of each of the hard magnetic phase and the soft magnetic phase being in the range of 1-100 nm; wherein the circumferential surface of the cooling roll has dimple correcting means for dividing dimples to be produced on a roll contact surface of the ribbon-shaped magnetic material which is in contact with the circumferential surface of the cooling roll, the dimple correcting means defined by a plurality of ridges provided by forming a plurality of grooves with an average width of 1-50 µm, the width of the grooves enabling the expelling of a gas that is entered between the molten alloy and the circumferential surface of the cooling roll, and a shape of the plurality of ridges and grooves with the average width of 1-50 µm formed on the circumferential surface of the cooling roll is transferred to a surface of the ribbon-shaped magnetic material after collision of the molten alloy to the cooling roll.
Filed: Apr il 16, 2002 Issued:	6,833,107	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Heat-treating furnace with magnetic field and heat treatment method using same Abstract A heat-treating furnace with a magnetic field comprising (a) a magnetic field-

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December 21, 2004 Expires: April 2022			generating means constituted by an outer, ring-shaped, permanent magnet assembly comprising a plurality of permanent magnet segments combined with their magnetization directions oriented such that a magnetic flux flows in a diameter direction, and an inner, ring-shaped, permanent magnet assembly disposed inside the outer, ring-shaped, permanent magnet assembly and comprising a plurality of permanent magnet segments combined with their magnetization directions oriented such that a magnetic flux flows in a diameter direction; and (b) a heat treatment means disposed in a center hole of the inner, ring-shaped, permanent magnet assembly and comprising a cooling means, a heating means, and a heat-treating container containing heat-treating holder for holding a plurality of articles to be heat-treated in this order from outside, wherein an axial center of a magnetic field generated by the inner and outer ring-shaped, permanent magnet assemblies is substantially identical with an axial center of an article assembly in the heat-treating container. What is claimed is: 1. A heat-treating furnace with a magnetic field comprising (a) a magnetic field-generating means constituted by one ring-shaped, permanent magnet assembly comprising a plurality of permanent magnet segments combined with their magnetization directions oriented such that a magnetic flux flows in a diameter direction, said permanent magnet segment being constituted by combining a plurality of permanent magnet pieces; and (b) a heat treatment means disposed in a center hole of said ring-shaped, permanent magnet assembly and comprising a cooling means, a heating means, and a heat-treating container for containing a heat-treating holder for holding a plurality of articles to be heat-treated in this order from outside, wherein said ring-shaped, permanent magnet assembly has an inner diameter of 120 mm or more, an outer diameter (D.sub.1) of 300 mm or more, and an axial length (H) of 100 mm or more, and wherein the axial length H and the outer diameter D.sub.1 of said ring-shaped, permanent magnet assembly meet the requirement of

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			2.ltoreq.D.sub.1 /H.ltoreq.10. 16. A method ***[process/method]*** for heat-treating a plurality of articles at a time in a magnetic field, using a heat-treating furnace with a magnetic field …
Filed: June 27, 2002 Issued: December 21, 2004 Expires: June 2022	[6,833,036]()	Assignee: TDK Corporation (Tokyo, JAPAN)	Rare earth permanent magnet Abstract A rare earth permanent magnet consists of 20-40 wt % of at least one rare earth element R, 0.5-4.5 wt % of boron B, 0.03-0.5 wt % of M (at least one of Al, Cu, Sn and Ga), 0.01-0.2 wt % of Bi, and the balance being at least one transition metal element T. What is claimed is: 1. A rare earth permanent magnet consisting ***[composition of matter]*** essentially of from 20 wt % to 40 wt % of at least one rare earth element R, from 0.5 wt % to 4.5 wt % of boron B, from 0.03 wt % to 0.5 wt % of M that is at least one element selected from the group of Al, Cu, Sn and Ga, from 0.01 wt % to 0.2 wt % of Bi, and the balance being at least one transition metal element T. 2. A rare earth permanent magnet comprising ***[composition of matter]*** from 20 wt % to 40 wt % of at least one rare earth element R, from 0.5 wt % to 4.5 wt % of boron B, from 0.03 wt % to 0.5 wt % of M that is at least one element selected from the group of Al, Cu, Sn and Ga, from 0.01 wt % to 0.2 wt % of Bi, and at least one transition metal element T
Filed: September 14, 2001	[6,818,041]()	Assignee: Neomax Co., Ltd	Magnetic alloy powder for permanent magnet and method for producing the same

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Issued: November 16, 2004 Expires: Sept 2021		(Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Abstract Magnetic alloy powder for a permanent magnet contains: R of about 20 mass percent to about 40 mass percent (R is Y, or at least one type of rare earth element); T of about 60 mass percent to about 79 mass percent (T is a transition metal including Fe as a primary component); and Q of about 0.5 mass percent to about 2.0 mass percent (Q is an element including B (boron) and C (carbon)). The magnetic alloy powder is formed by an atomize method, and the shape of particles of the powder is substantially spherical. The magnetic alloy powder includes a compound phase having Nd.sub.2 Fe.sub.14 B tetragonal structure as a primary composition phase. A ratio of a content of C to a total content of B and C is about 0.05 to about 0.90. What is claimed is: 1. Magnetic alloy powder ***[composition of matter]*** for a permanent magnet containing: R of about 20 mass percent to about 40 mass percent (R is Y or at least type of rare earth element); T of about 60 mass percent to about 79 mass percent (T is a transition metal including Fe as a primary component); and Q of about 0.5 mass percent to about 2.0 mass percent (Q is an element including B (boron) and C (carbon)), wherein the magnetic alloy powder is formed by an atomize method, the shape of particles of the powder being substantially spherical, the magnetic alloy powder includes a first compound phase having Nd.sub.2 Fe.sub.14 B tetragonal structure as a primary composition phase and a second compound phase having a diffraction peak in a position in which lattice spacing d is about 0.295 nm to about 0.300 nm, and a ratio of a content of C to a total content of B and C is about 0.05 to about 0.90. 5. A production method ***[process/method]*** of magnetic alloy powder for a permanent magnet including the steps of forming a molten alloy including R of about 20 mass percent to about 40 mass percent (R is Y or at least one type of rare earth element); T of about 60 mass percent to about 79 mass percent (T is

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			a transition metal including Fe as a primary component); and Q of about 0.5 mass percent to about 2.0 mass percent (Q is an element including B (boron) and C (carbon)), and atomizing the molten alloy into a non-oxidizing atmosphere to produce the magnetic alloy powder, said magnetic alloy powder including a first compound phase having Nd.sub.2 Fe.sub.14 B tetragonal structure as a primary composition phase and a second compound phase having a diffraction peak in a position in which lattice spacing d is about 0.295 nm to about 0.300 nm.
Filed: July 30, 2003 Issued: November 9, 2004 Expires: July 2023	6,814,776	Assignee: Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Iron base rare earth alloy powder and compound comprising iron base rare earth alloy powder and permanent magnet using the same Abstract An iron-based rare-earth alloy powder includes: a first iron-based rare-earth alloy powder, which has a mean particle size of 10 .mu.m to 70 .mu.m and of which the powder particles have aspect ratios of 0.4 to 1.0; and a second iron-based rare-earth alloy powder, which has a mean particle size of 70 .mu.m to 300 .mu.m and of which the powder particles have aspect ratios of less than 0.3. The first and second iron-based rare-earth alloy powders are mixed at a volume ratio of 1:49 to 4:1. In this manner, an iron-based rare-earth alloy powder with increased flowability and a compound to make a magnet are provided What is claimed is: 1. An iron-based rare-earth alloy powder ***[composition of matter]*** comprising: a first iron-based rare-earth alloy powder, which has a mean particle size of 10 .mu.m to 70 .mu.m and of which the powder particles have aspect ratios of 0.4 to 1.0; and a second iron-based rare-earth alloy powder, which has a mean particle size of 70 .mu.m to 300 .mu.m and of which the powder particles have aspect ratios of less than 0.3, wherein the first and

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			second iron-based rare-earth alloy powders are mixed at a volume ratio of 1:49 to 4:1. 2. The iron-based rare-earth alloy powder ***[composition of matter]*** of claim 1, wherein the first iron-based rare-earth alloy powder has a composition represented by the general formula: $(Fe_{1-m}T_m)_{100-x-y-z}Q_xR_yM_z$ where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C and always includes B; R is at least one rare-earth element selected from the group consisting of Pr, Nd, Dy and Tb; M is at least one element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb; and the mole fractions x, y, and z satisfy the inequalities of: 10 at %≦x≦30 at %; 2 at %≦y<10 at %; 0 at %≦z≦10 at %; and 0≦m≦0.5, respectively 12. A method of making ***[process/method]*** an iron-based rare-earth alloy powder, the method comprising the steps of: (a) providing a first iron-based rare-earth alloy powder, which has a mean particle size of 10 μm to 70 μm and of which the powder particles have aspect ratios of 0.4 to 1.0; (b) providing a second iron-based rare-earth alloy powder, which has a mean particle size of 70 μm to 300 μm and of which the powder particles have aspect ratios of less than 0.3; and (c) mixing the first and second iron-based rare-earth alloy powders at a volume ratio of 1:49 to 4:1
Filed: March 11, 2004 Issued:	[6,811,620](#)	Assignee: TDK Corporation (Tokyo, JAPAN)	R-T-B system rare earth permanent magnet Abstract An R--T--B system rare earth permanent magnet, which is a sintered body comprising: a main phase consisting of an R.sub.2 T.sub.14 B phase (wherein R represents one or more rare earth elements (providing that the rare earth

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November 2, 2004 Expires: March 2024			elements include Y), and T represents one or more transition metal elements essentially containing Fe, or Fe and Co); and a grain boundary phase containing a higher amount of R than the above main phase, wherein a product that is rich in Zr exists in the above R.sub.2 T.sub.14 B phase. The product that is rich in Zr has a platy or acicular form. The R--T--B system rare earth permanent magnet containing the product enables to inhibit the grain growth, while keeping a decrease in magnetic properties to a minimum, and to obtain a wide suitable sintering temperature range. What is claimed is: 1. An R--T--B system rare earth permanent magnet, comprising ***[composition of matter]*** a sintered body comprising: a main phase consisting of an R.sub.2 T.sub.14 B phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y), and T represents one or more transition metal elements essentially containing Fe, or Fe and Co); and a grain boundary phase containing a higher amount of R than said main phase, wherein a product that is rich in Zr exists in said R.sub.2 T.sub.14 B phase. 4. An R--T--B system rare earth permanent magnet according to claim 1, wherein said sintered body has a composition ***[composition of matter]*** consisting essentially of 28% to 33% by weight of R, 0.5% to 1.5% by weight of B, 0.03% to 0.3% by weight of Al, 0.3% or less by weight (excluding 0) of Cu, 0.05% to 0.2% by weight of Zr, 4% or less by weight (excluding 0) of Co, and the balance substantially being Fe.
Filed: May 17, 2002 Issued:	6,800,145	Assignee: Nissan Motor Co., Ltd. (Kanagawa, JAPAN)	Rare earth magnet alloy, manufacturing method thereof and product applied with rare earth magnet alloy Abstract A Nd--Fe--B type rare earth magnet alloy is provided with hard magnetic

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October 5, 2004 Expires: May 2022			phases each of which has a size equal to or less than 80 nm, soft magnetic phases each of which has a size equal to or less than 80 nm, with the hard and soft magnetic phases being present in a mixed structure, and partly anisotropic regions wherein axes of easy magnetization of the hard magnetic phases are aligned in one direction and each having a size equal to or greater than 0.1 .mu.m. Such a magnet alloy is obtained using a strip casting method or ultra cooling method and serves as material for an anisotropic exchange spring magnet to be applied to a motor. What is claimed is: 1. A rare earth magnet alloy ***[composition of matter]*** including Nd, Fe and B comprising: hard magnetic phases each of which has a size equal to or less than 80 nm; soft magnetic phases each of which has a size equal to or less than 80 nm, with the hard and soft magnetic phases being present in a mixed structure; and partly anisotropic regions having the hard magnetic chases and the soft magnetic phases, axes of easy magnetization of the hard magnetic phases in the partly anisotropic regions being aligned in one direction, each of the partly anisotropic regions having a size equal to or greater than 0.1 .mu.m. 8. A method of manufacturing ***[process/method]*** a rare earth magnet alloy, including Nd, Fe and B comprising: preparing an ingot of rare earth magnet composition; obtaining a molten mass of the ingot of the rare earth composition; and subjecting the molten mass to a rapid cooling treatment to obtain an alloy of rare earth magnet, which having: hard magnetic phases each of which has a size equal to or less than 80 nm; soft magnetic phases each of which has a size equal to or less than 80 nm, with the hard and soft magnetic phases being present in a mixed structure; and partly anisotropic regions having the hard magnetic phases in the partly axes of easy magnetization of the hard magnetic phases axes of easy magnetization of the hard magnetic phases in the partly anisotropie regions being aligned in one direction, each of the

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			partly anisotropic regions having a size equal to or greater than 0.1 .mu.m.
Filed: May 21, 2002 Issued: September 21, 2004 Expires: May 2022	6,793,742	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Preparation of bonded rare earth magnet-forming alloy and bonded rare earth magnet composition Abstract An alloy powder for bonded rare earth magnets is prepared by melting an alloy consisting essentially of 20-30 wt % of Sm or a mixture of rare earth elements (inclusive of Y) containing at least 50 wt % of Sm, 10-45 wt % of Fe, 1-10 wt % of Cu, 0.5-5 wt % of Zr, and the balance of Co, quenching the melt by a strip casting technique, to form a rare earth alloy strip containing at least 20% by volume of equiaxed crystals with a grain size of 1-200 .mu.m and having a gage of 0.05-3 mm, and heat treating the strip in a non-oxidizing atmosphere at 1000-1300.degree. C. for 0.5-20 hours, followed by aging treatment and grinding. What is claimed is: 1. A method for preparing ***[process/method]*** an alloy for bonded rare earth magnets, comprising the steps of: melting an alloy consisting essentially of 20 to 30% by weight of R which is samarium or a mixture of at least two rare earth elements (inclusive of Y) containing at least 50% by weight of samarium, 10 to 45% by weight of iron, 1 to 10% by weight of copper, 0.5 to 5% by weight of zirconium, and the balance of cobalt, quenching the melt by a strip casting technique, to form a rare earth alloy strip containing at least 20% by volume of equiaxed crystals with a grain size of 1 to 200 .mu.m and having a gage of 0.05 to 3 mm, heat treating the strip in a non-oxidizing atmosphere at 1000 to 1300.degree. C. for 0.5 to 20 hours, followed by aging treatment and grinding.
Filed:	6,790,296	Assignee:	Nanocomposite magnet and method for producing same

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Nov 8, 2001 Issued: September 14, 2004 Expires: Nov 2021		Neomax Co., Ltd. (Osaka, JAPAN) *Originally Sumitomo Special Metals Co., Ltd., now a 100% subsisidiary of Hitachi Metals.*	Abstract A method of making a material alloy for an iron-based rare earth magnet includes the step of forming a melt of an alloy with a composition of (Fe.sub.1-m T.sub.m).sub.100-x-y-z-n (B.sub.1-p C.sub.p).sub.x R.sub.y Ti.sub.z M.sub.n. T is Co and/or Ni; R is at least one element selected from Y (yttrium) and the rare earth elements; and M is at least one element selected from Al, Si, V, Cr, Mn, Ni, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, wherein the following inequalities are satisfied: 10<x.ltoreq.25 at %, *6.ltoreq.y<10 at %, 0.5.ltoreq.z.ltoreq.12 at %, 0.ltoreq.m.ltoreq.0.5, 0.ltoreq.n.ltoreq.10 at % and 0.ltoreq.p.ltoreq.0.25. Next, the melt is fed onto a shoot with a guide surface tilted at about 1 degree to about 80 degrees with respect to a horizontal plane, thereby moving the melt onto a melt/roller contact region. The melt is then rapidly cooled using a chill roller to make a rapidly solidified alloy including an R.sub.2 Fe.sub.14 B phase. What is claimed is: 1. A rapidly solidified alloy ***[composition of matter]*** having a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100-x-y-z-n Q.sub.x R.sub.y Ti.sub.z M.sub.n, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is a rare earth element; and M is at least one element selected from the group consisting of Al, Si, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Hf, Ta, W, Pt, Pb, Au and Ag, the mole fractions x, y, z, m and n satisfying the inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.5 at %.ltoreq.z.ltoreq.6 at %; 0.ltoreq.m.ltoreq.0.5; and 0 at %.ltoreq.n.ltoreq.5 at %, respectively, wherein the alloy has a thickness of between about 50 .mu.m and about 200 .mu.m, and wherein in the alloy, a crystal structure is located on each of two surfaces thereof that cross a thickness direction approximately at right angles.

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Filed: November 13, 2001 Issued: August 24, 2004 Expires: Nov 2021	6,780,255	Assignee: Nichia Chemical Industries, Ltd. (Tokushima, JAPAN)	Sm-fe-N based alloy powder and process for producing the same Abstract A magnetic powder of an Sm--Fe--N alloy, which has a mean particle diameter of 0.5 to 10 .mu.m, and either an average acicularity of 75% or above or an average sphericity of 78% or above. The powder exhibits an extremely high residual magnetization and an extremely high coercive force, since particles characterized by the above acicularity or sphericity have particle diameters approximately equal to that of the single domain particle and nearly spherical particle shapes. The powder can be produced by preparing an Sm--Fe oxide by firing a coprecipitate corresponding to the oxide, mixing the obtained oxide with metallic calcium and subjecting the mixture to reduction/diffusion and nitriding successively. What is claimed is: 1. A process for producing ***[process/method]*** a permanent magnet material comprising Sm--Fe--N based alloy powder, comprising: allowing a precipitate containing Sm and Fe to co-precipitate from a solution in which Sm and Fe are dissolved; calcining the precipitate to form a metal oxide; mixing the metal oxide with a metal reducing agent; reducing and diffusing the metal oxide mixed with the metal reducing agent into Sm--Fe alloy powder; and nitriding the Sm--Fe alloy powder to obtain said Sm--Fe--N based alloy powder, wherein said Sm--Fe--N based alloy powder has a particle shape of an average degree of roundness of not less than 85%.
Filed: June 14, 2002	6,777,097	Assignee: Shin-Etsu Chemical Co., Ltd.	Corrosion resistant rare earth magnet and its preparation Abstract On a surface of a rare earth permanent magnet R--T--M--B wherein R is a rare

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Issued: August 17, 2004 Expires: June 2022		(Tokyo, JAPAN)	earth element, T is Fe or Fe and Co, M is Ti, Nb, Al, V, Mn, Sn, Ca, Mg, Pb, Sb, Zn, Si, Zr, Cr, Ni, Cu, Ga, Mo, W or Ta, 5 wt %.ltoreq.R.ltoreq.40 wt %, 50 wt %.ltoreq.90 wt %, 0 wt %.ltoreq.M.ltoreq.8 wt %, and 0.2 wt %.ltoreq.B.ltoreq.8 wt %, a solution comprising a flake fine powder of Al, Mg, Ca, Zn, Si, Mn or an alloy thereof and a silicone resin is applied and baked to form an adherent composite coating, thereby providing a corrosion resistant rare earth permanent magnet. What is claimed is: 1. A corrosion resistant rare earth magnet ***[composition of matter]*** comprising a rare earth permanent magnet represented by R--T--M--B wherein R is at least one rare earth element inclusive of yttrium, T is Fe or Fe and Co, M is at least one element selected from the group consisting of Ti, Nb, Al, V, Mn, Sn, Ca, Mg, Pb, Sb, Zn, Si, Zr, Cr, Ni, Cu, Ga, Mo, W, and Ta, and B is boron, the contents of the respective elements are 5 wt %.ltoreq.R.ltoreq.40 wt %, 50 wt %.ltoreq.T.ltoreq.90 wt %, 0 wt %.ltoreq.M.ltoreq.8 wt %, and 0.2 wt %.ltoreq.B.ltoreq.8 wt %, and a composite coating formed on a surface of the permanent magnet by treating the permanent magnet with a solution comprising at least one flake fine powder selected from the group consisting of Al, Mg, Ca, Zn, Si, Mn and alloys thereof and a silicone resin, followed by heating. 4. A method ***[process/method]*** for preparing a corrosion resistant rare earth magnet comprising the steps of: providing a rare earth permanent magnet represented by R--T--M--B wherein R is at least one rare earth element inclusive of yttrium, T is Fe or Fe and Co, M is at least one element selected from the group consisting of Ti, Nb, Al, V, Mn, Sn, Ca, Mg, Pb, Sb, Zn, Si, Zr, Cr, Ni, Cu, Ga, Mo, W, and Ta, and B is boron, the contents of the respective elements are 5 wt %.ltoreq.R.ltoreq.40 wt %, 50 wt %.ltoreq.T.ltoreq.90 wt %, 0 wt %.ltoreq.M.ltoreq.8 wt %, and 0.2 wt %.ltoreq.B.ltoreq.8 wt %, treating a

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			surface of the permanent magnet with a solution comprising at least one flake fine powder selected from the group consisting of Al, Mg, Ca, Zn, Si, Mn and alloys thereof and a silicone resin, and heating the treated permanent magnet to form a composite coating on the permanent magnet.
Filed: May 29, 2003 Issued: June 22, 2004 Expires: May 2023	6,752,879	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Rare earth magnet and method for manufacturing the same Abstract A compact is produced from an alloy powder for R--Fe--B type rare earth magnets including particles having a size in a range of about 2.0 .mu.m to about 5.0 .mu.m as measured by a light scattering method using a Fraunhofer forward scattering in a proportion of approximately 45 vol. % or more and particles having a size larger than about 10 .mu.m in a proportion of less than about 1 vol. %. The compact is then sintered to obtain a R--Fe--B type rare earth magnet having an average crystal grain size in a range of about 5 .mu.m to about 7.5 .mu.m, and an oxygen concentration in a range of about 2.2 at. % to about 3.0 at. %. What is claimed is: 1. An R--Fe--B rare earth magnet ***[composition of matter]*** having an average crystal grain size in a range of about 5 .mu.m to about 7.5 .mu.m, and an oxygen concentration in a range of about 2.2 at. % to about 3.0 at. %. 2. The R--Fe--B rare earth magnet of claim 1, wherein ***[composition of matter]*** alloy powder as a material of the R--Fe--B rare earth magnet contains substantially no Dy.
Filed: May 30, 2001	6,746,545	Assignee: Shin-Etsu Chemical Co., Ltd.	Preparation of rare earth permanent magnets Abstract An R--Fe--B permanent magnet wherein R is Nd or a combination of Nd with

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Issued: June 8, 2004 Expires: May 2021		(Tokyo, JAPAN)	a rare earth element is prepared by casting an R--Fe--B alloy, crushing the alloy in an oxygen-free atmosphere of argon, nitrogen or vacuum, effecting comminution, compaction, sintering, aging, and cutting and/or polishing the magnet to give a finished surface. The magnet is then heat treated in an argon, nitrogen or low-pressure vacuum atmosphere having a limited oxygen partial pressure, obtaining a highly oil resistant sintered permanent magnet having corrosion resistance and hydrogen barrier property even in a high pressure hot environment of refrigerant and/or lubricant as encountered in compressors. What is claimed is: 1. A method ***[process/method]*** for preparing a rare earth permanent magnet to be exposed to a refrigerant and/or lubricant for an extended period of time, comprising the steps of: casting an alloy based on R, T and B, wherein R is neodymium or a combination of neodymium with one or more rare earth elements, T is iron or a mixture of iron and cobalt, and B is boron, said alloy consisting essentially of 17 to 33.5% by weight of neodymium, 26.8 to 33.5% by weight of the entire R, 0.78 to 1.25% by weight of B, 0.05 to 3.5% by weight of at least one element selected from the group consisting of Ni, Ga, Zr, Nb, Hf, Ta, Mn, Sn, Mo, Zn, Pb, Sb, Al, Si, V, Cr, Ti, Cu, Ca and Mg, the balance being T and incidental impurities, crushing the alloy in an oxygen-free atmosphere of argon, nitrogen or vacuum, followed by comminution, compacting under a magnetic field, sintering and aging, thereby yielding a sintered magnet having an oxygen concentration of up to 0.8% by weight, and magnetic properties including a residual flux density Br of 12.0 to 15.2 kG and a coercive fame iHc of 9 to 35 kOe, cutting and/or polishing the sintered magnet to give a sintered magnet with a finished surface, and heat treating the sintered magnet with a finished surface in an argon, nitrogen or low-pressure vacuum atmosphere having an oxygen partial pressure of 10.sup.-6 to 10.sup.0 torr for 10 minutes to 10 hours at a temperature of 200 to 1,100.degree. C.

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Filed: November 9, 1999 Issued: May 18, 2004 Expires: Nov 2019	6,737,011	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Method for producing ferrite magnet Abstract A ferrite magnet having a basic composition represented by the following general formula: (A.sub.1-x R.sub.x)O.n[(Fe.sub.1-y M.sub.y).sub.2 O.sub.3] by atomic ratio, wherein A is Sr and/or Ba, R is at least one of rare earth elements including Y, M is at least one element selected from the group consisting of Co, Mn, Ni and Zn, and x, y and n are numbers meeting the conditions of 0.01.ltoreq.x.ltoreq.0.4, [x/(2.6n)].ltoreq.y.ltoreq.[x/(1.6n)], and 5.ltoreq.n.ltoreq.6, and substantially having a magnetoplumbite crystal structure, is obtained by uniformly mixing a compound of Sr and/or Ba with an iron compound; calcining the resultant uniform mixture; adding a compound of the R element and/or the M element to the resultant calcined powder at a pulverization step thereof; and sintering the resultant mixture. The compound of the R element and/or the M element may be added at a percentage of more than 0 atomic % and 80 atomic % or less, on an element basis, at a mixing step before calcination. What is claimed is: 1. A method for ***[process/method]*** producing a ferrite magnet having a basic composition represented by the following general formula: $(A_{1-x}R_x)O.n[(Fe_{1-y}M_y)_2O_3]$ by atomic ratio, wherein A is Sr and/or Ba, R is at least one rare earth element including Y, M is at least one element selected from the group consisting of Co, Mn, Ni and Zn, and x, y and n are numbers meeting the following conditions: $0.01 \leqq x \leqq 0.4$, $[x/(2.6n)] \leqq y \leqq [x/(1.6n)]$, and $5 \leqq n \leqq 6$ said ferrite magnet substantially having a magnetoplumbite crystal structure,

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			said method comprising the steps of adding a compound of the R element and/or the M element at a percentage of more than 0 atomic % and 80 atomic % or less, on an element basis, at a step of uniformly mixing a compound of Sr and/or Ba with an iron compound; calcining the resultant uniform mixture; adding the remaining amount of said compound of the R element and/or the M element to the resultant calcined powder at a pulverization step thereof; and sintering the resultant mixture
Filed: September 12, 2002 Issued: April 27, 2004 Expires: Sept 2022	6,726,781	Assignee: University of Dayton (Dayton, OH) and Electron Energy Corporation (Landisville, PA)	High temperature permanent magnets Abstract A permanent magnet is provided which retains its magnetic properties and exhibits a linear extrinsic demagnetization curve at elevated temperatures up to 700.degree. C. The magnet is represented by the general formula RE(Co.sub.W Fe.sub.V Cu.sub.X T.sub.Y).sub.Z, where RE is a rare earth metal selected from the group consisting of Sm, Gd, Pr, Nd, Dy, Ce, Ho, Er, La, Y, Tb, and mixtures thereof and T represents a transition metal(s) selected from the group consisting of Zr, Hf, Ti, Mn, Cr, Nb, Mo, W, V, Ni, Ta, and mixtures thereof. What is claimed is: 1. A permanent magnet represented by the general formula ***[composition of matter]*** RE(Co.sub.w Fe.sub.v Cu.sub.x T.sub.y).sub.Z where RE is a rare earth element selected from the group consisting of Sm, Gd, Pr, Nd, Dy, Ce, Ho, Er, La, Y, Tb and mixtures thereof, and T is a transition metal selected from the group consisting of Zr, Hf, Ti, Mn, Cr, Nb, Mo, W, V, Ni, Ta, and mixtures thereof; said magnet exhibiting a substantially linear extrinsic demagnetization curve at a maximum operating temperature T.sub.M of between about 340.degree. C. to about 700.degree. C.
Filed:	6,709,533	Assignee: Sumitomo	Permanent magnet including multiple ferromagnetic phases and method of

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May 24, 2001 Issued: March 16, 2004 Expires: May 2021		Special Metals Co., Ltd. (Osaka, JAPAN)	producing the magnet Abstract An iron-based rare earth alloy magnet has a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one rare earth element substantially excluding La and Ce; and M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti. In this formula, the mole fractions x, y, z and m meet the inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; and 0.ltoreq.m.ltoreq.0.5, respectively. What is claimed is: 1. A method of manufacturing ***[process/method]*** an anisotropic magnet powder, comprising blending RFeBHx powder comprising at least one rare earth R element seleted from the group consisting of yttrium, boron and iron, with a diffusion powder comprising at least one R1 element selected from the group consisting of dysprosium, terbium, neodymium and praseodymium; diffusion heat-treating, wherein the at least one R1element is diffused uniformly on the surface and inside of the RFeBHx powder; and dehydrogenating, wherein hydrogen is removed from the mixture of the powder after the diffusion heat-treatment process. 2. The method according to claim 1 wherein the diffusion powder further contains one or more elements selected from the group consisting of 3d and 4d transition elements (TM) and wherein the at least one R1 element and the TM elements are diffused uniformly on the surface and inside of the RFeBHx powder by diffusion heat-treating.

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Filed: April 9, 2002 Issued: March 16, 2004 Expires: April 2022	6,707,361	Assignee: The Electrodyne Company, Inc. (Batavia, OH, USA)	Bonded permanent magnets Abstract A flexible permanent magnet containing atomized, generally spherical rare earth magnet particles bonded in a binder resin including a nitrile rubber and precipitated amorphous silica. The bonded permanent magnet exhibits high mechanical flexibility and elasticity, good magnetic properties, and good heat aging, and the magnet powder may be mixed with the binder resin with little to no risk of combustion. In an exemplary embodiment, a permanent magnet composition includes a nitrile rubber with about 23-37% acrylonitrile content, an ethylene vinyl acetate copolymer, a precipitated amorphous silica, and atomized, generally spherical rare earth magnet particles having a size distribution including a median particle size in the range of about 35-55 .mu.m with a standard deviation in the range of about 10-30 .mu.m and less than about 0.1% of the particles having a diameter above about 115 .mu.m. Bonded permanent magnets of the present invention exhibit a percent ultimate elongation greater than about 100%, and even greater than about 200%, thereby providing at least a 10-fold improvement in elasticity concurrently with good magnetic properties. What is claimed is: 1. A flexible permanent magnet composition comprising ***[composition of matter]*** : atomized, generally spherical rare earth magnet particles; and a binder comprising a nitrile rubber and a precipitated amorphous silica. …. 12. The composition of claim 1 wherein the rare earth magnet particles comprise an alloy selected from the group consisting of neodymium-iron-boron, praseodymium-iron-boron, samarium-cobalt, samarium-iron-cobalt, samarium-iron-nitride and dysprosium-cobalt.

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Filed: May 24, 2001 Issued: March 16, 2004 Expires: May 2021	6,706,124	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Permanent magnet including multiple ferromagnetic phases and method of producing the magnet Abstract An iron-based rare earth alloy magnet has a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one rare earth element substantially excluding La and Ce; and M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti. In this formula, the mole fractions x, y, z and m meet the inequalities of: 10 at %<x.ltoreq.20 at %; 6 at %.ltoreq.y<10 at %; 0.1 at %.ltoreq.z.ltoreq.12 at %; and 0.ltoreq.m.ltoreq.0.5, respectively. What is claimed is: 1. An iron-based rare earth alloy nanocomposite magnet with a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is B, which may optionally be replaced by C in a maximum proportion of 25 at % of Q; R is at least one rare earth element excluding La and Ce; and M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti, wherein the mole fractions x, y, z and m meet the inequalities of: 10 at %<x<20 at %; 6 at %<y<10 at % 0.1 at %<z<12 at %; and 0<m<0.5, respectively, and wherein said magnet comprises two or more ferromagnetic crystalline phases including hard and soft magnetic phases. 15. A bonded magnet formed by ***[process/method]*** molding a magnet powder, comprising the powder particles of the iron-based rare earth alloy magnet as recited in claim 11 and a resin binder.

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			16. A rapidly solidified alloy for an iron-based rare earth alloy nanocomposite magnet, the alloy having a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100x-y-z Q.sub.x R.sub.y M.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is B, which may optionally be replaced by C in a maximum proportion of 25 at % of Q; R is at least one rare earth element excluding La and Ce; and M is at least one metal element selected from the group consisting of Ti, Zr and Hf and always includes Ti, wherein the mole fractions x, y, z and m meet the inequalities of: 10 at %<x<20 at %; 6 at %<y<10 at % 0.1 at %<z<12 at %; and 0<m<0.5, respectively, and said alloy comprises two or more ferromagnetic crystalline phases including hard and soft magnetic phases, and an average grain size of the hard magnetic phase is larger than an average grain size of the soft magnetic phase.
Filed: May 2, 2001 Issued: February 24, 2004 Expires: May 2021	6,696,015	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Method for producing rare-earth magnet The method for producing a rare-earth sintered magnet of the present invention includes the steps of: compacting alloy powder for the rare-earth sintered magnet to form a green compact; loading the green compact into a case having a structure restricting a path through which gas flows between the outside and inside of the case, and placing a gas absorbent at least near the path; and sintering the green compact by heating the case including the green compact inside in a decompressed atmosphere. What is claimed is: 1. A method for producing ***[process/method]*** a rare-earth sintered magnet comprising the steps of: compacting alloy powder for the rare-earth sintered magnet to form a green compact; providing a sintering case which includes a container and a sintering plate wherein the sintering case has a structure

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			forming a gap through which gas flows from outside of the sintering case; placing the green compact onto the sintering plate, placing the sintering plate within the container and placing a gas absorbent at least near the gap; placing the sintering case in a sintering chamber, and heating the sintering case while inside the sintering chamber; and sintering the green compact.
Filed: August 5, 2002 Issued: February 24, 2004 Expires: Aug 2022	6,695,929	Assignee: Sumitomo Special Co., Ltd. (Osaka, JAPAN)	Method of making material alloy for iron-based rare earth magnet Abstract A melt of an iron-based rare earth material alloy, represented by (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z, is prepared, wherein T is Co and/or Ni; Q is B and/or C; R is selected from Y (yttrium) and the rare earth elements; M is selected from Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb; 10.ltoreq.x.ltoreq.30 at %; 2%.ltoreq.y<10 at %; 0.ltoreq.z.ltoreq.10 at % and 0.ltoreq.m.ltoreq.0.5. The melt is fed onto a guide to form a flow of the melt thereon and move the melt onto a melt/chill roller contact region, where the melt is rapidly cooled by the chill roller to make a rapidly solidified alloy. An oxygen concentration of the melt yet to be fed onto the guide is controlled at about 3,000 ppm or less in mass percentage. What is claimed is: 1. A method of making ***[process/method]*** a material alloy for an iron-based rare earth magnet, the method comprising the steps of: preparing a melt of an iron-based rare earth material alloy, the material alloy having a composition represented by the general formula: (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z, where T is at least one element selected from the group consisting of Co and Ni; Q is at least one element selected from the group consisting of B and C; R is at least one element selected from the group consisting of Y (yttrium) and the rare earth elements; and M is at least one element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Cu, Zn, Ga, Zr, Nb, Mo, Ag, Hf, Ta, W, Pt, Au and Pb, the mole fractions x, y, z and m

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			satisfying the inequalities of: 10 at %.ltoreq.x.ltoreq.30 at %; 2 at %.ltoreq.y<10 at %; 0 at %.ltoreq.z.ltoreq.10 at %; and 0.ltoreq.m.ltoreq.0.5, respectively; feeding the melt of the material alloy onto a guide and forming a flow of the melt on the guide for transfer to a chill roller so as to move the melt onto a region where the melt comes into contact with the chill roller; rapidly cooling the melt using the chill roller to make a rapidly solidified alloy; and controlling an oxygen concentration of the melt yet to be fed onto the guide such that the oxygen concentration is about 3,000 ppm or less in mass percentage.
Filed: November 5, 2001 Issued: January 13, 2004 Expires: Nov 2021	6,676,773	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Rare earth magnet and method for producing the magnet Abstract A method of making an alloy powder for an R--Fe--B-type rare earth magnet includes the steps of preparing a material alloy that is to be used for forming the R--Fe--B-type rare earth magnet and that has a chilled structure that constitutes about 2 volume percent to about 20 volume percent of the material alloy, coarsely pulverizing the material alloy for the R--Fe--B-type rare earth magnet by utilizing a hydrogen occlusion phenomenon to obtain a coarsely pulverized powder, finely pulverizing the coarsely pulverized powder and removing at least some of fine powder particles having particle sizes of about 1.0 .mu.m or less from the finely pulverized powder, thereby reducing the volume fraction of the fine powder particles with the particle sizes of about 1.0 .mu.m or less, and covering the surface of remaining ones of the powder particles with a lubricant after the step of removing has been performed. What is claimed is: 1. An alloy powder for an R--Fe--B-type rare earth magnet, the powder comprising ***[composition of matter]*** a pulverized material alloy that is to be used to form The R--Fe--B-type rare earth magnet and that includes a chilled

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			structure that constitutes about 2 volume percent to about 20 volume percent of the material alloy; wherein the powder has a volume particle size distribution with a single peak and a mean particle size (FSSS particle size) of about 4 .mu.m or less; and wherein in the volume particle size distribution, a total volume of particles that have particle sizes falling within a first particle size range is greater than a total volume of particles that have particle sizes falling within a second particle size range, where the first particle size range is defined by a particle size A representing the peak of the volume particle size distribution and a predetermined particle size B that is smaller than the particle size A, the second particle size range is defined by the particle size A and another predetermined particle size C that is larger than the particle size A, and the particle size C minus the particle size A is equal to the particle size A minus the particle size B.
Filed: May 21, 2001 Issued: December 30, 2003 Expires: May 2021	6,669,788	Assignee: General Electric Company (Schenectady, NY, USA), Batou Iron and Steel Group/ Co. LTD (Batou City, CHINA	Permanent magnetic materials of the Fe-B-R tpe, containing Ce and Nd and/or Pr, and process for manufacture Abstract A Fe--B--R type permanent magnetic, consisting of: 13-19 atomic % R, where R consists essentially of a mixture of rare earth elements Nd and/or Pr, and Ce, where Ce is between 0.2 and 5.0 wt. % of R; 4-20 atomic % B, and the balance comprising Fe. In a preferred aspect, R comprises 15-16 atomic % B; of which Ce is approximately 0.5% and the remaining rare earths Pr and Nd are in a ratio of 3:1. A process of producing a Fe--B--R permanent magnet as described above, and a Fe--B--R magnetic material made by such process. We claim: 1. A magnetic material having a composition of ***[composition of matter]*** Fe--B--R the material consisting essentially of: (i) 13-19 atomic % R, where R consists essentially of a mixture of rare earth elements Nd, Pr, and Ce, wherein

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			Ce is between approximately 0.2 wt. %. and no more than 5.0 wt. % of R, Pr is between about 70-76 wt. % and Nd is 29.8-23.8 wt. %; (ii) 4-20 atomic % B; and (iii) the balance comprising Fe with impurities. … 11. A process for preparing ***[process/method]*** a permanent magnetic material having a composition of Fe--B--R the process comprising the steps of: (a) preparing a metallic powder having a mean particle size of 0.3-80 microns, the metallic powder formed from a composition consisting of 15-16 atomic % R, wherein R consists essentially of the light rare earths Nd, Pr, and Ce, wherein Ce is between 0.2-5.0 wt. % of the R, the balance of R consisting essentially of Nd and Pr where Pr is between about 70-76 wt. %, Nd is between 28.9-23.8 wt. %; 4-8 atomic % B; and at least 52 atomic % Fe; (b) compacting the powder at a pressure of at least 1.5 ton/cm.sup.2 ; and (c) sintering the resulted body at a temperature of 900-1200.degree. C. in a non-oxidizing or reducing atmosphere.
Filed: April 23, 2001 Issued: December 9, 2003 Expires: April 2021	6,660,178	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a bonded magnet having high mechanical strength and excellent magnetic properties. The magnetic powder has an alloy composition containing a rare-earth element and a transition metal, wherein the magnetic powder includes particles each of which is formed with a number of ridges or recesses on at least a part of a surface thereof. In this magnetic powder, it is preferable that when the mean particle size of the magnetic powder is defined by a.mu.m, the average length of the ridges or recesses is equal to or greater than a/40 .mu.m. Further, preferably, the ridges or recesses are arranged in roughly parallel with each other so as to have an average pitch of 0.5-100 .mu.m. What is claimed is:

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			1. A magnetic powder comprising ***[composition of matter]*** : an alloy composition including a rare-earth element and a transition metal, the alloy composition being selected from the group consisting of Sm--Co based alloys, R--TM--B based alloys, Sm--Fe--N alloys, alloys having a composite structure in which a soft magnetic phase and a hard magnetic phase are adjacent one another, and mixtures of the alloys thereof, wherein R of the R--TM--B based alloy is at least one rare-earth element selected from the group consisting of La, Ce, Pr, Pm, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and misch metal; and wherein the magnetic powder includes particles each of which is formed with a number of ridges or recesses on at least a part of the surface thereof; and the ridges or recesses are arranged parallel with each other to have an average pitch of 1.0-35.3 .mu.m. … 10. A bonded magnet which has been manufactured by ***[process/method]*** binding the magnetic powder as claimed in claim 1, with a binding resin.
Filed: April 23, 2001 Issued: November 18, 2003 Expires: April 2021	6,648,989	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a bonded magnet having high mechanical strength and excellent magnetic properties. The magnetic powder has an alloy composition represented by the formula of R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z B.sub.z (where R is at least one rare-earth element, x is 10-15 at %, y is 0-0.30, and z is 4-10 at %), wherein the magnetic powder includes particles each of which is formed with a number of ridges or recesses on at least a part of the surface thereof. In this magnetic powder, it is preferable that when the mean particle size of the magnetic powder is defined by a.mu.m, the average length of the ridges or recesses is equal to or greater than a/40 .mu.m. Further, preferably, the ridges or recesses are arranged in roughly parallel with each other so as to have an average pitch

			of 0.5-100 .mu.m. What is claimed is: 1. A magnetic powder comprising ***[composition of matter]*** : an alloy composition represented by the formula R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z B.sub.z (where R is at least one rare-earth element selected from the group consisting of La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and misch metal, x is 10-15 at %, y is 0-0.30, and z is 4-10 at %) wherein the magnetic powder includes particles each of which is formed with a number of ridges or recesses on at least a part of a surface thereof; and the ridges or recesses are arranged parallel with each other to have an average pitch of 2.2-47.5 .mu.m.
Filed: Sept 24, 2001 Issued: November 18, 2003 Expires: Sept 2021	6,648,984	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Rare earth magnet and method for manufacturing the same Abstract A compact is produced from an alloy powder for R--Fe--B type rare earth magnets including particles having a size in a range of about 2.0 .mu.m to about 5.0 .mu.m as measured by a light scattering method using a Fraunhofer forward scattering in a proportion of approximately 45 vol. % or more and particles having a size larger than about 10 .mu.m in a proportion of less than about 1 vol. %. The compact is then sintered to obtain a R--Fe--B type rare earth magnet having an average crystal grain size in a range of about 5 .mu.m to about 7.5 .mu.m, and an oxygen concentration in a range of about 2.2 at. % to about 3.0 at. %. What is claimed is: 1. A method for manufacturing ***[process/method]*** R--Fe--B rare earth magnets, comprising the steps of: preparing alloy powder for R--Fe--B rare

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			earth magnets including particles having a size in a range of about 2.0 .mu.m to about 5.0 .mu.m as measured by a light scattering method using a Fraunhofer forward scattering in a proportion of approximately 45 vol. % or more and particles having a size larger than about 10 .mu.m in a proportion of less than approximately 1 vol. %: compacting said powder to produce a compact; and sintering said compact; wherein in the step of sintering, a sintered magnet having an average crystal grain size in a range of about 5 .mu.m to about 7.5 .mu.m is produced.
Filed: September 19, 2001 Issued: October 28, 2003 Expires: Sept 2021	6,638,367	Assignee: Sumitomo Metal Mining Co., Ltd. (Tokyo, JAPAN)	Method of producing highly weather-resistant magnet powder, and product produced by the same method Abstract The objects of the present invention are to provide a method of producing highly weather-resistant iron-based magnet powder containing a rare-earth element, particularly characterized by high coercive force in a practically important humid atmosphere, highly weather-resistant magnet powder produced by the same method, resin composition containing the same powder for bonded magnets, and bonded magnet containing the same powder. The present invention provides a method of producing a magnet powder by crushing an iron-based magnet powder containing a rare-earth element in an organic solvent, wherein phosphoric acid is added to the solvent in which the powder is crushed. We claim: 1. A method of producing a highly weather-resistant magnet powder comprising the steps of: crushing an iron-based magnet alloy powder containing a rare-earth element in an organic solvent which contains phosphoric acid at more than 0.1 mol but less than 2 mols per kg of the magnet alloy powder to the solvent in which said powder is crushed, and said magnet

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			alloy powder is thermally treated at 100.degree. C. or higher but lower than 400.degree. C. in an inert or vacuum atmosphere.
Filed: July 9, 2002 Issued: March 25, 2003 Expires: July 2022	6,537,385	Assignee: Sumitomo Special Metals Co., Ltd. (JAPAN)	Rare earth magnet and method for manufacturing the same Abstract The method for manufacturing alloy powder for R--Fe--B type rare earth magnets of the present invention includes a first pulverization step of coarsely pulverizing a material alloy for rare earth magnets and a second pulverization step of finely pulverizing the material alloy. In the first pulverization step, the material alloy is pulverized by a hydrogen pulverization method. In the second pulverization step, easily oxidized super-fine powder (particle size: 1.0 .mu.m or less) is removed to adjust the particle quantity of the super-fine powder to 10% or less of the particle quantity of the entire powder. What is claimed is: 1. A method for manufacturing alloy powder ***[process/method]*** for R--Fe--B rare earth magnets, comprising a first pulverization step of coarsely pulverizing an R--Fe--B alloy for rare earth magnets produced by a rapid cooling method and a second pulverization step of finely pulverizing the material alloy, wherein said second pulverization step comprises a step of removing at least part of the powder in which the concentration of rare earth element is greater than the average concentration of rare earth element contained in the entire powder. 10. A method for manufacturing an R--Fe--B rare earth magnet comprising the steps of: preparing alloy powder for R--Fe--B rare earth magnets using the method of claim 1; and compacting the alloy powder for R--Fe--B rare earth magnets to produce a permanent magnet.

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			11. A method for manufacturing an R--FE--B rare earth magnet comprising the steps of: preparing first alloy powder for R--Fe--B rare earth magnets using the method of claim 1; preparing second alloy powder for R--Fe--B rare earth magnets different from the first alloy powder in rare earth content; mixing the first alloy powder and the second alloy powder, forming mixed powder; compacting the mixed powder to produce a compact; and sintering the compact to produce a permanent magnet.
Filed: September 22, 2000 Issued: October 22, 2002 Expires: Sept 2020	6,468,440	Assignee: Kabushiki Kaisha Toshiba (Kawasaki, JAPAN)	Magnet powder and method for producing the same, and bonded magnet using the same Abstract Magnet powder has a composition expressed by (R.sup.1.sub.X R.sup.2.sub.Y B.sub.Z T.sub.100-X-Y-Z).sub.100-Q N.sub.Q (in formula, R.sup.1 is at least one kind of element selected from rare earth elements, R.sup.2 is at least one kind of element selected from Zr, Hf and Sc, T is at least one kind of element selected from Fe and Co, and X, Y, Z and Q are numbers satisfying 2 atomic %.ltoreq.X, 0.01 atomic %.ltoreq.Y, 4.ltoreq.X+Y.gtoreq.20 atomic %, 0.ltoreq.Z.ltoreq.10 atomic %, and 0.1.ltoreq.Q.ltoreq.20 atomic %, respectively), and TbCu.sub.7 crystal phase as a principal phase. In such magnet powder, a ratio of fine particles of which maximum diameter is 22 .mu.m or less is 20% by weight or less. Alternatively, surface roughness of particles constituting the magnet powder is 5 .mu.m or less in terms of maximum height R.sub.y provided in JIS B 0601-1994. Accordingly, to such a magnet powder, excellent magnetic properties can be obtained with reproducibility. What is claimed is: 1. A magnet powder comprising a composition ***[composition of matter]*** expressed by:

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			general formula: $(R^1{}_xR^2{}_yB_zT_{100-X-Y-Z})_{100-Q}N_Q$ wherein R^1 is at least one kind of element selected from rare earth elements, R^2 is at least one kind of element selected from Zr, Hf and Sc, T is at least one kind of element selected from Fe and Co, and X, Y, Z and Q are numbers satisfying 2 atomic %≦X, 0.01 atomic %≦Y, 4≦X+Y≦20 atomic %, 0≦Z≦10 atomic %, and 0.1≦Q≦20 atomic %, respectively, and having a $TbCu_7$ crystal phase as a principal phase; wherein an amount of a fine particle having a maximum diameter of 22 μm or less in the magnet powder is 20% by weight or less….. 18. A method of manufacturing a magnet powder ***[process/method]*** , comprising: forming a quenched alloy ribbon having an alloy composition expressed by the general formula: $R^1{}_xR^2{}_yB_zT_{100-x-y-z}$ wherein R^1 is at least one kind of element selected from rare earth elements, R^2 is at least one kind of element selected from Zr, Hf and Sc, T is at least one kind of element selected from Fe and Co, and X, Y and Z are numbers satisfying 2 atomic %≦X, 0.01 atomic %≦Y, 4≦X+Y≦20 atomic %, and 0≦Z≦10 atomic %, by melting the alloy composition and quenching the molten alloy composition, the quenched alloy ribbon having a $TbCu_7$ crystal phase as a principal phase and having an average surface area S of 0.5 mm^2/particle or more: and nitriding the quenched alloy ribbon by heating in an atmosphere containing nitrogen to form a magnet powder having a flake shape.
Filed: June 14, 2000	6,419,759	Assignee: Yang; Yingchang	Multielement interstitial hard magnetic material and process for producing magnetic powder and magnet using the same

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Issued: July 16, 2002 Expires: June 2020		(Beijing, CHINA) Cheng; Benpei (Beijing, CHINA) Ge; Senlin (Beijing, CHINA)	Abstract There is provided a multielement rare earth-iron interstitial permanent magnetic material having the formula of (R.sub.1-.alpha. R".sub..alpha.).sub.x (Mo.sub.1-.beta. M.sub..beta.).sub.y Fe.sub.100-x-y-z l.sub.z, wherein, R is a light rare earth element; R' is a heavy rare earth element; .alpha. is from 0.01 to 0.14; x is an atomic percent from 4 to 15; M is an element of IIIA, IVA, IVB, VB, VIB and VIIB families in the periodic table; .beta. is from 0.01 to 0.98; y is an atomic percent from 3 to 20; l is an element occupying the interstitial site of the crystal selected from the first and the second periodic groups. There is also provided a process for producing high performance anisotropic magnetic powder and magnet by using the above-mentioned material. We claim: 1. A multielement rare earth-iron interstitial permanent magnetic material having a ThMn12 crystal structure and the following formula ***[composition of matter]*** : $(R_{1-\alpha}R'_{\alpha})_x(Mo_{1-\beta}M_{\beta})_yFe_{100-x-y-z}l_z$ wherein, R is a light rare earth element selected from Pr, Nd, or a mixture of Pr and Nd; R′ is a heavy rare earth element selected from the group consisting of Gd, Tb, Dy, Ho, Er, and Y or a mixture of two or more thereof; α is from 0.01 to 0.14; x is an atomic percent from 4 to 15; M is an element selected from the group consisting of B, Ti, V, Cr, Mn, W, Si, Al, Ga, Nb, Sr, and Ta, or a mixture of two or more thereof; β is from 0.01 to 0.98; y is an atomic percent from 3 to 20; l is an element selected from the group consisting of H, C, N, and F, or a mixture of two or more thereof; and z is an atomic percent from 5 to 20.
Filed: August 16, 2001	6,416,593	Assignee: Kabushiki Kaisha	Magnetic material and manufacturing method thereof, and bonded magnet using the same

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Issued: July 9, 2002 Expires: Aug 2021		Toshiba (Kawasaki, JAPAN)	Abstract A magnetic material has a composition expressed by the following general formula, general formula: (where, R.sup.1 is at least one kind of element selected from rare earth elements, R.sup.2 is at least one kind of element selected from Zr, Hf, Ti and Sc, T is at least one kind of element selected from Fe and Co, and X, Y, Z and Q designate numerical values satisfying 0.5.ltoreq.X<1, 0.05.ltoreq.Y.ltoreq.0.2, 0.ltoreq.Z.ltoreq.0.1 and 0.1.ltoreq.Q.ltoreq.0.2), and includes 5 volume % or more of a Th.sub.2 Ni.sub.17 crystal phase. The magnetic material has a recrystallization texture of which average grain diameter is in the range of from 0.02 to 50 .mu.m, and is excellent in magnetic property. Such a magnetic material is obtained by giving a HDDR treatment (*Hydrogenation-Disproportionation-Desorption-Recombination*) to a mother alloy of which principal phase is a Th.sub.2 Ni.sub.17 crystal phase. What is claimed is: 1. A method of manufacturing a magnetic material ***[process/method]*** , comprising the steps of: preparing a mother alloy containing a Th_2Ni_{17} crystal phase as a principal phase, and a composition expressed by the following general formula: $(R^1xR^2{}_{1-x})_yB_zT_{1-y-z}$ (wherein, R^1 is at least one element selected from rare earth elements, R^2 is at least one element selected from Zr, Hf, Ti and Sc, T is at least one element selected from Fe and Co, and X, Y and Z designate numerical values satisfying 0.5≦X≦1, 0.005≦Y≦0.2, and Z ranging such that B is present in amount sufficient to increase the homogeneity and fitness phase of said magnetic material and/or to suppress the precipitation of a soft magnetic phase of said magnetic material, to ≦0.1); recrystallizing the mother alloy by making hydrogen absorb into the mother

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			alloy and hydrogen discharge from the mother alloy; and introducing nitrogen into the recrystallized mother alloy to obtain the magnetic material having a Th_2Ni_{17} crystal phase. 2. The method of manufacturing a magnetic material as set forth in claim 1: wherein the mother alloy includes 50 volume % or more of the Th.sub.2 Ni.sub.17, crystal phase
Filed: July 12, 1999 Issued: March 5, 2002 Expires: July 2019	6,352,599	Assignee: Santoku Corporation (Kobe, JAPAN)	High performance iron-rare earth-boron-refractory-cobalt nanocomposite Abstract Magnetic nanocomposite materials including iron, rare earth elements, boron, refractory metals and cobalt which have favorable magnetic properties and are suitable for making bonded magnets are disclosed. Compositions of the present invention can be of the formula: (N.sub.1-y La.sub.y).sub.v Fe.sub.100-v-w-x-z Co.sub.w M.sub.z B.sub.x, where M is at least one refractory metal selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo and W; v is from about 5 to about 15; w is greater than or equal to 5; x is from about 9 to about 30; y is from about 0.05 to about 0.5; and z is from about 0.1 to about 5. Preferably M is at least Cr. These materials have good magnetic properties and are suitable for use in preparing bonded magnets. What is claimed is: 1. A permanent magnet material characterized by a chemical formula ***[composition of matter]*** : $(RE_{1-y}La_y)_v Fe_{100-v-w-x-z} Co_w M_z B_x$, Wherein: RE is at least one element selected from the group consisting of Pr and Nd; M is Cr;

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			v is from about 9.5 to about 11.5 w is from about 5 to about 12 x is from about 9 to about 11.5 y is from about 0.05 to about 0.1 z is from about 2 to about 3, the magnet material having been made by rapid cooling from a molten state at a cooling rate between 10^4 to 10^7 degrees C./second to make a substantially amorphous material, followed by thermal treating at temperatures from about 600 to 750 degrees C. for 0.01 seconds to 120 minutes, the material containing the following phases: (i) a hard magnetic phase comprising at least one member of the group consisting of $RE_2Fe_{14}B$ and $RE_2(Fe,Co)_{14}B$, (ii) a soft magnetic phase comprising at least one member of the group consisting of α-Fe, Fe_3B, and α-(Fe,Co), (iii) one or more metal M boride precipitated phases. 21. A method of making ***[process/method]*** the magnet material of claim 1, comprising rapid cooling a composition of the chemical formula: $(RE_{1-y}La_y)_vFe_{100-v-w-x-z}Co_wM_zB_x$ as defined in claim 1, from a molten state at a cooling rate between 10^4 to 10^7 degrees C./second to make a substantially amorphous material, followed by thermal treating at temperatures from about 600 to 750 degrees C. for 0.01 seconds to 120 minutes
Filed: September 14, 2001 Issued: October 21, 2003	6,635,120	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Method for producing sintered rare earth magnet and sintered ring magnet Abstract A sintered rare earth magnet is produced by finely pulverizing a coarse rare earth magnet alloy powder to an average particle size of 1-10 .mu.m in a non-oxidizing atmosphere; introducing the resultant fine rare earth magnet alloy powder into a non-oxidizing liquid comprising at least one oil selected from

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Expires: Sept 2021			the group consisting of mineral oils, synthetic oils and vegetable oils, and at least one lubricant selected from the group consisting of esters of aliphatic acids and monovalent alcohols, esters of polybasic acids and monovalent alcohols, esters of aliphatic acids and polyvalent alcohols and their derivatives to prepare a slurry; molding the slurry; degreasing the resultant green body; sintering the degreased green body; and then heat-treating the green body. What is claimed is: 1. A method for producing ***[process/method]*** a sintered rare earth magnet comprising the steps of finely pulverizing a coarse rare earth magnet alloy powder to an average particle size of 1-10 .mu.m in a non-oxidizing atmosphere; introducing the resultant fine rare earth magnet alloy powder into a non-oxidizing liquid comprising at least one oil selected from the group consisting of mineral oils, synthetic oils and vegetable oils, and at least one lubricant selected from the group consisting of esters of aliphatic acids and monovalent alcohols, esters of polybasic acids and monovalent alcohols, esters of aliphatic acids and polyvalent alcohols and their derivatives to prepare a slurry; molding said slurry; degreasing the resultant green body, sintering the degreased green body; and then heat-treating said green body. 2. The method for producing a sintered rare earth magnet according to claim 1, wherein a weight ratio of said lubricant to said fine rare earth magnet alloy powder is 0.01/99.99 to 0.5/99.5. 3. A polar anisotropic ring magnet constituted by ***[composition of matter]*** an R--Fe--Co--Cu--B-based, sintered magnet comprising 28-33 weight % of R, wherein R is at least one rare earth element including Y, 50 atomic % or more of R being occupied by Nd, 0.8-1.5 weight % of B, 0.5-5 weight % of Co, and 0.01-0.3 weight % of Cu, the balance being substantially Fe and inevitable impurities; the amount of oxygen inevitably contained being 0.3 weight % or

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			less based on the total weight of said ring magnet; said ring magnet having a density of 7.56 g/cm.sup.3 or more; and a ratio of I (105)/I (006) being 0.5-0.8, wherein I (105) and I (006) are X-ray diffraction peak intensity measured with respect to (105) and (006) planes, respectively, at a middle position on an outer surface between magnetic poles of said ring magnet
Filed: July 24, 2002 Issued: September 30, 2003 Expires: July 2022	6,627,326	Assignee: Delphi Technologies, Inc. (Troy, MI, USA)	Manufacturing technique for multi-layered structure with magnet using an extrusion process Abstract An extruded magnetic structure includes a first layer of low alloy steel compressed powder and a second layer of rare earth metal compressed powder circumferentially disposed around the first layer. A third layer of compressed powder may be circumferentially disposed around the second layer. What is claimed is: 1. An extruded magnetic structure, comprising ***[composition of matter]*** : a first layer of low alloy steel compressed powder; and a second layer of rare earth metal compressed powder circumferentially disposed around said first layer. 7. The magnetic structure as in claim 1, wherein said rare earth metal compressed powder is an Nd.sub.2 Fe.sub.14 B alloy.
Filed: May 22, 2001 Issued: September 30, 2003	6,627,102	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder, manufacturing method of magnetic powder and bonded magnets Abstract Disclosed herein is a magnetic powder which can provide magnets having excellent magnetic properties and having excellent reliability especially excellent heat stability. The magnetic powder is composed of an alloy composition represented by (R.sub.1-a Dy.sub.a).sub.x (Fe.sub.1-b

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Expires: May 2021			Co.sub.b).sub.100-x-y B.sub.y (where R is at least one kind of rare-earth element, x is 7.1-9.9 at %, y is 4.6-8.0 at %, a is 0.02-0.2, and b is 0-0.30), wherein the magnetic powder is constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, and the intrinsic coercive force (H.sub.CJ) of the magnetic powder at a room temperature is in the range of 400-750 kA/m. What is claimed is: 1. A magnetic powder comprising ***[composition of matter]*** : an alloy composition represented by $(R_{1-a}Dy_a)_x(Fe_{1-b}Co_b)_{100-x-y}B_y$ (where R is at least one rare-earth element except Dy, x is 7.1-9.9 at %, y is 4.6-8.0 at %, a is 0.02-0.2, and b is 0-0.30), wherein the magnetic powder further comprises a composite structure having a soft magnetic phase and a hard magnetic phase, and an intrinsic coercive force (H_{CJ}) of the magnetic powder at room temperature is in the range of 400-750 kA/m. 13. A bonded magnet formed by ***[process/method]*** binding a magnetic powder with a binding resin, wherein the magnetic powder is composed of an alloy composition represented by $(R_{1-a}Dy_a)x(Fe_{1-b}Co_b)_{100-x-y-z}B_yM_z$ (where R is at least one rare-earth element except Dy, M is at least one element selected from Cu, Ga, Si, Sn, In, Ag and Al, x is 7.1-9.9 at %, y is 4.6-8.0 at %, z is equal to or less than 3.0 at % (not including 0), a is 0.02-0.2, and b is 0-0.30), and the magnetic powder further comprises a composite structure having a soft magnetic phase and a hard magnetic phase, and an intrinsic coercive force (H_{CJ}) of the bonded magnet at room temperature is in the range of 400-760 kA/m.
Filed: July 30, 2001	6,623,541	Assignee: Shin-Etsu Chemical	Sintered rare earth magnet and making method Abstract

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Issued: September 23, 2003 Expires: July 2021		Co., Ltd. (Tokyo, JAPAN)	A sintered rare earth magnet consisting essentially of 20-30% by weight of R (wherein R is Sm or a mixture of Sm and another rare earth element), 10-45% by weight of Fe, 1-10% by weight of Cu, 0.5-5% by weight of Zr, and the balance of Co has on its surface a composite layer containing Sm.sub.2 O.sub.3 and/or CoFe.sub.2 O.sub.4 in Co or Co and Fe. The magnet is resistant to hydrogen embrittlement. What is claimed is: 1. A sintered rare earth magnet consisting ***[composition of matter]*** essentially of 20 to 30% by weight of R wherein R is samarium or at least two rare earth elements containing at least 50% by weight of samarium, 10 to 45% by weight of iron, 1 to 10% by weight of copper, 0.5 to 5% by weight of zirconium, and the balance of cobalt and incidental impurities, said sintered rare earth magnet having on its surface a composite layer containing Sm.sub.2 O.sub.3 or CoFe.sub.2 O.sub.4 or both in Co or Co and Fe. 6. A method for preparing a sintered rare earth magnet ***[process/method]*** , comprising the steps of: casting an alloy consisting essentially of 20 to 30% by weight of R wherein R is samarium or at least two rare earth elements containing at least 50% by weight of samarium, 10 to 45% by weight of iron, 1 to 10% by weight of copper, 0.5 to 5% by weight of zirconium, and the balance of cobalt and incidental impurities, grinding the alloy, followed by comminution, compacting in a magnetic field, sintering and aging to form a sintered magnet, cutting and/or polishing the sintered magnet for surface finishing, and heat treating in an atmosphere having an oxygen partial pressure of 10.sup.-6 to 152 torr for about 10 minutes to 20 hours so as to form on the surface of the rare earth magnet a composite layer containing Sm.sub.2 O or CoFe.sub.2 O.sub.4 or both in Co or Co and Fe.
Filed:	6,617,044	Assignee:	Surface treating process, surface treating apparatus, vapor-depositing material,

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March 12, 2002 Issued: September 9, 2003 Expires: March 2022		Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	and rare earth metal-based permanent magnet with surface treated Abstract A surface treating process according to the present invention, a vapor deposited film is formed from an easily oxidizable vapor-depositing material on the surface of a work by evaporating the vapor-depositing material in a state in which the vapor deposition controlling gas has been supplied to at least zones near a melting/evaporating source and the work within a treating chamber. Thus, the vapor deposited film can be formed stably on the surface of a desired work without requirement of a long time for providing a high degree of vacuum and without use of a special apparatus. In addition, the use of the surface treating process ensures that a corrosion resistance can be provided to a rare earth metal-based permanent magnet extremely liable to be oxidized, without degradation of a high magnetic characteristic of the magnet. A surface treating apparatus according to the present invention includes a melting/evaporating source for melting and evaporating a wire-shaped vapor-depositing material containing a vapor deposition controlling gas, and a member for retaining a work on which the vapor-depositing material is deposited. The melting/evaporating source and the work retaining member are disposed in a treating chamber of the surface treating chamber. The apparatus further includes a vapor-depositing material supply means for supplying the wire-shaped vapor-depositing material containing the vapor deposition controlling gas to the melting-evaporating source. What is claimed is: 1. A work having a vapor deposited film formed thereon from at least one metal selected from the group consisting of aluminum, titanium, zinc, tin, lead and bismuth by ***[process/method]*** a surface treating process for forming a vapor deposited film from an easily oxidizable vapor-depositing material on the surface of the work, comprising the step of evaporating the vapor-

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			depositing material in a state in which a vapor deposition controlling gas has been supplied to at least zones near a material melting/evaporating source and the work within a treating chamber such that said vapor deposited film contains hydrogen in a range from 1 ppm to 20 ppm. 2. A work according to claim 1, wherein said work is a rare earth metal-based permanent magnet.
Filed: June 27, 2001 Issued: August 5, 2003 Expires: June 2021	6,602,352	Assignee: Sumitomo Special Metals Co., Ltd. (JAPAN)	Method for manufacturing rare earth magnet and powder compacting apparatus Abstract A method and apparatus for manufacturing a rare earth magnet is disclosed. In a first step, a compact is produced by compacting rare earth alloy powder in a predetermined space in an orienting magnetic field. Next, a demagnetizing process is performed for the compact, and the compact is ejected from the predetermined space. Then, a additional demagnetizing process is performed for magnetic powder adhering to a surface of the compact by applying an magnetic field to the compact after the compact is ejected. What is claimed is: 1. A method for manufacturing a rare earth magnet ***[process/method]*** comprising: a first step of producing a compact by compacting rare earth alloy powder in a predetermined space in an orienting magnetic field; a second step of performing a demagnetizing process for the compact by applying a first magnetic field to the compact; a third step of ejecting the compact from the predetermined space after the second step; and a fourth step of performing a demagnetizing process for magnetic powder adhering to a surface of the compact by applying a second magnetic field to the compact after the third step.

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Filed: August 14, 2001 Issued: July 22, 2003 Expires: Aug 2021	6,596,096	Assignee: General Electric Company (Schenectady, NY)	Permanent magnet for electromagnetic device and method of making Abstract Permanent magnets, devices including permanent magnets and methods for manufacture are described with the permanent magnet comprising, for example: iron-boron-rare earth alloy particulate having an intrinsic coercive force of at least about 1591 kiloamperes/meter (about 20 kiloOersteds) and a residual magnetization of at least about 0.8 tesla (about 8 kiloGauss), wherein the rare earth content comprises praseodymium, a light rare earth element selected from the group consisting of cerium, lanthanum, yttrium and mixtures thereof, and balance neodymium; and a binder bonding the particulate. What is claim is: 1. A method of fabricating [***process/method]*** a permanent magnet, comprising: sintering to form an iron-boron-rare earth alloy; fracturing the sintered iron-boron-rare earth alloy into particulates having a rare earth content comprising (1) praseodymium, (2) cerium, lanthanum or yttrium and (3) neodymium; and the binding the particulates with a binder to provide a moldable material; and molding moldable material into a permanent magnet. 2. The method of claim 1, comprising sintering, melt solidifying the iron-boron-rare earth alloy and fracturing the alloy into the particulates. 3. The method of claim 1, comprising sintering, melt spinning the iron-boron-rare earth alloy and fracturing the alloy into the particulates. 4. The method of claim 1, comprising melt solidifying the sintered alloy and fracturing the solidified and sintered alloy into the particulates.
Filed:	6,589,367	Assignee:	Anisotropic rare earth-based permanent magnet material

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December 18, 2001 Issued: July 8, 2003 Expires: Dec 2021		Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Abstract Disclosed is a magnetically anisotropic rare earth-based permanent magnet having a nanocomposite structure consisting of fine dispersion of a magnetically hard phase, e.g., Nd.sub.2 Fe.sub.14 B, in alignment relative to the easy magnetization axis, a magnetically soft phase and a non-magnetic phase having a melting point lower than those of the magnetically hard and soft phases. The permanent magnet is prepared in a process in which a quenched thin magnet alloy ribbon having a composition capable of forming a magnetically hard phase, magnetically soft phase and non-magnetic phase by a heat treatment is subjected to a heat treatment in a magnetic field of at least 3 T at a temperature not lower than the melting point of the non-magnetic phase so that the liquid phase formed from the non-magnetic phase serves to facilitate rotating orientation of the magnetically hard grains to be aligned in the direction of the magnetic field relative to the easy magnetization axis. What is claimed is: 1. A magnetically anisotropic (rare earth)/(iron,cobalt)/boron-based nanocomposite permanent magnet material ***[composition of matter]*** , in which the rare earth element is selected from the group consisting of praseodymium, neodymium, terbium and dysprosium, having a metallographic structure comprising a magnetically hard phase of which the crystalline grains are aligned in a direction relative to the easy magnetization axis, a magnetically soft phase consisting of crystalline grains and a non-magnetic phase having a melting point lower than the melting points of the magnetically hard and soft phases, in which the crystalline grains of each of the magnetically hard and soft phases have an average grain diameter in the range from 20 to 200 nm and are dispersed in the non-magnetic phase, and wherein the non-magnetic phase is selected from the group consisting of RCu.sub.2, in which R is a rare earth element selected from the group consisting of praseodymium, neodymiun,

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			terbium and dysprosium, La, LaCu.sub.2, La--Cu alloys of which the content of La is at least 25 atomic %, La--Co and alloys of which the content of La is at least 55 atomic %. 2. The magnetically anisotropic (rare earth)/(iron,cobalt)/boron-based nanocomposite permanent magnet material as defined in claim 1 which is a product prepared by the method ***[process/method]*** comprising the step of subjecting a quenched thin magnetic alloy ribbon of a composition, from which a magnetically hard phase, a magnetically soft phase and a non-magnetic phase having a melting point lower than the melting points of the magnetically hard and soft phases are formed by a heat treatment, to a heat treatment for crystallization in a magnetic field of at least 3 T at a temperature not lower than the melting point of the non-magnetic phase or the eutectic point between the non-magnetic phase and the magnetically hard or soft phase but lower than the melting points of the magnetically hard and soft phases.
Filed: July 10, 2001 Issued: March 4, 2003 Expires; July, 2021	6,527,874 **Note: many claims of infringment**	Assignee: Sumitomo Special Metals Co., Ltd. (JAPAN)	Rare earth magnet and method for making same Abstract A rapidly solidified alloy is produced by quenching and solidifying a melt of an alloy having a general formula represented by (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z where T denotes at least one kind of element selected from the group consisting of Co and Ni, Q denotes at least one kind of element selected from the group consisting of B and C, R denotes at least one kind of rare earth element, and M denotes at least one kind of element selected from the group consisting of Nb and Mo, and the mole fractions x, y, z, and m respectively satisfy 2.ltoreq.x.ltoreq.28 (atom %), 8.ltoreq.y.ltoreq.30 (atom %), 0.1 .ltoreq.z<1.0 (atom %), and 0.ltoreq.m.ltoreq.0.5 (atom %). The rapidly solidified alloy is then pulverized and sintered to manufacture a rare earth permanent magnet. The cooling rate is controlled to be in the range of 10.sup.2 K/sec to 10.sup.4 K/sec, so that the

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			alloy structure is uniformly fine and the added element M is uniformly dispersed. What is claimed is: 1. A rapidly solidified alloy sintered magnet having a general formula ***[composition of matter]*** represented by (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z where T denotes at least one element selected from the group consisting of Co and Ni, Q denotes at least one element selected from the group consisting of B and C, R denotes at least one rare earth element, and M denotes Nb, and the mole fractions x, y, z, and m respectively satisfy 2.ltoreq.x.ltoreq.28 (atom %), 8.ltoreq.y.ltoreq.30 (atom %), 0.1.ltoreq.z<1.0 (atom %), and 0.ltoreq.m.ltoreq.0.5 (atom %). 4. A method for manufacturing ***[process/method]*** a rare earth sintered magnet, comprising the steps of: producing a rapidly solidified alloy by quenching and solidifying a melt of an alloy having a general formula represented by (Fe.sub.1-m T.sub.m).sub.100-x-y-z Q.sub.x R.sub.y M.sub.z where T denotes at least one element selected from the group consisting of Co and Ni, Q denotes at least one element selected from the group consisting of B and C, R denotes at least one rare earth element, and M denotes Nb, and the mole fractions x, y, z, and m respectively satisfy 2.ltoreq.x.ltoreq.28 (atom %), 8.ltoreq.y.ltoreq.30 (atom %), 0.1.ltoreq.z<1.0 (atom %), and 0.ltoreq.m.ltoreq.0.5 (atom %); producing a powder of the rapidly solidified alloy, and manufacturing a permanent magnet by sintering the powder of the rapidly solidified alloy.
Filed: July 20, 2000	6,558,482	Assignee: Seiko Epson Corporation	Magnetic powder and isotropic bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a magnet having a

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Issued: May 6, 2003 Expires: July 2020		(JAPAN)	high magnetic flux density and excellent magnetizability and reliability especially excellent heat resisting property (heat stability). The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one kind of rare-earth element, x is 8.1-9.4 at %, y is 0-0.30, z is 4.6-6.8 at %, and w is 0.02-1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein the magnetic powder has characteristics in which, when the magnetic powder is formed into an isotropic bonded magnet by mixing with a binding resin and then molding it, the irreversible susceptibility (X.sub.irr) which is measured by using an intersectioning point of a demagnetization curve in the J-H diagram representing the magnetic characteristics at the room temperature and a straight line which passes the origin in the J-H diagram and has a gradient (J/H) of -3.8.times.10-.sup.6 H/m as a starting point is less than 5.0.times.10-.sup.7 H/m, and the intrinsic coercive force (H.sub.CJ) of the magnet at the room temperature is in the range of 406-717 kA/m. What is claimed is: 1. A magnetic powder comprising ***[composition of matter]*** : an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one rare-earth element, x is 8.1-9.4 at %, and y is 0.0-0.30, z is 4.6-6.8 at %, and w is 0.02-1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase; the soft magnetic phase and the hard magnetic phase have a mean crystal grain size of 1-100 nm; wherein the magnetic powder has characteristics in which, when an isotropic bonded magnet is molded by mixing the magnet powder with a binding resin, the irreversible susceptibility (X.sub.irr) which is measured by using an intersectioning point of a demagnetization curve in the J-H diagram representing the magnetic characteristics at room temperature and a straight

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			line which passes the origin in the J-H diagram and has a gradient (J/H) of -3.8-10.sup.-6 H/m as a starting point is less than 5.0.times.10.sup.-7 H/m, and the intrinsic coercive force (Hcj) of the magnet at room temperature is in the range of 406-717 kA/m.
Filed: February 28, 2001 Issued: April 29, 2003 Expires: Feb 2021	6,555,018	Assignee: Magnequench, Inc. (Indianapolis, IN, USA)	Bonded magnets made with atomized permanent magnetic powders Abstract The invention relates to magnets, particularly bonded magnets, of the Re--Fe--B type made from atomized magnetic powders and to methods of producing the powders and the magnet. The magnetic powders comprise, by weight, about 15% to 25% of RE; about 0.8% to 2.0% of B; about 1% to 10% of T; and balanced with Fe, Co, or mixtures thereof; wherein RE is one or more rare earth elements selected from the group consisting of Y, La, Ce, Pr, Nd, Sm, Er, Gd, Tb, Dy, Ho, Tm, Yb and Lu, and T is one or more elements selected from the group consisting of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W. To produce bonded magnets, the atomized powders are heat treated, combined with a binder, pressed or molded, and cured to produce the bonded magnets. As compared to bonded magnets made from melt-spun powders or from other conventional atomized powders, bonded magnets of the present invention exhibit one or more of the following properties: less loss of intrinsic coercivity under repeated injection molding cycles; less internal magnetic shearing loss; improved flowability of the magnetic powders; improved Br and part integrity; less environmental degradation after exposure to high temperature and less flux loss; complex shapes and high part integrity; lower viscosity of the magnetic powder-binder mixtures; and high magnetic strength even for small-dimension magnets. What is claimed is: 1. A bonded magnet made from magnetic powders obtained by an atomization

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			process ***[process/method]***, said powders comprising ***[composition of matter]*** , by weight, above 15% to about 25% of RE; about 0.8% to about 2.0% of B; about 1% to about 10% of T; and balanced with Fe, Co, or mixtures thereof, wherein RE is one or more rare earth elements selected from the group consisting of Y, La, Ce, Pr, Nd, Sm, Er, Gd, Tb, Dy, Ho, Tm, Yb and Lu; and T is one or more elements selected from the group consisting of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W; and wherein the magnetic powders comprise a metallurgically complex structure substantially having the formula of Nd.sub.2 Fe.sub.14 B as the primary magnetic phase.
Filed: January 5, 2001 Issued: April 22, 2003 Expires: Jan 2021	6,551,418	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and isotropic bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a bonded magnet having excellent magnetic properties and having excellent reliability especially excellent heat stability. The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one kind of rare-earth element, x is 7.1-9.9 at %, y is 0-0.30, z is 4.6-6.9 at %, and w is 0.02-1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein the magnetic powder has magnetic properties in which, when the magnetic powder is formed into an isotropic bonded magnet having a density .rho. [Mg/m.sup.3] by mixing with a binding resin and then molding it, the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at the room temperature satisfies the relationship represented by the formula (BH).sub.max /.rho..sup.2 [.times.10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.1, and the intrinsic coercive force (H.sub.CJ) of the bonded magnet at the room temperature is in the range of 320-720 kA/m. What is claimed is:

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			1. A magnetic powder comprising ***[composition of matter]*** : an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w B.sub.z Al.sub.w (where R is at least one rare-earth element, x is 7.1-9.0 at %, y is 0-0.30, z is 4.6-6.9 at %, and w is 0.02-1.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase; the soft magnetic phase and the hard magnetic phase have a mean crystal grain size of 1-100 nm; wherein the magnetic powder has magnetic properties in which, when an isotropic bonded magnet having a density .rho. [Mg/in.sup.3] is molded by mixing the magnetic powder with a binding resin, the maximum magnetic energy product (BH).sub.max [kJ/m.sup.3] of the bonded magnet at room temperature satisfies the relationship represented by the formula (BH).sub.max /.rho..sup.2 [.times.10.sup.-9 J.multidot.m.sup.3 /g.sup.2].gtoreq.2.1, and the intrinsic coercive force (H.sub.CJ) of the bonded magnet at room temperature is in the range of 320-720 kA/m. 2. The magnetic powder as claimed in claim 1, wherein when the isotropic bonded magnet having a density .rho.[Mg/in.sup.3] is molded ***[process/method]*** by mixing the magnetic powder with the binding resin, the remanent magnetic flux density Br[T] at room temperature satisfies the relationship represented by the formula of Br/.rho. [.times.10.sup.-6 T.multidot.m.sup.3 /g].gtoreq.0.125
Filed: August 31, 2001 Issued: March 4, 2003	6,527,822	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Quenched thin ribbon of rare earth/iron/boron-based magnet alloy Abstract Disclosed is a novel thin ribbon of a rare earth/iron/boron-based magnet alloy prepared by quenching of an alloy melt by the method of strip casting, from which a sintered permanent magnet is obtained by the powder metallurgical

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Expires: Aug 2021			method. The sintered permanent magnet can be imparted with greatly improved magnetic properties or, in particular, residual magnetic flux density when the thin alloy ribbon as the base material thereof has a metallographic phase structure containing "four-phase regions" consisting of (a) an .alpha.-iron phase, (b) a R-rich phase, in which R is a rare earth element selected from praseodymium, neodymium, terbium and dysprosium, (c) a R.sub.x T.sub.4 B.sub.4 phase, in which T is iron or a combination of iron and a transition metal element other than iron and rare earth elements and x is a positive number varying with the rare earth element, and (d) a R.sub.2 T.sub.14 B phase, in which R and T each have the same meaning as defined above, each phase being dispersed with a grain diameter in a limited range, in a volume fraction of from 1 to 10%. What is claimed is: 1. A rare earth-based permanent magnet which is ***[composition of matter]*** a sintered body of a powder of a thin ribbon of a rare earth-based magnet alloy, having a metallographic phase structure of which the volume fraction of a four-phase region consisting of (a) an α-iron phase having α-iron grains with a grain diameter of 0.1 to 20 μm, (b) an R-rich phase which is a phase richer in the content of rare earth element than in an $R_2T_{14}B$ phase, R being a rare earth element selected from praseodymium, neodymium, terbium and dysprosium, said R-rich phase having R-rich grains with a grain diameter of 0.1 to 20 μm, (c) an $R_xT_4B_4$ phase, in which R has the same meaning as defined above, T is iron or a combination of iron and a transition metal element other than iron and the rare earth elements and x is a positive number larger than 1 varying with the rare earth element, said $R_xT_4B_4$ phase having $R_xT_4B_4$ grains with a grain diameter of 0.1 to 10 μm and (d) the $R_2T_{14}B$ phase, in which R and T each have the same meaning as defined above, the $R_2T_{14}B$ phase having $R_2T_{14}B$ grains with a grain diameter of 0.1 to 20 μm, each phase being uniformly dispersed in the four-phase region, is in the range from 1 to 20% by volume,

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			with the proviso that the rest of the volume fraction consists of the R-rich phase, $R_xT_4B_4$ phase and $R_2T_{14}B$ phase or consists of the R-rich phase and $R_2T_{14}B$ phase. 5. The rare earth-based permanent magnet as claimed in claim 1wherein the powder is obtained ***[process/method]*** by hydrogen decrepitation and pulverization of the thin ribbon of a rare earth-based magnet alloy.
Filed: Ma rch 5, 1999 Issued: February 25, 2003 Expires: March 2019	6,524,399	Assignee: Pioneer Metals and Technology, Inc. (Boston, MA, USA)	Magnetic material Abstract Magnetic materials having a coercivity not less than about 1000 Oersted are prepared in a single step procedure. A molten mixture of a desired composition having a relatively high boron content is cooled at a rate slower than about 105 degrees Celsius per second. Preferably, the molten mixture is cooled by depositing it on a chilled surface such that it forms a layer between about 120 and about 300, and preferably between about 120 and about 150, microns thick. What is claimed is: 1. The method of ***[process/method]*** producing a magnetic material comprising the steps of: providing a molten mixture including boron, one or more rare earths and one or more transition metals; and cooling said mixture at a rate slower than about 10.sup.5 degrees Celsius per second and faster than about 10.sup.4 Celsius per second, the molten mixture containing not less than about ten atomic percent boron, not less than about 60 atomic percent transition metals, and not more than about 10 atomic percent rare earths, wherein at least about 90 percent by weight of said rare earths comprise Nd, Pr, or a mixture thereof.

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			2. The method of claim 1 wherein said molten mixture is cooled by impinging said molten mixture on a heat conducting surface so that said mixture forms a layer having a thickness between about 120 and about 300 microns.
Filed: January 12, 2001 Issued: February 18, 2003 Expires: Jan 2021	6,521,054	Assignee: Seiko Epson Corporation (JAPAN)	Magnetic powder and isotropic bonded magnet Abstract Disclosed herein is a magnetic powder which can provide a magnet having excellent magnetic properties and having excellent reliability especially excellent in heat stability. The magnetic powder is composed of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w-v B.sub.z Al.sub.w V.sub.v (where R is at least one kind of rare-earth element, x is 7.1-9.9 at %, y is 0-0.30, z is 4.6-6.9 at %, w is 0.02-1.5 at % and v is 0.2-3.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase, wherein the magnetic powder has magnetic properties in which, when the magnetic powder is formed into an isotropic bonded magnet by mixing with a binding resin and then molding it, the irreversible susceptibility (.chi..sub.irr) which is measured by using an intersectioning point of a demagnetization curve in the J-H diagram representing the magnetic characteristics at the room temperature and a straight line which passes the origin in the J-H diagram and has a gradient (J/H) of -3.8.times.10.sup.-6 H/m as a starting point is less than 5.0.times.10.sup.-7 H/m, and the intrinsic coercive force (H.sub.CJ) of the bonded magnet at the room temperature is in the range of 320-720 kA/m. What is claimed is: 1. Magnetic powder composed ***[composition of matter]*** of an alloy composition represented by R.sub.x (Fe.sub.1-y Co.sub.y).sub.100-x-z-w-v B.sub.z Al.sub.w V.sub.v (where R is at least one rare-earth element, x is 7.1-

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			9.9 at %, y is 0-0.30, z is 4.6-6.9 at %, and w is 0.02-1.5 at % and v is 0.2-3.5 at %), the magnetic powder being constituted from a composite structure having a soft magnetic phase and a hard magnetic phase; wherein the magnetic powder has characteristics in which, when an isotropic bonded magnet is molded by mixing the magnet powder with a binding resin, a irreversible susceptibility (x.sub.irr) is equal to or less than 5.0.times.10.sup.-7 H/m; the irreversible susceptibility is measured by using a point where a demagnetization curve in a J-H diagram and a straight line that passes through the origin in the J-H diagram intersect; the demagnetization curve represents the magnetic characteristics at room temperature, and the straight line has a gradient (J/H) of -3.8.times.10.sup.-6 ; and the intrinsic coercive force (H.sub.CJ) of the magnet at room temperature is in the range of 320-720 kA/m. 2. The magnetic powder as claimed in claim 1, wherein when an isotropic bonded magnet having a density .rho. is molded ***[process/method*** from a mixture of the magnetic powder and a binding resin, the remanent magnetic flux density Br at room temperature satisfies the relationship represented by the formula of Br/.rho.[.times.10.sup.-6 T.multidot.m.sup.3 /g].gtoreq.0.125.
Filed: January 3, 2002 Issued: January 14, 2003 Expires: Jan 2022	6,507,193	Assignee: General Electric Company (Niskayuna, NY, USA)	Residuum rare earth magnet Abstract A permanent magnet for an MRI scanner is made by removing extraneous elements from an ore containing rare earth elements to leave elements Pr and Nd therein, and then selectively stripping therefrom a portion of the element Nd as a byproduct to leave an ore residuum including both elements Pr and Nd therein. The residuum is alloyed with a transition metal to form an alloy therewith. The alloy is then formed into a rare earth permanent magnet configured for use in the MRI scanner.

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			We claim: 1. A method of making ***[process/method]*** a magnetic imaging resonance scanner including a permanent magnet field generator comprising: forming permanent magnet in said generator from ore containing rare earth elements including Pr and Nd by selectively stripping therefrom said element Nd as a byproduct to leave a residuum including both elements Pr and Nd therein, and alloying said residuum with a transition metal and boron to form a mixed rare earth permanent magnet; assembling said permanent magnets as a pair of spaced apart pads on opposite sides of a magnetic yoke; assembling a pair of pole pieces adjacent said pads for shaping magnetic field therefrom in an imaging zone therebetween; assembling a plurality of gradient coils adjacent said pole pieces for locally varying magnetic field in said imaging zone; assembling an RF coil adjacent said imaging zone for radiating excitation energy therein; and operatively joining said gradient coils and RF coil to a computer for magnetically resonating a target in said imaging zone for imaging thereof. 2. A method according to claim 1 further comprising partially removing cerium from said ore to reduce said cerium component of said rare earth elements to greater than about 0.6%.
Filed: February 2, 1999 Issued: December 17, 2002 Expires:	6,494,968	Assignee: Toda Kogyo Corporation (Hiroshima, JAPAN)	Lamellar rare earth-iron-boron-based magnet alloy particles, process for producing the same and bonded magnet produced therefrom Abstract Lamellar rare earth-iron-boron-based magnet alloy particles for a bonded magnet, having an intrinsic coercive force (iHc) of not less than 3.5 kOe, a residual magnetic flux density (Br) of not less than 9.5 kG, and a maximum energy product ((BH).sub.max) of not less than 13 MGOe. These particles have an average major axial diameter of 60 to 500 .mu.m, an average minor

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Feb 2019			axial diameter of 50 to 460 .mu.m, an average axis ratio (major axial diameter/minor axial diameter) of 1.1 to 10 and an average aspect ratio (major axial diameter/thickness) of 3 to 100. The magnet alloy particles have a residual magnetic flux density (Br) as high as not less than 10 kG, an intrinsic coercive force (iHc) as large as not less than 3.5 kOe and a maximum energy product ((BH).sub.max) as large as not less than 13 MGOe, are used as a material for high-performance bonded magnets. What is claimed is: 1. Lamellar rare earth-iron-boron-based magnet alloy particles having a composition ***[composition of matter]*** represented by the formula: $R_xFe_{(100-x-y-z-w)}Co_yM_zB_w$ wherein R is at least one rare earth element selected from the group consisting of Nd, Pr, Dy, Tb and Ce, M is at least one element selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W, Mn, Cu, Ga, Ag and Si, x is 5 to 9, y is 1.0 to 9.0, z is 0.1 to 5, w is 2 to 7, (x+w) is not less than 9, and (y+z) is more than 5, said particles having an intrinsic coercive force (iHc) of not less than 3.5 kOe, a residual magnetic flux density (Br) of not less than 9.5 kG, and a maximum energy product ($(BH)_{max}$) of not less than 13 MGOe, and having an average major axial diameter of 60 to 500 µm, an average minor axial diameter of 50 to 460 µm, an average axis ratio (major axial diameter/minor axial diameter) of 1.1 to 10 and an average aspect ratio (major axial diameter/thickness) of 3 to 100. 9. A process for producing ***[process/method]*** the lamellar rare earth-iron-boron-based magnet alloy particles of claim 1, for a bonded magnet, comprising the steps of: preparing a mixture having a composition of the rare earth-iron-boron-based magnet alloy particles; heat-melting said obtained mixture to produce a molten alloy; discharging said molten alloy through a nozzle; spraying a gas onto said molten alloy discharged to form droplets of said molten alloy; before solidification of said droplets, causing said droplets to

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			collide against a cone-shaped or disc-shaped rotary cooling member which is disposed along the falling direction of said droplets to subject said droplets to quench solidification and is rotated, thereby forming quenched and solidified particles; and heat-treating said quenched and solidified particles in the temperature range of 600 to 850° C.
Filed: May 9, 2001 Issued: December 10, 2002 Expires: May 2021	6,491,765 **Note: many claims of infringment**	Assignee: Sumitomo Special Metals Co. (JAPAN)	Rare earth magnet and method for manufacturing the same Abstract The method for manufacturing alloy powder for R--Fe--B type rare earth magnets of the present invention includes a first pulverization step of coarsely pulverizing a material alloy for rare earth magnets and a second pulverization step of finely pulverizing the material alloy. In the first pulverization step, the material alloy is pulverized by a hydrogen pulverization method. In the second pulverization step, easily oxidized super-fine powder (particle size: 1.0 .mu.m or less) is removed to adjust the particle quantity of the super-fine powder to 10% or less of the particle quantity of the entire powder. We claim: 1. A method for manufacturing alloy powder for R--Fe--B rare earth magnets, comprising ***[process/method]*** a first pulverization step of coarsely pulverizing a material alloy for rare earth magnets and a second pulverization step of finely pulverizing the material alloy, wherein said first pulverization step comprises a step of pulverizing the material alloy by a hydrogen pulverization method, and said second pulverization step comprises a step of removing at least part of fine powder having a particle size of 1.0 .mu.m or less to adjust the particle quantity of the fine powder having a particle size of 1.0 .mu.m or less to 10% or less of the particle quantity of the entire powder. 3. The method of claim 1 or 2, wherein in said pulverization step, the alloy is

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			finely pulverized in a high-speed flow of gas. 12. The method of claim 11, wherein the melt of the alloy is cooled by a strip casting method.
Original filing: Oct 27, 1987 Original Issue: Jan 8, 1991 Refiling: Nov 2, 2001 Reissue: March 25, 2003 Expires: Nov 2021	RE38,042 Reissue of 4983232	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Anisotropic magnetic powder and magnet thereof and method of producing same Abstract A the magnetically anisotropic magnetic powder having an average particle size of 1-1000 .mu.m and made from a magnetically anisotropic R-TM-B-Ga or R-TM-B-Ga-M alloy having an average crystal grain size of 0.01-0.5 .mu.m, wherein R represents one or more rare earth elements including Y, TM represents Fe which may be partially substituted by Co, B boron, Ga gallium, and M one or more elements selected from the group consisting of Nb, W, V, Ta, Mo, Si, Al, Zr, Hf, P, C and Zn. This is useful for anisotropic resin-bonded magnet with high magnetic properties. What is claimed is: 1. A magnetically anisotropic magnetic powder ***[composition of matter]*** of rare earth-iron-boron having improved thermal stability, having an average particle size of 1-1000 .mu.m and made from a magnetically anisotropic R-TM-B-Ga alloy having an average crystal grain size of 0.01-0.5 .mu.m, wherein R represents one or more rare earth elements including Y, TM represents Fe which may be partially substituted by Co, B represents boron and Ga represents gallium, wherein said R-TM-B-Ga alloy comprises 11-18 atomic % of R, 4-11 atomic % of B, 5 atomic % or less of Ga, and balance Fe which may be partially substituted by 30 at. % or less of Co, and inevitable impurities.

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			7. A magnetically anisotropic pressed powder magnet ***[composition of matter]*** having improved thermal stability, made of magnetically anisotropic R-TM-B-Ga alloy having an average crystal grain size of 0.01-0.5 .mu.m wherein R consisting essentially of Nd part of which may be substituted with Dy, TM represents Fe which may be partially substituted by Co, B represents boron, and Ga represents gallium, said magnetically anisotropic R-TM-B-Ga alloy having an axis of easy magnetization, wherein said R-TM-B-Ga alloy comprises 11-18 atomic % of R, 4-11 atomic % of B, 5 atomic % or less of Ga and balance Fe which may be partially substituted by 30 .[.at %.]. .Iadd.atomic % .Iaddend.or less of Co, and inevitable impurities. 11. A magnetically anisotropic resin-bonded magnet ***[composition of matter]*** of rare earth-iron-boron having improved thermal stability composed of 15-40 volume % of a resin binder and balance R-TM-B-Ga alloy powder having an average crystal grain size of 0.01-0.5 .mu.m, wherein R represents one or more rare earth elements including Y, TM represents Fe which may be partially substituted by Co, B represents boron and Ga represents gallium, said magnetically anisotropic R-TM-B-Ga alloy having an axis of easy magnetization, wherein said R-TM-B-Ga alloy comprises 11-18 atomic % of R, 4-11 atomic % of B, 5 atomic % or less of Ga, and balance Fe which may be partially substituted by 30 at % or less of Co, and inevitable impurities
Original filing: Dec 13, 1988 Original issue: Mar 17, 1992	RE38,021 reissue of 5096509	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Anisotropic magnetic powder and magnet thereof and method of producing same Abstract A the magnetically anisotropic magnetic powder having an average particle size of 1--1000 .mu.m and made from a magnetically anisotropic R-TM-B-Ga or R-TM-B-Ga-M alloy having an average crystal grain size of 0.01-0.5 .mu.m, wherein R represents one or more rare earth elements including Y, TM represents Fe which may be partially substituted by Co, B boron, Ga gallium,

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Refile: Nov 2, 2001 Reissue: March 11, 2003 Expire: Nov 2023			and M one or more elements selected from the group consisting of Nb, W, V, Ta, Mo, Si, Al, Zr, Hf, P, C and Zn. This is useful for anisotropic resin-bonded magnet with high magnetic properties. What is claimed is: 1. A method of producing ***[process/method]*** a magnetically anisotropic magnetic powder comprising the steps of rapidly quenching a melt of an R-TM-B-Ga alloy, wherein R represents one or more rare earth elements including Y, TM represents Fe which may be partially substituted by Co, B represents boron and Ga represents gallium, to form flakes of an amorphous or partially crystallized R-TM-B-Ga alloy, pressing the flakes to provide a pressed powder body having a higher density, subjecting it to plastic deformation while heating to provide a magnetically anisotropic R-TM-B-Ga alloy, and then pulverizing it. 2. The method of producing ***[process/method]*** magnetically anisotropic magnetic powder according to claim 1, wherein said R-TM-B-Ga alloy consists essentially of 11-18 atomic % of a rare earth element, 4-11 atomic % of boron, 30 atomic % or less of Co, 5 atomic % or less of Ga and balance Fe and inevitable impurities. 3. A method of producing ***[process/method]*** a magnetically anisotropic magnetic powder comprising the steps of rapidly quenching a melt of an R-TM-B-Ga-M alloy, wherein R represents one or more rare earth elements including Y, TM represents Fe which may be partially substituted by Co, B represents boron, Ga represents gallium, and M represents one or more elements selected from the group consisting of Nb, W, V, Ta, Si, Al, Zr, Hf, Mo, P, C and Zn to form flakes of an amorphous or partially crystallized R-TM-B-Ga-M alloy, pressing the flakes to have a higher density to provide a pressed powder body, subjecting it to plastic deformation while heating to

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			provide a magnetically anisotropic R-TM-B-Ga-M alloy, and then pulverizing it.
Filed: Dec 30, 1997 Issued: November 12, 2002 Expires: December, 2017	6,478,890	Assignee: Magnequench,Inc. (Anderson, IN, USA)	This patent is a continuation in part of 6,183,572. Re-Fe-B powders exhibiting high intrinsic induction Isotropic rare earth material of high intrinsic induction Abstract Isotropic magnetic alloy powder having an intrinsic magnetic induction of at least two third of its magnetic remanence and method for making same are provided. The powder is made from an alloy having a composition comprising, by weight percentage, approximately 15 to 35 percent of one or more rare earth metals, approximately 0.5 to 4.5 percent of boron, and approximately 0 to 20 percent of cobalt, balanced with iron. The alloy powder is made by a process wherein an amount of the alloy is melt and spun in an inert environment, preferably at a distance between an orifice and a wheel being less than one and one half inches, into ribbons, followed by crushing the ribbons into powder and annealing the powder. What is claimed is: 1. Isotropic magnetic material comprising ***[composition of matter]*** one or more are earth metals, boron, and iron, said magnetic material having an intrinsic magnetic induction, when measured at two third of its intrinsic coercivity and without taking into consideration of demagnetization correction factor, of at least two-thirds of its magnetic remanence; wherein said magnetic material comprises niobium in an amount of less than 0.1%, by weight, and gallium in an amount of less than 0.01%, by weight. 3. The magnetic material of claim 1 wherein said intrinsic magnetic induction

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			is at least 75 percent of its magnetic remanence. 4. The magnetic material of claim 1 having been made by a process ***[process/method]*** comprising a melt spinning step
Filed: September 15, 2000 Issued: October 29, 2002 Expires: Sept 2020	6,471,786	Assignee: Sumitomo Special Metals Co., Ltd. (JAPAN)	Method for preparing nanocomposite magnet powder and method for producing nanocomposite magnet Abstract The inventive method for preparing nanocomposite magnet powder includes the step of preparing material alloy powder for a nanocomposite magnet represented by a general formula Fe.sub.100-x-y-z-u R.sub.x B.sub.y Co.sub.z M.sub.u where R is a rare-earth element of which 90-100 atomic percent is Pr and/or Nd while 0-10 atomic percent is another lanthanoid and/or Y, and the molar fractions x, y, z and u meet the inequalities of 2.ltoreq.x.ltoreq.6, 16.ltoreq.y.ltoreq.20, 0.2.ltoreq.z.ltoreq.7 and 0.01.ltoreq.u.ltoreq.7, respectively. The powder includes a metastable phase and an amorphous structure existing in a metal structure. Heat treatment is performed for the material alloy powder to crystallize Fe.sub.3 B and Fe--R--B compounds from the amorphous structure. An integral value of the difference between a temperature-time curve represented by the temperature of the material alloy powder as a function of the heat treatment time during the heat treatment and a reference temperature-time curve is in a range from 10.degree. C..multidot.sec to 10,000.degree. C..multidot.sec, the reference temperature-time curve being obtained when heat treatment similar to the above heat treatment is performed for an equivalent amount of alloy that has the same composition as the material alloy but does not include the amorphous structure. What is claimed is: 1. A method for preparing nanocomposite magnet powder ***[process/method]***,

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			the method comprising the steps of: preparing material alloy powder for a nanocomposite magnet, the powder being represented by a general formula Fe.sub.100-x-y R.sub.x B.sub.y, Fe.sub.100-x-y-z R.sub.x B.sub.y Co.sub.z, Fe.sub.100-x-y-u R.sub.x B.sub.y M.sub.u or Fe.sub.100-x-y-z-u R.sub.x B.sub.y Co.sub.z M.sub.u where R is a rare-earth element; 78-100 atomic percent of R is Pr and/or Nd, 0-22 atomic percent of R is another lanthanoid and/or Y; M is at least one element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo, Hf, Ta, W, Pt, Pb, Au and Ag; the molar fractions x, y, z and u meet the inequalities of 2.ltoreq.x.ltoreq.6, 16.ltoreq.y.ltoreq.20, 0.2.ltoreq.z.ltoreq.7 and 0.01.ltoreq.u.ltoreq.7, respectively, the powder including a metastable phase and an amorphous structure existing in a metal structure; and heat-treating said material alloy powder to crystallize Fe.sub.3 B and Fe--R--B compounds from the amorphous structure, wherein an integral value of the difference between a temperature-time curve represented by the temperature of the material alloy powder for the nanocomposite magnet and the heat treatment time in the step of heat-treating the material alloy powder for the nanocomposite magnet and a reference temperature-time curve is in a range from 10.degree. C..multidot.sec to 10,000.degree. C..multidot.sec, said reference temperature-time curve being obtained by heat-treating said material alloy powder for said nanocomposite magnet for an equivalent amount of alloy having the same composition as said material alloy for the nanocomposite magnet without said amorphous structure.
Filed: March 8, 2001 Issued: October 8, 2002	6,461,565 **Note: many claims of infringment**	Assignee: Sumitomo Special Metals Co., Ltd. (JAPAN)	Method of pressing rare earth alloy magnetic powder Abstract A green compact of a rare earth alloy magnetic powder is made by pressing the powder. The powder is pressed within an air environment that has a temperature controlled at 30.degree. C. or less and a relative humidity controlled at 65% or less.

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Expires: March 2021			We claim: 1. A method of forming a green compact of a rare earth alloy magnetic powder ***[process/method]*** comprising the steps of: providing a rare earth alloy powder, providing a controlled environment having a temperature ranging from 5.degree. C. to 30.degree. C. and a relative humidity ranging from 40% to 65%, and pressing the rare earth alloy powder within the controlled environment. 9. The method of claim 1 or 2, further comprising ***[process/method]*** the steps of: providing a die pressing machine comprising: a die with a die hole for forming at least a portion of a cavity, and first and second punches for compacting the powder inside the hole; filling the cavity with the powder with at least an upper end of the second punch inserted into the die hole; compacting the powder in the die between the first and second punches, thereby forming a green compact of the powder; and ejecting the compact out of the die hole. 10. The method of claim 9, further comprising the step of sintering the compact
Filed: May 8, 2000 Issued: September 24, 2002 Expires:	6,454,993	Assignee: Delphi Technologies, Inc. (Troy, MI, USA)	Manufacturing technique for multi-layered structure with magnet using an extrusion process Abstract A method is provided for manufacturing a multi-layered magnetic rod in which a steel powder is reduced and extruded through a die. To improve the magnetic properties, a layer of rare earth magnetic power formed around the low alloy steel in the extruder chamber. A second layer of coating formed around the rare earth powder and the three layers are co-extruded through the die to produce a layered rod having improved magnetic properties. The resulting

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May 2020			magnetic rod may be machined using conventional machining methods. What is claimed is: 1. A method for extrusion manufacture of multi-layer structure with a ring permanent magnet ***[process/method]*** comprising the steps of: injecting a first powdered metal into a extrusion container; injecting a second powdered metal into said extrusion container; extruding the powder through a die so as to form a magnetic rod; and stripping said magnetic rod from said die. 13. The method ***[process/method]*** of claim 10 wherein said first powdered metal is a low alloy steel. 14. The method of claim 13 wherein said second powdered metal is a rare earth element.
Filed: November 24, 1999 Issued: September 10, 2002 Expires: Nov 2019	6,447,621	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-T-B rare earth sintered magnet having improved squareness ratio and method for producing same Abstract An R--T--B rare earth sintered magnet containing an R.sub.2 T.sub.14 B-type intermetallic compound as a main phase and thus having improved squareness ratio is produced by carrying out a reduction and diffusion method comprising the steps of (a) mixing oxide powder of at least one rare earth element R, T-containing powder, wherein T is Fe or Fe and Co, B-containing powder, and a reducing agent such as Ca, (b) heating the resultant mixture at 900-1350.degree. C. in a non-oxidizing atmosphere, (c) removing reaction by-products from the resultant reaction product by washing, and (d) carrying out a heat treatment for Ca removal by heating the resultant R--T--B rare earth alloy powder at 900-1200.degree. C. in vacuum at 1 Torr or less, followed by pulverization of the resultant alloy powder bulk, molding, sintering in vacuum,

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			heat treatment, and surface treatment. The alloy powder bulk obtained by the heat treatment for Ca removal is preferably pulverized after removal of its surface layer. What is claimed is: 1. An R--T--B rare earth sintered magnet formed from R--T--B alloy powder ***[composition of matter]*** produced by a reduction and diffusion method, which R--T--B rare earth sintered magnet has an improved squareness ratio and contains as a main phase an R.sub.2 T.sub.14 B-type intermetallic compound, wherein R is at least one rare earth element including Y, at least one of Nd, Dy and Pr being indispensable, and T is Fe or Fe and Co, the amount of Ca contained as an inevitable impurity being 0.01 weight % or less, and c-axis directions of core portions of the main-phase crystal grain particles being deviated by 5.degree. or more from those of surface layer portions of the main phase crystal grain particles, wherein the number of said main phase crystal grain particles each having a surface layer portion is 50% or less of the total number of said main phase crystal grain particles. 7. The R--T--B rare earth sintered magnet according to claim 1, wherein said reduction and diffusion method ***[process/method]*** comprises the steps of: (a) a mixing oxide powder of at least one rare earth element R, wherein R is at least one rare earth element including Y, at least one of Nd, Dy and Pr being indispensable, T-containing powder, wherein T is Fe or Fe and Co, B-containing powder, and at least one reducing agent selected from the group consisting of Ca, Mg and hydrides thereof, (b) heating the resultant mixture at 900-1350.degree. C. in a non-oxidizing atmosphere, (c) removing reaction by-products from the resultant reaction product by washing, and (d) carrying out a heat treatment for Ca removal by heating the resultant R--T--B rare earth alloy powder at 900-1200.degree. C. in vacuum at 1 Torr or less, followed by pulverization of the resultant alloy powder bulk, molding, sintering in vacuum,

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			heat treatment, and surface treatment.
Filed: May 14, 1999 Issued: July 30, 2002 Expires: May 2019	6,425,961	Assignee: Alps Electric Co., Ltd. (Tokyo, JAPAN) Inoue; Akihisa (Miyagi-Ken, JAPAN)	Composite hard magnetic material and method for producing the same Abstract The present invention provides a method for producing a composite hard magnetic material, wherein a composite powder--prepared by mixing; a composite hard magnetic material produced by consolidating a composite powder prepared by mixing an alloy powder having an amorphous phase containing a main component Co and at least Sm, and an alloy powder comprising an amorphous phase as a principal phase and containing at least Fe and/or Co, rare earth elements R and B; an alloy powder having an amorphous phase containing a main component Co and at least Sm; and an alloy powder having an amorphous phase containing at least Fe and/or Co, rare earth elements R and B--is consolidated by taking advantage of softening phenomenon caused by crystallization of the amorphous phase in the alloy powder comprising an amorphous phase as a principal phase. What is claimed is: 1. A composite hard magnetic material comprising ***[composition of matter]***: a body-centered cubic (bcc) structure selected from the group consisting of a Fe phase of the bcc structure, a FeCo phase of the bcc structure, and combinations thereof a $R_2Fe_{14}B$ phase (wherein R represents one or more elements among rare earth elements), a SmCo phase, and an amorphous phase, at least one crystalline phase comprising a fine crystalline phase, a combination of all fine crystalline phases being at least 50% by volume and each fine crystalline phase having a mean crystal grain size of at most 100 nm; said composite hard magnetic material formed by consolidating a composite powder, said composite powder containing a first alloy powder comprising at least 50% by weight of an amorphous phase as a principal phase and containing at least Co and Sm, and a second alloy powder comprising at least 50% by weight of

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			an amorphous phase as a principal phase and containing at least one of Fe and Co, and rare earth elements R and B; said first alloy powder being represented by the following formula: $(Co_{1-f}T_f)_{100-x-y-z-t}M_xSm_yR_zQ_t$ (wherein T is selected from the group consisting of Fe, Ni, and combinations thereof, M is selected from the group consisting of Nb, Zr, Ta, Hf, and combinations thereof; R is selected from the group consisting of Sc, Y, La, Ce, Pr, Nd, Pm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and combinations thereof: and Q is selected from the group consisting of P, C, Si, B, and combinations thereof, f being represented by $0 \leqq f \leqq 0.5$, x being represented by $0 \leqq x \leqq 4$, y being represented by $8 \leqq y \leqq 16$, z being represented by $0 \leqq z \leqq 5$, t being represented by $0.5 \leqq t \leqq 10$ and x+y+z being represented by $8 \leqq x+y+z \leqq 16$ in at %, respectively); and said second alloy powder being represented by the following formula: $T_gM_hR_jB_k$ (wherein T is selected from the group consisting of Fe, Fe—Co, Fe—Ni, Fe—Co—Ni, Co, and Co—Ni; M is selected from the group consisting of Zr, Nb, Ta, Hf, Ti, V, Mo, W. and combinations thereof; R represents one or more elements among rare earth elements; and B represents boron; g, h, j and k indicating composition ratios are in the range of $50 \leqq g$, $0 \leqq h \leqq 15$, $3 \leqq j \leqq 20$ and $2 \leqq k \leqq 20$, respectively); and said first alloy powder and said second alloy powder being mixed in a proportion of 5:95 to 80:20 in the composite powder.
Filed: August 31, 2001 Issued: 6,419,723 Expires:	6,419,723	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Thin ribbon of rare earth-based permanent magnet alloy Abstract Disclosed is a thin alloy ribbon prepared by the strip casting method as an intermediate for the preparation of a sintered rare earth-based permanent magnet or, in particular, a neodymium/iron/boron-type permanent magnet. The thin alloy ribbon is characterized by a specific volume fraction of the four-phase coexisting region consisting of the .alpha.-iron phase, R-rich phase,

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Aug 2021			R.sub.X T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase each having an average grain diameter in a specified range and a specific volume fraction of the chill crystalline phase. When these requirements are satisfied, the sintered rare earth-based permanent magnet prepared from the thin alloy ribbons can be imparted with improved magnetic properties and high sintering density even without increasing the sintering temperature. What is claimed is: 1. A rare earth permanent magnet which is a sintered block of a powder of a thin alloy ribbon prepared by ***[process/method]*** the strip casting method from a melt of an alloy comprising a rare earth element R selected from the group consisting of praseodymium, neodymium, terbium and dysprosium, element T which is iron or a combination of iron with a transition metal element other than iron and rare earth elements and boron B, which comprises from 1 to 10% by volume fraction of a four-phase coexisting region consisting of an .alpha.iron phase having an average grain diameter of 0.1 to 20 .mu.m, R-rich phase having an average grain diameter of 0.1 to 20 .mu.m, R.sub.X T.sub.4 B.sub.4 phase, the subscript x being a number larger than 1 but smaller than 1.2, having an average grain diameter of 0.1 to 10 .mu.m and R.sub.2 T.sub.14 B phase having an average grain diameter of 0.1 to 20 .mu.m and from 1 to 30% by volume fraction of a chill crystalline phase having an average grain diameter not exceeding 3 .mu.m, the balance of the volume fractions consisting of a combination of the R-rich phase, R.sub.X T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase of a combination of the R-rich phase and R.sub.2 T.sub.4 B phase. 2. A rare earth permanent magnet as claimed in claim 1 in which ***[composition of matter]*** the average grain diameters of the .alpha.-iron phase, R-rich phase, R.sub.X T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase are in the ranges from 0.1 to 10 .mu.m, from 0.1 to 10 .mu.m, from 0.1 to 10 .mu.m and from 0.1 to 10 .mu.m, respectively.

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			3. The rare earth permanent magnet as claimed in claim 1 in which the volume fraction of the four-phase coexisting region is in the range from 2 to 5%
Filed: March 13, 2000 Issued: July 2, 2002 Expires: March 2020	6,413,327	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Nitride type, rare earth magnet materials and bonded magnets formed therefrom Abstract A nitride-type, rare earth magnet material having a basic composition represented by R.sub..alpha. T.sub.100-(.alpha.+.beta.+.gamma.+.delta.) M.sub..beta. B.sub..gamma. N.sub..delta. (atomic %), wherein R is at least one rare earth element including Y, as a rare earth element Sm must be present, T is Fe alone or a combination of Fe and Co and/or Ni, M is at least one element selected from the group consisting of Al, Ti, V, Cr, Mn, Cu, Ga, Zr, Nb, Mo, Hf, Ta, W and Zn, 6.ltoreq..alpha..ltoreq.15, 0.5.ltoreq..beta..ltoreq.10, 0.ltoreq..gamma..ltoreq.4, and 4.ltoreq..delta..ltoreq.30, which is substantially composed of a hard magnetic phase of an R.sub.2 T.sub.17 -type structure having an average crystal grain size of 0.01-1 .mu.m, an average area ratio of .alpha.-Fe being 5% or less. What is claimed is: 1. A nitride, rare earth magnet material ***[composition of matter]*** having a basic composition represented by: $R_\alpha T_{100-(\alpha+\beta+\gamma+\delta)} M_\beta B_\gamma N_\delta$ (atomic %), wherein R is at least one rare earth element including Y, where as a rare earth element Sm must be present, T is Fe alone or a combination of Fe and Co and/or Ni, M is at least one element selected from the group consisting of Al, Ti, V, Cr, Mn, Cu, Ga, Zr, Nb, Mo, Hf, Ta, W and Zn, $6 \leqq \alpha \leqq 15$, $0.5 \leqq \beta \leqq 10$, $0 \leqq \gamma \leqq 4$, and $4 \leqq \delta \leqq 30$, said nitrided, rare earth magnet material being substantially composed of a hard magnetic phase of an R_2T_{17}structure having an average crystal grain size of 0.01-1 μm, and an average area ratio of α-Fe being 5% or less.

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			7. The nitride, rare earth magnet material according to claim 1, produced by ***[process/method]*** subjecting a mother alloy having substantially the same composition as said basic composition except for containing no nitrogen to rapid quenching at a peripheral speed of a quenching roll that is 0.05-15 m/second to produce a thin ribbon, followed by a homogenizing heat treatment at 1010-1280° C. for 1-40 hours in an inert gas atmosphere containing no nitrogen, a hydrogenation/decomposition reaction treatment by heating at 675-900° C. for 0.5-8 hours in hydrogen gas at 0.1-10 atm or in an inert gas atmosphere, excluding nitrogen gas, having a hydrogen partial pressure of 0.1-10 atm, a dehydrogenation/recombination reaction treatment by heating at 700-900° C. for 0.5-10 hours in vacuum of 1×10^{-1} Torr or less, and then a nitriding treatment
Filed: March 16, 2000 Issued: 6,387,293 Expires: March 2020	6,387,293	Assignee: Seiko Epson Corporation (JAPAN)	Composition for rare earth bonded magnet use, rare earth bonded magnet and method for manufacturing rare earth bonded magnet Abstract A composition for a rare earth bonded magnet, the rare earth bonded magnet and the method for manufacturing the rare earth bonded magnet are provided that produce little decline in mechanical strength caused by the addition of a lubricant and have excellent molding properties. The rare earth bonded magnet of the present invention is manufactured from the composition for the magnet that contains rare earth magnetic powder, binding resin containing thermoplastic resin, and fluorine-based resin powder, by compaction molding, extrusion molding or injection molding. The fluorine-based resin powder has the properties of improving mainly lubrication between a molding and a metallic mold. The content of the fluorine-based resin powder in the composition for the rare earth bonded magnet is preferably less than 20 vol % relative to the thermoplastic resin, and the particle diameter of the fluorine-based resin powder is preferably 2-30 .mu.m.

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			What is claimed is: 1. A composition for a rare earth bonded magnet ***[composition of matter]*** comprising rare earth magnetic powder and binding resin containing thermoplastic resin; wherein the composition comprises fluorine-based resin powder with a particle size of 2-30 .mu.m and 2-12 vol % of an antioxidant. 6. A rare earth bonded magnet prepared by ***[process/method]*** bonding rare earth magnetic powder with binding resin containing thermoplastic resin; wherein the magnet contains fluorine-based resin powder with a particle size of 2-30 .mu.m; said rare earth bonded magnet has a rare earth magnetic powder content of 68-76 vol % when prepared by an injection molding method; and said rare earth bonded magnet has a rare earth magnetic powder content of 78.1-83 vol % when prepared by an extrusion molding method.
Filed: August 16, 2000 Issued: April 9, 2002 Expires: Aug 2020	6,368,551	Assignee: Sanei Kasei Co., Ltd. (Tokyo, JAPAN)	Method for preparation of sintered permanent magnet Abstract The method for preparation of sintered permanent magnets according to the present invention comprises the steps of: mixing fully fine powder of a crystalline mother alloy for permanent magnet containing a rare-earth element, Fe and B as the essential components with fine powder of zinc oxide, compaction molding the resulted mixture in the presence of a magnetic field, sintering the compacted mixture in vacuum to cause generation of oxygen and metallic zinc by thermal decomposition of the zinc oxide; segregation of a part of metallic component in the mother alloy at the boundary and inside of the mother alloy crystal; formation of amorphous metallic oxide by forced oxidation of the segregated metal with the generated oxygen; crystallization of

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			the amorphous metallic oxide; formation of an epitaxial junction between the crystallized metallic oxide and the mother alloy crystal; and evaporation of the metallic zinc into the vacuum, and quenching the sintered compact. What is claimed is: 1. A method for preparation of sintered permanent magnets comprising ***[process/method]*** the steps of: * mixing fully fine powder of a crystalline mother alloy for permanent magnet containing a rare-earth element, Fe and B as the essential components with fine powder of zinc oxide, * compaction molding the resulted mixture in the presence of a magnetic field, * sintering the compacted mixture in vacuum to cause generation of oxygen and metallic zinc by thermal decomposition of the zinc oxide; segregation of a part of metallic component in the mother alloy at the boundary and inside of the mother alloy crystal; formation of amorphous metallic oxide by forced oxidation of the segregated metal with the generated oxygen; crystallization of the amorphous metallic oxide; formation of an epitaxial junction between the crystallized metallic oxide and the mother alloy crystal; and evaporation of the metallic zinc into the vacuum, and * quenching the sintered compact.
Filed: Jul y 12, 1999 Issued:	6,352,599	Assignee: Santoku Corp (Kobe, JAPAN)	High performance iron-rare earth-boron-refractory-cobalt nanocomposite Abstract Magnetic nanocomposite materials including iron, rare earth elements, boron, refractory metals and cobalt which have favorable magnetic properties and are

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March 5, 2002 Expires: July 2019			suitable for making bonded magnets are disclosed. Compositions of the present invention can be of the formula: (N.sub.1-y La.sub.y).sub.v Fe.sub.100-v-w-x-z Co.sub.w M.sub.z B.sub.x, where M is at least one refractory metal selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo and W; v is from about 5 to about 15; w is greater than or equal to 5; x is from about 9 to about 30; y is from about 0.05 to about 0.5; and z is from about 0.1 to about 5. Preferably M is at least Cr. These materials have good magnetic properties and are suitable for use in preparing bonded magnets. What is claimed is: 1. A permanent magnet material characterized ***[composition of matter]*** by a chemical formula: $(RE_{1-y}La_y)_v Fe_{100-v-w-x-z} Co_w M_z B_x$, wherein RE is at least one element selected from the group consisting of Pr and Nd; M is Cr; v is from about 9.5 to about 11.5 w is from about 5 to about 12 x is from about 9 to about 11.5 y is from about 0.05 to about 0.1 z is from about 2 to about 3 the magnet material having been made by rapid cooling from a molten state at a cooling rate between 10^4 to 10^7 degrees C./second to make a substantially amorphous material, followed by thermal treating at temperatures from about 600 to 750 degrees C. for 0.01 seconds to 120 minutes, the material containing the following phases: (i) a hard magnetic phase comprising at least one member of the group consisting of $RE_2Fe_{14}B$ and $RE_2(Fe,Co)_{14}B$, (ii) a soft magnetic phase comprising at least one member of the group consisting of α-Fe, Fe_3B, and α-(Fe,Co), (iii) one or more metal M boride precipitated phases

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			21. A method of making ***[process/method]*** the magnet material of claim 1, comprising rapid cooling a composition of the chemical formula: $(RE_{1-y}La_y)_vFe_{100-v-w-x-z}Co_wM_zB_x$ as defined in claim 1, from a molten state at a cooling rate between 10^4 to 10^7 degrees C./second to make a substantially amorphous material, followed by thermal treating at temperatures from about 600 to 750 degrees C. for 0.01 seconds to 120 minutes.
Filed: February 12, 1999 Issued: April 23, 2002 Expires: Feb 2019	[6,377,049](https://cmi.ameslab.gov/resources/magnet-table)	Assignee: General Electric Company (Schenectady, NY, USA)	Residuum rare earth magnet Abstract A permanent magnet for an MRI scanner is made by removing extraneous elements from an ore containing rare earth elements to leave elements Pr and Nd therein, and then selectively stripping therefrom a portion of the element Nd as a byproduct to leave an ore residuum including both elements Pr and Nd therein. The residuum is alloyed with a transition metal to form an alloy therewith. The alloy is then formed into a rare earth permanent magnet configured for use in the MRI scanner. 1. A method of making ***[process/method]*** a permanent magnet comprising: providing ore containing rare earth elements including Ce, Nd, and Pr; partially removing said element Ce from said ore; removing extraneous elements from said ore to leave elements Ce, Pr, and Nd therein; selectively stripping from said ore a portion of said element Nd as a byproduct to leave an ore residuum including elements Ce, Pr, and Nd; alloying said residuum with a transition metal to form an alloy therewith; and

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			forming said residuum alloy into a mixed rare earth permanent magnet. 2. A method according to claim 1 wherein said element Pr is not stripped from said ore and remains in said residuum.
Filed: February 1, 2000 Issued: January 15, 2002 Expires: Feb 2020	6,338,761	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Iron-based permanent magnets and their fabrication as well as iron-based permanent magnet alloy powders for permanent bonded magnets and iron-based bonded magnets Abstract With the intention of establishing fabrication methods for cheaply produced (Fe,Co)--Cr--B--R-type bonded magnets or (Fe,Co)--Cr--B--R--M-type bonded magnets containing few rare earth elements and having a coercive force iHc above 5 kOe and a residual magnetic flux density Br above 5.5 kG matching the cost performance of hard ferrite magnets, we have obtained iron-based permanent magnets consisting of microcrystal clusters where the average crystal size of each component phase is in the range 1 nm .about.30 nm and where both a soft magnetic phase consisting of a ferromagnetic alloy whose main components are .alpha.-Fe and a ferromagnetic alloy having iron, and a hard magnetic phase having a Nd.sub.2 Fe.sub.14 B-type crystal structure coexist within the same powder particles, by melt-quenching of a (Fe,Co)--Cr--B--R(Pr,Nd)-type molten alloy or a (Fe,Co)--Cr--B--R--M (M=Al,Si,S,Ni, Cu,Zn,Ga,Ag,Pt,Au,Pb)-type molten alloy of a particular composition containing few rare earth elements, to obtain an essentially amorphous structure or a structure both amorphous and with small amounts of fine crystals, and by applying a crystallization heat treatment under specific conditions. By grinding this iron-based permanent magnet to an average powder particle size of 3 .mu.m.about.500 .mu.m and combining the resultant iron-based permanent magnet alloy powder with a resin, we can obtain an iron-based bonded magnet with good thermal and magnetic properties and with the

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			magnetic characteristics iHc.gtoreq.5 kOe, Br.gtoreq.5.5 kG and (BH)max.gtoreq.6 MGOe. What is claimed is: 1. A method for manufacturing ***[process/method]*** an iron-base permanent magnet consisting of fine crystal aggregates of mutually distributed magnetically soft and hard magnetic phases, comprising: (a) providing a molten metal mixture whose composition is represented by the formula $Fe_{100-x-y-z-a}Cr_xB_yR_zCo_a$, wherein R is Pr or Nd or mixtures thereof and wherein x, y, z and a satisfy the following values: 0.01≦x≦at % 15≦y≦30 at % 3≦z≦6 at % 0.01≦a≦30 at %; (b) rapidly solidifying said molten metal mixture into an amorphous material or essentially amorphous material containing fine crystals dispersed in an amorphous matrix, and then (c) heat treating the resulting rapidly solidified material for crystallization of the amorphous material or the essentially amorphous material at a heating rate between 10° C./min and 50° C./sec from near a temperature at which crystallization starts to an isothermal heat treatment temperature of 600° C. to 750° C. to produce a magnetically hard material wherein a soft magnetic phase consisting of α-iron and a ferromagnetic phase having iron as a main component and a hard magnetic phase having a $Nd_2Fe_{14}B$ tetragonal crystal structure coexist in the iron-base permanent magnet, provided that the hard magnetic phase having the $Nd_2Fe_{14}B$ tetragonal crystal structure is not a primary phase of said iron-base permanent magnet, the

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			constituent phases of said iron-base permanent magnet having a mean crystal size within the range of 1 nm to 30 nm.
Filed: Dec 31, 1997 Issued: December 25, 2001 Expires: Dec 2021	6,332,933	Assignee: Santoku Corp (Kobe, JAPAN)	Iron-rare earth-boron-refractory metal magnetic nanocomposites Abstract Magnetic nanocomposite materials including iron, rare earth elements, boron, refractory metal and, optionally, cobalt are disclosed. Neodymium and lanthanum are preferred rare earth elements. The amounts of Nd, La, B and refractory metal are controlled in order to produce both hard and soft magnetic phases, as well as a refractory metal boride precipitated phase. The refractory metal boride precipitates serve as grain refiners and substantially improve the magnetic properties of the nanocomposite materials. The materials are particularly suitable for making bonded magnets. 1. A permanent magnet material ***[composition of matter]*** characterized by magnetic properties of BH_{max}>8 MGOe, B_r>7.2 KG and H_{ci}>6 KOe and having the chemical formula: $((RE)_{1-y}(La)_y)_v Fe_{100-v-w-x-z} Co_w M_z B_x$, wherein RE is at least one element selected from the group consisting of Pr and Nd; M is at least one refractory metal selected from the group consisting of W, Ti, V, Nb, Hf; Cr, Zr and Mo; v=about 9.5 to about 11.5 atomic percent w=0 to about 15 atomic percent x=about 9.5 to about 11 atomic percent y=about 0.05 to about 0.15 z=about 2 to about 3 atomic percent the material having been made by rapid cooling from melt as ribbons, filaments, particulates or powders at a cooling rate between 10^4 to 10^6 degrees C/second followed by annealing at temperatures between 650 to 750 degrees C for 0.01 seconds to 120 minutes, the material consisting of the following

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			phases: (i) a hard magnetic phase $RE_2Fe_{14}B$ with an average grain size between 10 to 100 nanometers, (ii) one or more soft magnetic phases selected from the group consisting of α-Fe, α-(Fe,Co), Fe_3B, $(Fe,Co)_3B$, Fe_2B and $(Fe,Co)_2B$ each having an average grain size between 2 to 60 nanometers, (iii) one or more metal M boride precipitated phases with an average size of 1 to 30 nanometers wherein M is one element selected from the group consisting of Ti, V, Nb, Hf, Cr, Zr and Mo. 36. A method of making ***[process/method]*** a permanent magnet material of claim **1**, characterized by magnetic properties of BH_{max}>8 MGOe, B_r>7.2 KG and H_{ci}>6 KOe, comprising providing a molten composition having the chemical formula: $((RE_{1-y}(La)_y)_v Fe_{100-v-w-x-z}Co_wM_zB_x$, wherein RE is at least one element selected from the group consisting of Pr and Nd; M is at least one refractory metal selected from the group consisting of W, Ti, V, Nb, Hf, Cr, Zr and Mo; v=about 9.5 to about 11.5 atomic percent w=0 to about 15 atomic percent x=about 9.5 to about 11 atomic percent y=about 0.05 to about 0. 15 z=about 2 to about 3 atomic percent, rapidly solidifying the molten composition by cooling from melt as ribbons, filaments, particulates or powders at a cooling rate between 10^4 to 10^6 degrees C/second to form a substantially amorphous product; and thermally treating the substantially amorphous product by annealing at temperatures between 650 to 750 degrees C for 0.01 seconds to 120 minutes to form the magnetic material, the material consisting of the following phases:

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			(i) a hard magnetic phase $RE_2Fe_{14}B$ with an average grain size between 10 to 100 nanometers, (ii) one or more soft magnetic phases selected from the group consisting of α-Fe, α-(Fe,Co), Fe_3B, $(Fe,Co)_3B$, Fe_2B and $(Fe,Co)_2B$ each having an average grain size between 2 to 60 nanometers, (iii) one or more metal M boride precipitated phases with an average size of 1 to 30 nanometers wherein M is one element selected from the group consisting of Ti, V, Nb, Hf, Cr, Zr and Mo.
Filed: April 12, 1999 Issued: December 11, 2001 Expires: April 2019	6,328,817	Assignee: Santoku Metal Industry Co., Ltd. (Kobe, JAPAN)	Powder for permanent magnet, method for its production and anisotropic permanent magnet made using said powder Abstract There is provided a powder for permanent magnet comprising needle-like fine particles of Fe or Fe--Co alloy as a base material, a hard magnetic layer and a separation layer of an oxide of rare earth element provided outside said hard magnetic layer. What is claimed is: 1. A powder for a permanent magnet comprising ***[composition of matter]*** fine particles with a major axis and a minor axis of 0.1 to 3 μm and 0.03 to 0.4 μm, respectively, of an Fe or Fe—Co alloy as a base material, a hard magnetic layer containing Fe, Sm and N provided on a surface of said fine particles, and a separation layer of an oxide of R provided outside said hard magnetic layer, wherein R represents one or more rare earth elements selected from the group consisting of Nd, La, Ce, Pr, Sm, and Y. 4. A method for producing ***[process/method]*** a powder for a permanent magnet, which comprises coating a surface of Fe fine particles or Fe—Co alloy fine particles, said fine particles having a major axis of 0.1 to 3 μm and a minor axis of 0.03 to 0.4 μm, with a hydroxide of R by a wet deposition method;

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			subjecting the fine particles to filtration and drying; heat-treating the dried fine particles in an atmosphere of a hydrogen gas, an inert gas, or a mixture thereof; coating the resultant Fe fine particles or Fe—Co alloy fine particles coated with an oxide of R with Sm in a vacuum at a temperature of 500 to 1000° C.; further heat-treating the fine particles to form a compound layer containing Fe and Sm on the surface of the Fe fine particles or Fe—Co alloy fine particles; and subjecting the heat-treated fine particles to a nitriding treatment in a nitrogen-containing gas; wherein R represents one or more rare earth elements selected from the group consisting of Nd, La, Ce, Pr, Sm, and Y.
Filed: June 7, 2000 Issued: November 27, 2001 Expires: June 2020	6,322,637	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Thin ribbon of rare earth-based permanent magnet alloy Abstract Disclosed is a thin alloy ribbon prepared by the strip casting method as an intermediate for the preparation of a sintered rare earth-based permanent magnet or in particular, a neodymium/iron/boron-type permanent magnet. The thin alloy ribbon is characterized by a specific volume fraction of the four-phase coexisting region consisting of the .alpha.-iron phase, R-rich phase, R.sub.x T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase each having an average grain diameter in a specified range and a specific volume fraction of the chill crystalline phase. When these requirements are satisfied, the sintered rare earth-based permanent magnet prepared from the thin alloy ribbons can be imparted with improved magnetic properties and high sintering density even without increasing the sintering temperature. What is claimed is: 1. A thin alloy ribbon prepared by ***[process/method]*** the strip casting method from a melt of an alloy comprising a rare earth element R selected from the

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			group consisting of praseodymium, neodymium, terbium and dysprosium, element T which is iron or a combination of iron with a transition metal element other than iron and rare earth elements and boron B, which comprises from 1 to 10% by volume fraction of a four-phase coexisting region consisting of an .alpha.-iron phase having an average grain diameter of 0.1 to 20 .mu.m, R-rich phase having an average grain diameter of 0.1 to 20 .mu.m, R.sub.x T.sub.4 B.sub.4 phase, the subscript x being a number larger than 1 but smaller than 1.2, having an average grain diameter of 0.1 to 10 .mu.m and R.sub.2 T.sub.14 B phase having an average grain diameter of 0.1 to 20 .mu.m and from 1 to 30% by volume fraction of a chill crystalline phase having an average grain diameter not exceeding 3 .mu.m, the balance of the volume fractions consisting of a combination of the R-rich phase, R.sub.x T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase or a combination of the R-rich phase and R.sub.2 T.sub.14 B phase. 2. The thin alloy ribbon as claimed in claim 1 in which ***[composition of matter]*** the average grain diameters of the .alpha.-iron phase, R-rich phase, R.sub.x T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase are in the ranges from 0.1 to 10 .mu.m, from 0.1 to 10 .mu.m, from 0.1 to 10 .mu.m and from 0.1 to 10 .mu.m, respectively.
Filed: February 11, 2000 Issued: November 20, 2001 Expires: Feb 2020	6,319,335	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Quenched thin ribbon of rare earth/iron/boron-based magnet alloy Abstract Disclosed is a novel thin ribbon of a rare earth/iron/boron-based magnet alloy prepared by quenching of an alloy melt by the method of strip casting, from which a sintered permanent magnet is obtained by the powder metallurgical method. The sintered permanent magnet can be imparted with greatly improved magnetic properties or, in particular, residual magnetic flux density when the thin alloy ribbon as the base material thereof has a metallographic phase structure containing "four-phase regions" consisting of (a) an .alpha.-

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			iron phase, (b) a R-rich phase, in which R is a rare earth element selected from praseodymium, neodymium, terbium and dysprosium, (c) a R.sub.x T.sub.4 B.sub.4 phase, in which T is iron or a combination of iron and a transition metal element other than iron and rare earth elements and x is a positive number varying with the rare earth element, and (d) a R.sub.2 T.sub.14 B phase, in which R and T each have the same meaning as defined above, each phase being dispersed with a grain diameter in a limited range, in a volume fraction of from 1 to 10%. What is claimed is: 1. A thin ribbon of a rare earth-based magnet alloy ***[composition of matter]*** , having a metallographic phase structure of which the volume fraction of a four-phase region consisting of (a) an .alpha.-iron phase having .alpha.-iron grains with a grain diameter of 0.1 to 20 .mu.m, (b) an R-rich phase which is a phase richer in the content of rare earth element than in an R.sub.2 T.sub.14 B phase, R being a rare earth element selected from praseodymium, neodymium, terbium and dysprosium, said R-rich phase having R-rich grains with a grain diameter of 0.1 to 20 .mu.m, (c) an R.sub.x T.sub.4 B.sub.4 phase, in which R has the same meaning as defined above, T is iron or a combination of iron and a transition metal element other than iron and the rare earth elements and x is a positive number larger than 1 varying with the rare earth element, said R.sub.x T.sub.4 B.sub.4 phase having R.sub.x T.sub.4 B.sub.4 grains with a grain diameter of 0.1 to 10 .mu.m and (d) the R.sub.2 T.sub.14 B phase, in which R and T each have the same meaning as defined above, the R.sub.2 T.sub.14 B phase having R.sub.2 T.sub.14 B grains with a grain diameter of 0.1 to 20 .mu.m, each phase being uniformly dispersed in the four-phase region, is in the range from 1 to 20% by volume, with the proviso that the rest of the volume fraction consists of the R-rich phase, R.sub.x T.sub.4 B.sub.4 phase and R.sub.2 T.sub.14 B phase or consists of the R-rich phase and R.sub.2 T.sub.14

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			B phase. 5. A powder of a rare earth-based magnet alloy which is a product obtained by ***[process/method]*** hydrogen decrepitation and pulverization of the thin ribbon of a rare earth-based magnet alloy defined in claim 1.
Filed: December 6, 1999 Issued: October 16, 2001 Expires: Dec 2019	6,302,972	Assignee: Sumitomo Special Metals Co., LTD (JAPAN)	Nanocomposite magnet material and method for producing nanocomposite magnet Abstract An inventive material alloy for a nanocomposite magnet is represented by a general formula Fe.sub.100-x-y R.sub.x B.sub.y, Fe.sub.100-x-y-z R.sub.x B.sub.y Co.sub.z, Fe.sub.100-x-y-u R.sub.x B.sub.y M.sub.u or Fe.sub.100-x-y-z-u R.sub.x B.sub.y Co.sub.z M.sub.u. R is a rare-earth element. 90 atomic percent or more of R is Pr and/or Nd, while equal to or larger than 0 atomic percent and less than 10 atomic percent of R is another lanthanoid and/or Y. M is at least one element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo, Hf, Ta, W, Pt, Pb, Au and Ag. The molar fractions x, y, z and u meet the inequalities of 2.ltoreq.x.ltoreq.6, 16.ltoreq.y.ltoreq.20, 0.2.ltoreq.z.ltoreq.7 and 0.01.ltoreq.u.ltoreq.7, respectively. The alloy includes a metastable phase Z represented by at least one of a plurality of Bragg reflection peaks observable by X-ray diffraction analysis. The at least one peak corresponds to a lattice spacing of 0.179 nm.+-.0.005 nm. An intensity of the Bragg reflection peak represents 5 to 200 percent, both inclusive, of a maximum intensity of a halo pattern. An intensity of a (110) Bragg reflection peak of body-centered Fe represents less than 5 percent of the maximum intensity of the halo pattern. What is claimed is: 1. A material alloy ***[composition of matter]*** for a nanocomposite magnet, the alloy being represented by a general formula $Fe_{100-x-y}R_xB_y$,

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			$Fe_{100-x-y-z}R_xB_yCo_z$, $Fe_{100-x-y-u}R_xB_yM_u$ or $Fe_{100-x-y-z-u}R_xB_yCo_zM_u$, where R is a rare-earth element, 90 atomic percent or more of R being Pr and/or Nd, while equal to or larger than 0 atomic percent and less than 10 atomic percent of R being another lanthanoid and/or Y, M is at least one element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo, Hf, Ta, W, Pt, Pb, Au and Ag, and the molar fractions x, y, z and u meet the inequalities of $2 \leqq x \leqq 6$, $16 \leqq y \leqq 20$, $0.2 \leqq z \leqq 7$ and $0.01 \leqq u \leqq 7$, respectively, and wherein the alloy includes a metastable phase Z represented by at least one of a plurality of Bragg reflection peaks observable by X-ray diffraction analysis, the at least one peak corresponding to a lattice spacing of 0.179 nm±0.005 nm, an intensity of the Bragg reflection peak representing 5 to 200 percent, both inclusive, of a maximum intensity of a halo pattern, and wherein an intensity of a (110) Bragg reflection peak of body-centered Fe represents less than 5 percent of the maximum intensity of the halo pattern. 3. A method for preparing ***[process/method]*** a material alloy for a nanocomposite magnet, the alloy being represented by a general formula $Fe_{100-x-y}R_xB_y$, $Fe_{100-x-y-z}R_xB_yCo_z$, $Fe_{100-x-y-u}R_xB_yM_u$ or $Fe_{100-x-y-z-u}R_xB_yCo_zM_u$, where R is a rare-earth element; 90 atomic percent or more of R is Pr and/or Nd, while equal to or larger than 0 atomic percent and less than 10 atomic percent of R is another lanthanoid and/or Y; M is at least one element selected from the group consisting of Al, Si, Ti, V, Cr, Mn, Ni, Cu, Ga, Zr, Nb, Mo, Hf, Ta, W, Pt, Pb, Au and Ag; the molar fractions x, y, z and u meet the inequalities of $2 \leqq x \leqq 6$, $16 \leqq y \leqq 20$, $0.2 \leqq z \leqq 7$ and $0.01 \leqq u \leqq 7$, respectively, the method comprising the steps of forming a melt of the material alloy, and rapidly quenching and solidifying the melt, wherein a cooling rate of the alloy is adjusted in the rapid quenching and solidifying step such that the material alloy solidified includes a metastable

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			phase Z represented by at least one of a plurality of Bragg reflection peaks observable by X-ray diffraction analysis, the at least one peak corresponding to a lattice spacing of 0.179 nm±0.005 nm, an intensity of the Bragg reflection peak representing 5 to 200 percent, both inclusive, of a maximum intensity of a halo pattern, an intensity of a (110) Bragg reflection peak of body-centered Fe representing less than 5 percent of the maximum intensity of the halo pattern.
Filed: March 26, 1999 Issued: September 18, 2001 Expires: March 2019	6,290,782	Assignee: Kabushiki Kaisha Toshiba (Kawasaki, JAPAN)	Magnetic material and manufacturing method thereof, and bonded magnet using the same Abstract A magnetic material has a composition expressed by the following general formula, (where, R.sup.1 is at least one kind of element selected from rare earth elements, R.sup.2 is at least one kind of element selected from Zr, Hf, Ti and Sc, T is at least one kind of element selected from Fe and Co, and X, Y, Z and Q designate numerical values satisfying 0.5.ltoreq.X<1, 0.05.ltoreq.Y.ltoreq.0.2, 0.ltoreq.Z.ltoreq.0.1 and 0.1.ltoreq.Q.ltoreq.0.2), and includes 5 volume % or more of a Th.sub.2 Ni.sub.17 crystal phase. The magnetic material has a recrystallization texture of which average grain diameter is in the range of from 0.02 to 50 .mu.m, and is excellent in magnetic property. Such a magnetic material is obtained by giving a HDDR treatment to a mother alloy of which principal phase is a Th.sub.2 Ni.sub.17 crystal phase. What is claimed is: 1. A magnetic material consisting ***[composition of matter]*** essentially of a composition expressed by the following general formula, general formula: $\{R^1{}_X R^2{}_{1-X})_Y B_Z T_{1-Y-Z}\}_{1-Q} N_Q$ (where, R^1 is at least one kind of element selected from rate earth elements, R^2 is at least one kind of element selected from Zr, Hf, Ti and Sc, T is at least one kind of element selected from Fe and Co, and X, Y, Z and Q designate numerical values satisfying 0.5≦X<1, 0.05≦Y≦0.2, 0≦Z≦0.1 and

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			0.1<Q≦0.2); and including 5 volume % or more of a Th_2Ni_{17} crystal phase; wherein the average grain diameter of the magnetic material is in the range of from 0.02 to 50 μm. 3. The magnetic material as set forth in claim **1**: wherein the magnetic material has a recrystallization texture obtained ***[process/method]*** by recrystallization of a mother alloy due to absorption and desorption of hydrogen, and the mother alloy having the Th_2Ni_{17}crystal phase as a principal phase.
Filed: March 25, 1998 Issued: August 28, 2001 Expires: March 2018	6,280,536	Assignee: Alps Electric Co., Ltd. (Tokyo, JAPAN) Akihisa Inoue (Miyagi-ken, JAPAN) Toda Kogyo Corp. (Hiroshima, JAPAN)	Fe based hard magnetic alloy having super-cooled liquid region Abstract The present invention provides a Fe based hard magnetic alloy having a very wide temperature interval in the super-cooled liquid region, having a hard magnetism at room temperature, being able to be produced thicker than amorphous alloy thin films obtained by conventional liquid quenching methods, and having a high material strength, wherein the Fe based hard magnetic alloy comprises Fe as a major component and containing one or a plurality of elements R selected from rare earth elements, one or a plurality of elements M selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W and Cu, and B, the temperature interval .DELTA. T.sub.x in the super-cooled liquid region represented by the formula of .DELTA. T.sub.x =T.sub.x -T.sub.g (wherein T.sub.x and T.sub.g denote a crystallization initiation temperature and glass transition temperature, respectively) being 20.degree. C. or more. What is claimed is: 1. A Fe based hard magnetic alloy comprising ***[composition of matter]*** Fe as a major component and containing one or a plurality of elements R selected from rare earth elements, one or a plurality of elements M selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Cu, and B, and represented by the following

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			formula: $Fe_{100-x-y-z-w-t}R_xM_yT_zB_wL_t$ wherein T is one or a plurality of elements selected from Co and Ni, with x, y, z, w and t being in ranges of 2≦x≦15, 2≦y≦20, 0≦z≦20, and 10≦w≦30 and 0≦t≦5 in atomic percentages, respectively, and the element L is one or a plurality of elements selected from Ru, Rh, Pd, Os, Ir, Pt, Al, Si, Ge, Ga, Sn, C, and P, wherein a crystalline phase comprising one or two of α-Fe phase and Fe_3B phase and a crystalline phase comprising $Nd_2Fe_{14}B$ are precipitated in said Fe based hard magnetic alloy 2. A Fe based hard magnetic alloy according to claim **1**, wherein the Fe based hard magnetic alloy has been heated ***[process/method]*** in the range of 500° C. to 850° C.
Filed: September 30, 1999 Issued: August 21, 2001 Expires: Sept 2019	6,277,211	Assignee: Magnequench Inc. (Anderson, IN USA)	Cu additions to Nd-Fe-B alloys to reduce oxygen content in the ingot and rapidly solidified ribbon Abstract A process is disclosed for producing rare earth-iron-boron alloys and magnets with reduced oxygen content and improved yield. Such a reduction in oxygen content and improvement in yield are achieved by including copper in a melt having a composition comprising a rare earth, boron, and iron, and subsequently solidifying the melt. What is claimed is: 1. A process ***[process/method]*** for preparing a rare earth-iron-boron alloy comprising the steps of: (a) preparing a melt having a composition comprising:

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			(i) one or more rare-earth elements selected from the group consisting of Y, La, Ce, Pr, Nd, Sm, Er, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu; (ii) boron; (iii) iron; and (iv) copper in an amount of less than 0.25 weight percent; and (b) solidifying said melt; whereby said alloy has reduced oxygen content compared with an alloy prepared by a process where said melt lacks said copper.
Filed: September 24, 1999 Issued: July 17, 2001 Expires: Sept 2019	6,261,387	Assignee: Magnequench International, Inc. (Anderson, IN USA)	Rare-earth iron-boron magnet containing cerium and lanthanum Abstract Permanent rare-earth magnets containing Ce are fabricated with coercivity greater than 4 kOe. One composition for such magnets is [Ce.sub.y R.sub.1-y].sub.z (F.sub.1-v B.sub.v).sub.1-z, where R is one or more rare-earth elements, F is Fe or Fe--Co, and the relative elemental atomic composition is 0.0<y.ltoreq.0.3, 0.04.ltoreq.z.ltoreq.0.25, and 0.01.ltoreq.v.ltoreq.0.30. Another composition is [(Ce.sub.x La.sub.1-x).sub.y R.sub.1-y].sub.z (F.sub.1-v B.sub.v).sub.1-z, with the relative elemental atomic composition x<0.4 or 0.9<x.ltoreq.1.0 and 0.2.ltoreq.y.ltoreq.0.8, 0.04.ltoreq.z.ltoreq.0.25, and 0.01.ltoreq.v.ltoreq.0.30. What is claimed is: 1. A permanent rare-earth magnet having a composition ***[composition of matter]*** expressed as $[(Ce_xLa_{1-x})_yR_{1-y}]_z(F_{1-v}B_v)_{1-z}$,

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			wherein R is one or more rare-earth elements selected from the group consisting of Y, Pr, Nd, Sm, Er, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu; wherein F is Fe or Fe and up to 20 atomic percent Co by substitution; and wherein subscripts denote the relative elemental atomic composition with $0.9<x\leqq1.0$, $0.2\leqq y\leqq0.8$, $0.04\leqq z\leqq0.16$, and $0.01 <v <0.30$ said magnet having an intrinsic coercivity of above 4 kOe. 30. A permanent fully dense isotropic or anisotropic rare-earth magnet comprising an alloy having a composition expressed ***[composition of matter]*** as $[(Ce_xLa_{1-x})_yR_{1-y}]_z(F_{1-v}B_v)_{1-z}$, wherein R is one or more rare-earth elements selected from the group consisting of Y, Pr, Nd, Sm, Er, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu; wherein F is Fe or Fe and up to 20 atomic percent Co by substitution; and wherein subscripts denote the relative elemental atomic composition with $0.9<x\leqq1.0$, $0.2\leqq y\leqq0.8$, $0.04\leqq z\leqq0.16$, and $0.01\leqq v\leqq0.30$ said magnet having an intrinsic coercivity of above 4 kOe.
Filed: October 21, 1998 Issued: July 17, 2001	6,261,386	Assignee: Wisconsin Alumni Research Foundation (Madison, WI)	Nanocrystal dispersed amorphous alloys Abstract Compositions and methods for obtaining nanocrystal dispersed amorphous alloys are described. A composition includes an amorphous matrix forming element (e.g., Al or Fe); at least one transition metal element; and at least one crystallizing agent that is insoluble in the resulting amorphous matrix. During devitrification, the crystallizing agent causes the formation of a high density

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Expires: Oct 2018			nanocrystal dispersion. The compositions and methods provide advantages in that materials with superior properties are provided. What is claimed is: 1. A nanocrystal dispersed amorphous alloy composition ***[composition of matter]*** comprising: aluminum; at least one transition metal; at least one rare earth element; at least one crystallization agent that is immiscible in an amorphous precursor mixture of said aluminum, said at least one transition metal, and said at least one rare earth element, and at least one element selected from the group consisting of tin and calcium. 7. A nanocrystal dispersed amorphous alloy composition ***[composition of matter]*** comprising: iron: neodymium; boron; at least one crystallization agent that is immiscible in an amorphous precursor mixture of said iron, said neodymium and said boron, and

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			a flux including phosphorous, and wherein said boron is present in an amount of from approximately 1 at. % to approximately 8 at. %.
Filed: September 16, 1998 Issued: July 17, 2001 Expires: Sept 2018	6,261,385	Assignee: Shin-Etsu Chemical Co., Ltd. (Tokyo, JAPAN)	Magnetically anisotropic rare earth-based nanocomposite permanent magnet Abstract Disclosed is a novel magnetically anisotropic rare earth-based permanent magnet having a nanocomposite structure consisting of a hard magnetic phase such as Nd.sub.2 Fe.sub.14 B and a soft magnetic phase such as bcc-iron, Fe.sub.3 B and Fe.sub.2 B in a volume ratio of 10:90 to 90:10 uniformly dispersed each in the other in a fineness of a few tens nanometers, in which particles of the hard magnetic phase are aligned in a direction relative to the easy magnetization axes of the particles. Such an anisotropic permanent magnet can be prepared by the method comprising: preparing a starting amorphous alloy of a composition susceptible to dispersion precipitation of the hard magnetic phase, for example, by the melt-spun method; forming the amorphous alloy into a magnet block; heating the magnet block at 600 to 1000.degree. C. to effect dispersion precipitation of the hard magnetic phase; and deforming the magnet block at the elevated temperature by compression unidirectionally so that the particles of the hard magnetic phase are aligned relative to the easy magnetization axes of the particles. What is claimed is: 1. A magnetically anisotropic rare earth-based permanent magnet having a nanocomposite structure ***[composition of matter]*** consisting of a hard magnetic phase and a soft magnetic phase finely and uniformly dispersed each

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			in the other in a volume ratio in the range from 10:90 to 90:10, particles of the hard magnetic phase being aligned in a direction relative to the easy magnetization axes of the particles, wherein the hard magnetic phase has a chemical composition of the formula Sm.sub.2 Co.sub.17 or Sm.sub.2 (Fe,Co).sub.17 and the soft magnetic phase is cobalt or a Fe--Co alloy. 5. A method ***[process/method]*** for the preparation of a magnetically anisotropic rare earth-based permanent magnet having a nanocomposite structure consisting of a hard magnetic phase and a soft magnetic phase in a volume ratio in the range from 10:90 to 90:10 finely and uniformly dispersed each in the other, particles of the hard magnetic phase being aligned in a direction relative to the easy magnetization axes of the particles, which comprises the steps of: (a) preparing a starting amorphous alloy in the form of a quenched thin ribbon by the melt-spun method, the amorphous alloy having a chemical composition which is an average of the composition of the hard magnetic phase and the composition of the soft magnetic phase weighted relative to the volume ratio of the respective phases in the range from 10:90 to 90:10; (b) forming the starting amorphous alloy into the form of a magnet block; (c) heating the magnet block at a temperature in the range from 600 to 1000.degree. C.; and (d) deforming the magnet block compressively at a temperature in the range from 600 to 1000.degree. C. along a direction, the hard magnetic phase having a chemical composition selected from the group consisting of Nd.sub.2 Fe.sub.14 B, Nd.sub.2 (Fe,Co).sub.14 B, Sm.sub.2 Co.sub.17, Sm.sub.2 (Fe,Co).sub.17, Sm(Fe,M.sup.1).sub.12, Sm(Fe,Co,M.sup.1).sub.12, Sm.sub.2 Fe.sub.17 nitride, Sm.sub.2 (Fe,Co).sub.17 nitride, (Nd,M.sup.2)Fe.sub.x

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			nitride and (Nd,M.sup.2)(Fe,Co).sub.x nitride, in which M.sup.1 is an element selected from the group consisting of titanium, vanadium, chromium, molybdenum, silicon and copper and M.sup.2 is an element selected from the group consisting of titanium, vanadium, zirconium, molybdenum, hafnium, tantalum, silicon and aluminum, and the soft magnetic phase being selected from the group consisting of bcc-iron, cobalt, Fe.sub.3 B, Fe.sub.2 B, Fe--Co alloys, (Fe,Co).sub.3 B, (Fe,Co).sub.2 B, Fe--M.sup.1 alloys, Fe--M.sup.1 intermetallic compounds, Fe--Co--M.sup.1 alloys, Fe--Co--M.sup.1 intermetallic compounds, Fe--M.sup.2 alloys, Fe--M.sup.2 intermetallic compounds, Fe--Co--M.sup.2 alloys and Fe--Co--M.sup.2 intermetallic compounds, in which M.sup.1 and M.sup.2 each have the same definition as given above and the subscript x is a number in the range from 5 to 12
Filed: December 1, 1998 Issued: May 22, 2001 Expires: Dec 2018	6,235,129	Assignee: ALPS Electric Co., Ltd. (JAPAN)	Hard magnetic material Abstract A hard magnetic material contains Co as a main component, at least one element Q of P, C, Si and B, and Sm, and an amorphous phase and a fine crystalline phase. The texture of the hard magnetic material contains 50% by volume or more of fine crystalline phase having an average crystal grain size of 100 nm or less, and has a mixed phase state containing a soft magnetic phase and a hard magnetic phase. Further, anisotropy is imparted to the crystal axis of the hard magnetic phase. What is claimed is: 1. A hard magnetic material comprising ***[composition of matter]*** Co as a main component, at least one element Q of P, C, Si and B, and at least 8 atomic % Sm, and an amorphous phase and a fine crystalline phase. 2. The hard magnetic material of claim 1, prepared by ***[process/method]***

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			heating an alloy powder, and then consolidating the alloy. 5. The hard magnetic material according to claim 1, comprising a soft magnetic phase and a hard magnetic phase. 6. The hard magnetic material according to claim 5, wherein the soft magnetic phase contains at least one of a bcc-Fe phase, a bcc-(FeCo) phase, a D.sub.20 E.sub.3 Q phase containing dissolved atoms, and the residual amorphous phase, and the hard magnetic phase contains at least a E.sub.2 D.sub.17 phase containing dissolved atoms; wherein D is at least one element of the transition metals, E is at least one element of Sm, Sc, Y, La, Ce, Pr, Pm, Nd, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu, and Q is at least one of P, C, Si and B. 7. The hard magnetic material according to claim 6, wherein the crystal axis of the hard magnetic phase is oriented to impart magnetic anisotropy.
Filed: December 30, 1997 Issued: February 6, 2001 Expires: December, 2017	6,183,572	Assignee: Magnequench International, Inc. (Anderson, IN USA)	This patent is directed to isotropic Nd-Fe-B powders exhibiting high intrinsic induction. Isotropic rare earth material of high intrinsic induction Abstract Isotropic magnetic alloy powder having an intrinsic magnetic induction of at least two third of its magnetic remanence and method for making same are provided. The powder is made from an alloy having a composition comprising, by weight percentage, approximately 15 to 35 percent of one or more rare earth metals, approximately 0.5 to 4.5 percent of boron, and approximately 0 to 20 percent of cobalt, balanced with iron. The alloy powder is made by a process wherein an amount of the alloy is melt and spun in an inert environment, preferably at a distance between an orifice and a wheel being less than one and one half inches, into ribbons, followed by crushing the ribbons into powder

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			and annealing the powder. What is claimed is: 1. Isotropic magnetic material consisting ***[composition of matter]*** of, by weight percentage, approximately 15 to 35 percent of one or more rare earth metals, approximately 0.5 to 4.5 percent of boron, approximately 0 to 20 percent of cobalt and balanced with iron, said material having an intrinsic magnetic induction, when measured at two third of its intrinsic coercivity and without taking into consideration of demagnetization correction factor, of at least two-thirds of its magnetic remanence. 4. The magnetic material of claim 1 having been made by ***[process/method]*** a process comprising a melt spinning step.
Filed: September 29, 1995 Issued: February 6, 2001 Expires: Sept 2015	6,183,571	Assignee: Inoue; Akihisa (Sendai, JAPAN)	Permanent magnetic material and permanent magnet Abstract With the object of improving magnetic properties by remaining amorphous phase of a quenched R--Fe--B permanent magnet, in a quenched permanent magnetic material comprising Fe as a major component, at least one lanthanoid element, R, and boron, the permanent magnetic material comprises 10 percent by area or less of a soft magnetic remaining amorphous phase, and the balance being a crystalline phase substantially formed by heat treatment and containing R--Fe--B hard magnetic compound. A bulk magnet is made of the permanent magnetic material by plastic forming. What is claimed is: 1. A permanent magnet obtained by ***[process/method]*** binding with a resin a powder of quenched permanent magnetic material comprising Fe, at least one

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			lanthanoid element R, and boron, the permanent magnetic material comprising about 2-10 percent of a soft magnetic amorphous phase and a balance being a crystalline phase containing an R—Fe—B hard magnetic compound; wherein boron and a lanthanoid element exist in said amorphous phase at a concentration which is higher than a concentration in said crystalline phase; wherein the composition of the permanent magnetic material expressed by atomic percent is $Fe_aR_bB_c$, 40≦a<91, 4.5≦b≦35, 0.5≦c≦30, 9.5≦b+c; and wherein said quenched permanent magnetic material has a residual magnetic flux density Br of at least 0.96 T. 2. A quenched permanent magnetic material comprising ***[composition of matter]*** Fe, at least one lanthanoid element R, boron and an element X, X being at least one element selected from the group of Cd, Au, In, Mg, Pd, Pt, Ru, Sn and Zn, wherein the permanent magnetic material comprises about 2-10 percent of a soft magnetic amorphous phase and a balance is a crystalline phase containing an R—Fe—B hard magnetic compound; wherein said crystalline phase further includes a soft magnetic material phase smaller than the width of a domain wall of the permanent magnetic material; and wherein said boron and said lanthanoid element exist in said amorphous phase at a concentration which is higher than a concentration in said crystalline phase; wherein the composition of the permanent magnetic material expressed by atomic percent is $Fe_aR_bB_cX_d$, 40≦a<91, 4.5≦b≦35, 0.5≦c≦30, 0≦d≦5, 9.5≦b+c; and wherein said quenched permanent magnetic material has a residual magnetic flux density Br of at least 0.96 T.
File: August 21, 1998	6,172,589	Assignee: Alps Electric Co., Ltd	Hard magnetic alloy having supercooled liquid region, sintered or cast product thereof or stepping motor and speaker using the alloy

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Issue: January 9, 2001 Expire: August 2018		. (Tokyo, JAPAN) Akihisa Inoue (Miyagi-ken, JAPAN)	Abstract A hard magnetic alloy obtained by heat treatment, at a heating rate of 20.degree. C./min or more, of a glassy alloy containing Fe as a main component, at least one element R selected from the rare earth elements, at least one selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Cu, and B, and having a supercooled liquid region having a temperature width .DELTA.Tx of 20.degree. C. or more, which is represented by the equation .DELTA.Tx=Tx-Tg (wherein Tx indicates the crystallization temperature, and Tg indicates the glass transition temperature), and a sintered compact, a cast magnet, a stepping motor and a speaker each of which includes the hard magnetic alloy What is claimed is: 1. A hard magnetic alloy having soft and hard magnetic phases, the hard magnetic alloy obtained by ***[process/method]*** heat treatment of a glassy alloy at a heating rate of 20° C./min or more, wherein the glassy alloy contains Fe as a main component, at least one element R selected from the rare earth elements, the content of the at least one element R being no greater than 15 atomic %, at least one element M selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Cu, and B, and having a supercooled liquid region having a temperature width ΔTx of 20° C. or more, which is represented by the equation ΔTx=Tx−Tg, wherein Tx indicates the crystallization temperature, and Tg indicates a glass transition temperature. 10. A cast magnet having soft and hard magnetic phases, the cast magnet obtained by ***[process/method]*** casting a glassy alloy composition and then performing heat treatment, where the glassy alloy composition contains Fe as a main component, at least one element R selected from the rare earth elements, the content of the at least one element R being no greater than 15 atomic %, at least one element M selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Cu, and B, and having a supercooled liquid region having a temperature width ΔTx of 20° C. or more, which is represented by the equation ΔTx=Tx−Tg, wherein

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			Tx indicates the crystallization temperature, and Tg indicates a glass transition temperature.
Filed: May 20, 1999 Issued: January 2, 2001 Expires: May 2019	6,168,673	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN	Sheet magnet having microcrystalline structure and method of manufacturing the same, and method of manufacturing isotropic permanent magnet powder Abstract An having a residual magnetic flux density Br of not less than 10 kG, a cost performance equal to that of a hard ferrite magnet, and a thickness of 70-300 .mu.m contributing to the miniaturization and thinning of a magnetic circuit, and a method of manufacturing the same. When a molten alloy of a predetermined structure having a small content of a rare earth element is subjected to continuous casting using a cooling roll in an inert gas atmosphere with reduced pressures of not more than 30 kPa at a predetermined peripheral speed of the roll, it turns into a crystalline structure substantially not less than 90% of which comprises a Fe.sub.3 B type compound and a compound phase having .alpha. --Fe and Nd.sub.2 Fe.sub.14 B type crystalline structures compatible with the former. A continuous thin-film magnet of 70-300 .mu.m in thickness comprising a microcrystalline structure of 10-50 nm in average crystal grain diameter having magnetic characteristics of iHc.gtoreq.2 kOe, Br.gtoreq.10 kG and practically usable as a permanent magnet can be obtained. A thin-film magnet which has heretofore been difficult to be industrially produced can be mass-produced at a low price by a simple method.object of this invention is to provide a thin-film magnet What is claimed is: 1. A method for manufacturing ***[process/method]*** a thin-film magnet with a fine crystal structure, having magnetic properties of iHc≧2 kOe and Br≧10 kG, a thickness of 70 μm to 300 μm, and comprising fine crystals with mean crystal grain diameters of 50 nm or less, wherein 90% or more of the crystal structure comprises Fe_3B compounds coexisting with compound phases having

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			α —Fe and $Nd_2Fe_{14}B$ crystal structures, said method comprising the steps of: continuously casting in an inert gas atmosphere at reduced pressures of 30 kPa or less, on a single cooling roller or between a pair of rollers rotating at a specific peripheral speed, an alloy melt having a composition expressed as $Fe_{100-x-y}B_x R_y$ (R is one or two of Pr, Nd, or Dy) where the symbols x and y satisfy the following values: $15 \leqq x \leqq 30$ at % $1 \leqq y \leqq 5$ at %.
Filed: November 5, 1996 Issued: November 7, 2000 Expires: Nov 2016	6,143,193	Assignee: Seiko Epson Corporation (JAPAN)	Rare earth bonded magnet, rare earth magnetic composition, and method for manufacturing rare earth bonded magnet Abstract A rare earth bonded magnet comprising a rare earth magnet powder bonded with a binder resin is manufactured by extrusion or injection molding. A rare earth bonded magnet manufactured by extrusion molding has a rare earth magnet powder content of 78.1 to 83.0 percent by volume. A rare earth bonded magnet manufactured by injection molding has a rare earth magnet powder content of 68.0 to 76.0 percent by volume. Preferably, the rare earth metal powder is at least one of Sm--Co alloys, R--Fe--B alloys wherein R is at least one of rare earth elements including Y, and Sm--Fe--N alloys. Preferably, the thermoplastic resin include polyamide, liquid crystal polymer, and Polyphenylene sulfide. Preferably, the rare earth bonded metal has a void ratio of 2 percent by volume or less. A rare earth bonded magnet is manufactured by kneading a rare earth magnetic composition comprising a rare earth magnet powder and a thermoplastic resin, and by extruding or injecting the mixture after kneading. A rare earth magnetic composition used for extrusion molding contains a rare earth metal powder of 77.6 to 82.5 percent by volume, and a rare earth magnetic composition used for injection molding contains a rare earth metal powder of 67.6 to 75.5 percent by volume. Preferably, such rare earth magnetic compositions further comprise an antioxidant, such as a

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			chelating agent. Thus, a rare earth bonded magnet showing excellent moldability and magnetic properties and high mechanical strength at a minimum binding resin can be obtained. What is claimed is: 1. A rare earth bonded magnet ***[composition of matter]*** produced from a rare earth magnetic composition comprising a rare earth magnet powder, a thermoplastic resin and a chelating agent for preventing oxidation of said rare earth magnet powder and said thermoplastic resin by extrusion molding, wherein the content of the rare earth magnet powder in the rare earth bonded magnet ranges from 78.1 to 83 percent by volume and said rare earth bonded magnet has a void ratio of 2 percent by volume or less thereby yielding a high magnetic energy product having excellent fluidity during extrusion molding such that a variety of different shaped and sized magnets may be formed, said rare earth magnet powder selected from the group consisting of: a first composition comprising (1) R wherein R is at least one rare earth element including Y, (2) transition metals including Fe as the main ingredient, and (3) B; and a second composition comprising rare earth elements containing Sm as the main ingredient, transition metals including Fe as the main ingredient, and interstitial elements containing N as the main ingredient.
Filed: September 29, 1999 Issued: 6,136,100	6,136,100	Assignee: Magnequench International, Inc. (Anderson, IN USA)	Rare-earth alloy powders for magnets and process for making magnets from rare-earth alloy powders Abstract A process for passivating rare-earth alloy powders such that magnets formed from the powders have fewer expansion defects is described. By exposing the

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Expires: Sept 2019			rare-earth alloy powders to a humid atmosphere, rare-earth oxide impurities that could result in eruptions in the magnets are reduced. Magnets made from the passivated powder show fewer expansion defects than magnets made from unpassivated powder. What is claimed is: 1. A process for ***[process/method]*** passivating rare-earth alloy powders comprising the steps of: (a) exposing said alloy powders to a humid atmosphere; and (b) drying said alloy powders. 5. A process for passivating rare-earth alloy powders comprising the steps of: (a) exposing alloy powders to a humid atmosphere, the powders having a composition comprising approximately 15 to 34 weight percent of RE, 0.8 to 1.2 weight percent of B, balanced with at least one of Fe and Co, wherein RE is one or more rare-earth elements selected from the group consisting of Y, La, Ce, Pr, Nd, Sm, Er, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu; and (b) drying said powders.
Filed: March 19, 1993 Issued: October 24, 2000	6,136,099	Assignee: Seiko Epson Corporation (Tokyo, JAPAN)	Rare earth-iron series permanent magnets and method of preparation Abstract A rare earth-iron series magnet formed from an alloy ingot using a one-step hot working process is provided. The alloy ingot includes between about 8 and 30 atomic percent of at least one rare earth element, between about 2 and 28 atomic percent of boron, less than about 50 atomic percent of cobalt, less than

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Expires: Oct 2017			about 15 atomic percent of aluminum and the balance of iron and other impurities that are inevitably included during the preparation process. The alloy is cast to obtain a cast ingot and the hot working is performed on the cast ingot at a temperature of greater than about 500.degree. C. in order to make the crystal grains of the ingot fine and to align the axis of the grains in a desired direction. What is claimed is: 1. A method for ***[process/method]*** producing a permanent magnet having as principal constituents at least one rare earth metal, iron, boron and copper, comprising: providing a magnet alloy composition including at least one rare earth metal, iron, boron and copper; melting the magnet alloy composition including the rare earth metal, iron, boron and copper, casting the alloy composition into an ingot, hot working the alloy ingot at a temperature of at least about 500.degree. C. with a strain rate of from about 10.sup.-4 to 10.sup.2 per second 10. The method ***[process/method]*** of claim 1, further including the steps of: pulverizing the hot worked ingot to provide a powder; kneading the powder with an organic binder, and curing the kneaded powder and binder mixture to yield a resin-bonded magnet.

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			16. A method for ***[process/method]*** producing a permanent magnet having as principal constituents at least one rare earth metal, iron, boron and copper comprising: melting a magnet alloy composition including a rare earth metal, iron, copper and boron, casting the alloy composition into an ingot, hot working the alloy ingot at a temperature of at least about 500.degree. C. with a strain rate of from about 10.sup.-1 to 10.sup.2 per second and the ratio of reduction is at least about 80%, the ratio defined as (d.sub.1 - d.sub.2)/d.sub.1 .times.100, wherein d.sub.1 is a dimension before processing and d.sub.2 is the dimension after processing.
Filed: February 12, 1999 Issued: September 19, 2000 Expires: Feb 2019	6120620	Assignee: General Electric Company (Schenectady, NY)	Praseodymium-rich iron-boron-rare earth composition, permanent magnet produced therefrom, and method of making Abstract A permanent magnet having substantially stable magnetic properties is disclosed having as the active magnetic component a sintered product of compacted particulate iron-boron-rare earth intermetallic material, said sintered product having pores which are substantially non-interconnecting, a density of at least 87 percent of theoretical and a composition consisting essentially of in atomic percent about 13 to about 19 percent rare earth elements, about 4 to about 20 percent boron and about 61 to about 83 percent of iron with or without impurities; where the rare earth content is greater than 50 percent praseodymium with an effective amount of a light rare earth selected from the group consisting of cerium, lanthanum, yttrium and mixtures thereof, and balance neodymium.

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			What is claimed is: 1. A sintered intermetallic product comprising ***[composition of matter]*** compacted and sintered particulate of an iron-boron-rare earth alloy having substantially non-interconnecting pores with a density of at least 87 percent of theoretical and where the alloy further comprises about 13 to about 19 atomic percent rare earth, where the rare earth content consists essentially of greater than 50 percent praseodymium, an effective amount of light rare earth selected from the group consisting of cerium, lanthanum, yttrium and mixtures thereof, and balance neodymium; about 4 to about 20 atomic percent boron; and balance iron with or without impurities. 47. A praseodymium-rich anisotropic permanent magnet of the iron-boron-rare earth alloy comprising ***[composition of matter]*** in atomic percent about 13 to about 19 percent rare earth element or elements, about 4 to about 20 percent boron, and about 61 to about 83 percent of iron with or without impurities; where the rare earth content is greater than 50 percent praseodymium with an effective amount of a light rare earth selected from the group consisting of cerium, lanthanum, yttrium and mixtures thereof, and balance neodymium; where the magnet consists essentially of substantially non-interconnecting pores having a density of at least 87 percent theoretical and substantially magnetically aligned grains of RE.sub.2 Fe.sub.14 B tetragonal crystals.
Filed: December 22, 1998 Issued: June 20, 2000	6,078,237	Assignee: Shin-Etsu Chemical Co., Ltd. (JAPAN)	Rare earth-based permanent magnet material and method for the preparation thereof Abstract Disclosed is a rare earth-based, magnetically anisotropic permanent magnet material consisting of a rare earth element, e.g., neodymium or praseodymium, iron optional in combination with cobalt and boron and having excellent

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Expires: Dec 2018			magnetic properties by virtue of the magnetic coupling between the magnetically hard and soft phases. The magnet material has a structure consisting of crystalline particles of, e.g., Nd.sub.2 Fe.sub.14 B, having a particle diameter of 1 .mu.m or larger and fine crystals of iron of submicron size in a rod-shaped or platelet form precipitated within each crystalline particle of Nd.sub.2 Fe.sub.14 B. This magnet material can be prepared by several different methods including, for example, a solid phase reaction of an intermetallic compound of Nd.sub.2 Fe.sub.17 with boron to effect a double decomposition reaction producing Nd.sub.2 Fe.sub.14 B and iron. What is claimed is: 1. A rare earth-based permanent magnet material comprising ***[composition of matter]*** , as the essential ingredients, at least one kind of the rare earth elements R, iron Fe and boron B and having a metallographic structure consisting of a magnetically hard phase of the formula R.sub.2 Fe.sub.14 B and a magnetically soft phase of iron Fe, in which the phase of R.sub.2 Fe.sub.14 B is in the form of crystalline particles having a particle diameter of at least 1 μm and the phase of iron is precipitated within the crystalline particles of R.sub.2 Fe.sub.14 B in a rod-shaped form or in the form of a platelet having a dimension not exceeding 200 nm. 4. A rare earth-based permanent magnet material ***[composition of matter]*** comprising, as the essential ingredients, at least one kind of the rare earth elements R, iron Fe, cobalt Co and boron B and having a metallographic structure consisting of a magnetically hard phase of the formula R.sub.2 (Fe,Co).sub.14 B and a magnetically soft phase of an alloy of iron and cobalt, in which the phase of R.sub.2 (Fe,Co).sub.14 B is in the form of crystalline particles having a particle diameter of at least 1 μm and the phase of the alloy of iron and cobalt is precipitated within the crystalline particles of R.sub.2 (Fe,Co).sub.14 B in a rod-shaped form or in the form of a platelet having a dimension not exceeding 200 nm.

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Filed: Aug 11, 1993 Issued: April 4, 2000 Expires: Aug. 2013	6,045,751	Patent owner: VACUUMSCHMELZE GMBH & CO. Germany	Method of manufacturing a permanent magnet on the basis of NdFeB Abstract A description is given of a method of manufacturing a permanent magnet on the basis of NdFeB. In this method a powder of NdFeB and a powder of a Ga alloy, consisting mainly of Ga and one or more than one rare earth metals (RE), is mixed to form a mixture which is subsequently aligned, compressed and sintered. Such alloys can be ground into homogeneous, fine-grain powders in a simple manner. The composition of the alloy preferably corresponds to the formula REGa.sub.x, where x=1 or x=2. Alloys which are very suitable contain Dy and/or Tb as the rare earth metal. We claim: 1. A method of manufacturing ***[process/method]*** a permanent magnet comprising NdFeB, said method comprising forming a mixture of a powder of NdFeB and a powder of an alloy consisting in an amount of at least 50% of Ga and at least one rare earth metal in an amount not greater than 50%; magnetically orienting said mixture; compressing said thus oriented mixture and sintering the resultant compressed mixture in an oxygen-free atmosphere. 5. A method as claimed in claim 1, characterized in that the average particle size of the powder of the Ga alloy in the mixture is smaller than the average particle size of the powder of NdFeB.
Filed: June 5, 1996 Issued:	6,019,859	Assignee: Sumitomo Special Metals Co., Ltd.	Iron-based permanent magnets and their fabrication as well as iron-based permanent magnet alloy powders for permanent bonded magnets and iron-based bonded magnets Abstract

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February 1, 2000 Expires: June 2016		(Osaka, JAPAN)	With the intention of establishing fabrication methods for cheaply produced (Fe,Co)--Cr--B--R-type bonded magnets or (Fe,Co)--Cr--B--R--M-type bonded magnets containing few rare earth elements and having a coercive force iHc above 5 kOe and a residual magnetic flux density Br above 5.5 kG matching the cost performance of hard ferrite magnets, we have obtained iron-based permanent magnets consisting of microcrystal clusters where the average crystal size of each component phase is in the range 1 nm .about.30 nm and where both a soft magnetic phase consisting of a ferromagnetic alloy whose main components are .alpha.-Fe and a ferromagnetic alloy having iron, and a hard magnetic phase having a Nd.sub.2 Fe.sub.14 B-type crystal structure coexist within the same powder particles, by melt--quenching of a (Fe,Co)--Cr--B--R(Pr,Nd)-type molten alloy or a (Fe,Co)--Cr--B--R--M (M=Al,Si,S,Ni, Cu,Zn,Ga,Ag,Pt,Au,Pb)-type molten alloy of a particular composition containing few rare earth elements, to obtain an essentially amorphous structure or a structure both amorphous and with small amounts of fine crystals, and by applying a crystallization heat treatment under specific conditions. By grinding this iron-based permanent magnet to an average powder particle size of 3 .mu.m.about.500 .mu.m and combining the resultant iron-based permanent magnet alloy powder with a resin, we can obtain an iron-based bonded magnet with good thermal and magnetic properties and with the magnetic characteristics iHc.gtoreq.5 kOe, Br.gtoreq.5.5 kG and (BH)max.gtoreq.6 MGOe. What is claimed is: 1. An iron-base permanent magnet consisting of ***[composition of matter]*** fine crystal aggregates consisting of mutually distributed magnetically soft and hard magnetic phases, wherein the permanent magnet has a compositional formula represented by Fe.sub.100-x-y-z-a Cr.sub.x B.sub.y R.sub.z Co.sub.a (where R is Pr or Nd or mixtures thereof), wherein symbols x, y, z, and a satisfy the following values:

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			0.01.ltoreq.x.ltoreq.7 at % 15<y.ltoreq.30 at % 3.ltoreq.z.ltoreq.6 at % 0.01.ltoreq.a.ltoreq.30 at %, and wherein the soft magnetic phase, which consists of .alpha.-iron and a ferromagnetic phase containing iron as a main component, and the hard magnetic phase, which has a Nd.sub.2 Fe.sub.14 B crystal structure, coexist in the permanent magnet, provided that the hard magnetic phase having a Nd.sub.2 Fe.sub.14 B crystal structure is not a primary phase of said iron-base permanent magnet, the constituent phases of the permanent magnet having mean crystal sizes within the range of 1 nm to 30 nm.
Filed: September 20, 1996 Issued: December 21, 1999 Expires: Sept 2016	6,004,407	Assignee: Alps Electric Co., Ltd (Tokyo, JAPAN) Inoue; Akihisa (Tokyo, JAPAN) Masumoto; Tsuyoshi (Tokyo, JAPAN)	Hard magnetic materials and method of producing the same Abstract Hard magnetic materials of the present invention contain at least one element of Fe, Co and Ni as a main component, at least one element M of Zr, Nb, Ta and Hf, at least one rare earth element R and B. The texture of the materials has at least 70% of fine crystalline phase having an average grain size of 100 nm or less, and the residue having an amorphous phase, the fine crystalline phase mainly composed of bcc-Fe or bcc-Fe compound, Fe--B compound and/or R.sub.2 Fe.sub.14 B.sub.1. What is claimed is: 1. A hard magnetic material having the following composition ***[composition of matter]*** formula:

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			T.sub.x M.sub.y R.sub.z B.sub.w wherein the texture thereof comprises at least 70% of fine crystalline phase comprising a soft magnetic phase and a hard magnetic phase having an average grain size of 100 nm or less, and the residue comprising an amorphous phase, the soft magnetic phase comprising bcc-Fe or bcc-Fe compound and Fe--B compound and the hard magnetic phase comprising R.sub.2 T.sub.14 B.sub.1, and wherein T indicates at least one element of Fe, Co and Ni; M indicates at least one element of Zr, Nb, Ta and Hf; R indicates at least one rare earth element; and x, y, z and w respectively indicates the composition ratios satisfying the conditions below: 86≦x,0.5.ltoreq.y.ltoreq.3,3≦z≦7,3≦w≦7.
Filed: May 21, 1997 Issued: December 7, 1999 Expires: May 2017	5,997,804	Assignee: Hitachi Metals Ltd. (Tokyo, JAPAN)	Rare earth permanent magnet and method for producing the same Abstract A rare earth permanent magnet consisting essentially, by weight, of 27.0-31.0% of at least one rare earth element including Y, 0.5-2.0% of B, 0.02-0.15% of N, 0.25% or less of O, 0.15% or less of C, at least one optional element selected from the group consisting of 0.1-2.0% of Nb, 0.02-2.0% of Al, 0.3-5.0% of Co, 0.01-0.5% of Ga and 0.01-1.0% of Cu, and a balance of Fe, and a production method thereof. The contents of rare earth element, oxygen, carbon and oxygen in the magnet are regulated within the specific ranges. What is claimed is: 1. A method for ***[process/method]*** producing a rare earth permanent magnet consisting essentially, by weight, of 27.0-31.0% of at least one rare earth element including Y, 0.5-2.0% of B, 0.02-0.15% of N, 0.25% or less of O, 0.15% or less of C, at least one optional element selected from the group consisting of 0.1-2.0% of Nb, 0.02-2.0% of Al, 0.3-5.0% of Co, 0.01-0.5% of

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			Ga and 0.01-1.0% of Cu, and a balance of Fe, said method comprising the steps of: finely pulverizing in a mill a coarse powder of an R-Fe-B-based alloy, wherein said R-Fe-B-based alloy consists essentially, by weight, of 27.0-0-31.0% of at least one rare earth element R including Y,0.5-2.0% of B, at least one optional element selected from the group consisting of 0.1-2.0% of Nb, 0.02-2.0% of Al, 0.3-5.0% of Co, 0.01-0.5% of Ga and 0.01-1.0% of Cu, and a balance of Fe, in a nitrogen gas atmosphere having an oxygen content of substantially zero or in an argon gas atmosphere having an oxygen content of substantially zero and containing 0.0001-0.1 volume % of nitrogen, under a pressure of 5-10 kgf/cm.sup.2 while feeding said coarse powder into said mill at a feeding rate of 3-20 kg/hr; recovering the fine powder into a solvent in a nitrogen gas atmosphere or an argon gas atmosphere in the form of a slurry; wet-compacting said slurry to form a green body while applying a magnetic field; heat-treating said green body in a vacuum furnace to remove said solvent therefrom; and sintering said heat-treated green body in said vacuum furnace. 2. The method ***[process/method]*** according to claim 1 wherein said coarse powder is obtained by strip-casting a melt of said R-Fe-B-based alloy into an alloy strip having 1 mm or less;

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			heat-treating said alloy strip at 800-1100.degree. C. in an inert gas atmosphere or in vacuo; and coarsely pulverizing said heat-treated alloy strip
Filed: June 25, 1997 Issued: November 2, 1999 Expires: June 2017	5,976,273	Assignee: Alps Electric Co., Ltd. Japan Inoue; Akihisa Japan	Hard magnetic material Abstract A hard magnetic material of the present invention contains Fe as a main component and further contains elements R and L, and B. Not less than 60% of the structure of the hard magnetic material is composed of a fine crystalline phase having an average grain size of not more than 100 nm and the rest is composed of an amorphous phase. The fine crystalline phase essentially consists of bcc-Fe and contains at least R.sub.2 Fe.sub.14 B.sub.1. What is claimed is: 1. A hard magnetic material ***[composition of matter]*** comprising: Fe.sub.100-x-y-z R.sub.x L.sub.y B.sub.z, said hard magnetic material having: Fe as a main component; at least one element R selected from the rare earth elements; at least one element L selected from Al and Ga; and B; and x, y, and z satisfy the following relationships: 3.ltoreq.x.ltoreq.40, 3.ltoreq.y.ltoreq.20, 1.ltoreq.z.ltoreq.3, and y/z.gtoreq.1.0; and

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			not less than 60% of the structure of said hard magnetic material being a fine crystalline phase having an average grain size of not less than 100 nm, the rest being an amorphous phase, said hard magnetic material essentially consisting of bcc-Fe and containing at least R.sub.2 Fe.sub.14 B, wherein said hard magnetic material has been prepared from a molten metal by quenching, said hard magnetic material has a structure essentially consisting of an amorphous phase immediately after quenching, and has said fine crystalline phase precipitated by heat treatment. 3. A hard magnetic material according to claim 1, wherein ***[composition of matter]*** not more than 80% of said B is replaced with C.
Filed: March 27, 1998 Issued: October 19, 1999 Expires: March 2018	5,968,290	Assignee: Kabushiki Kaisha Toshiba (Kawasaki, JAPAN)	Permanent magnet material and bonded magnet Abstract A permanent magnet material has a principal phase of TbCu7 type crystal structure and improved magnetic properties. This permanent magnet material is represented by the general formula: R1.sub.x R2.sub.y B.sub.z N.sub.u M.sub.100-x-y-z-u, wherein R1 is at least one rare earth element including Y, R2 is at least one element selected from the group consisting of Zr, Hf and Sc, M is at least one element selected from Fe and Co, x, y, z and u are atomic percents individually defined as x.gtoreq.2, y.gtoreq.0.01, 4.ltoreq.x+y.ltoreq.20, 0.ltoreq.z.ltoreq.10, and 0<u.ltoreq.20. The permanent magnet material has a principal phase of a TbCu.sub.7 type crystal structure. The permanent magnet material satisfies the relation of t.ltoreq.60 and .sigma./t.ltoreq.0.7, wherein t(nm) is an average crystal grain size of the principal phase and .sigma.(nm) is a standard deviation of the crystal grain size.… We claim:

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			1. A permanent magnet material ***[composition of matter]*** which is represented by the general formula: R1.sub.x R2.sub.y B.sub.z N.sub.u M.sub.100-x-y-z-u wherein R1 is at least one element selected from the group consisting of rare earth elements and Y, R2 is at least one element selected from the group consisting of Zr, Hf and Sc, M is at least one element selected from Fe and Co, x, y, z and u are atomic percents individually defined as x≧2, y≧0.01, 4≦x+y≦20, 0≦z≦10, and 0<u≦20, said permanent magnet material having a principal phase of a TbCu.sub.7 crystal structure, and said permanent magnet material is made from a rapid-quenched alloy ribbon which is prepared using a melt spun process, satisfying the conditions of 5≦t≦50 and σ≦0.20t, wherein t(μm) is the average thickness of said alloy ribbon and σ(μm) is the standard deviation of thickness in said alloy ribbon 12. A permanent magnet material ***[composition of matter]*** which is represented by the general formula: R1.sub.x R2.sub.y B.sub.z N.sub.u M.sub.100-x-y-z-u wherein R1 is at least one element selected from the group consisting of rare earth elements and Y, R2 is at least one element selected from the group consisting of Zr, Hf and Sc, M is at least one element selected from Fe and Co, x, y, z and u are atomic percents individually defined as x≧2, y≧0.01, 4≦x+y≦20, 0≦z≦10, and 0<u≦20, said permanent magnet material having a principal phase of a TbCu.sub.7 crystal structure, and satisfying the relation of t≦60 and σ/t≦0.7, wherein t(nm) is the average crystal grain size of the principal phase and σ(nm) is the standard deviation of the crystal grain size
Filed: December 3, 1997 Issued:	5968289	Assignee: Kabushiki Kaisha Toshiba	Permanent magnetic material and bond magnet Abstract A permanent magnetic material of the present invention has a TbCu.sub.7 phase as the principal phase and high magnetic characteristics with an

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October 19, 1999 Expires: Dec 2017		(Kawasaki, JAPAN)	extremely small variation among the values. This permanent magnetic material is expressed in a general formula: wherein R1 is at least one element selected from the rare earth elements including Y, R2 is at least one element selected from Zr, Hf and Sc, A is at least one element selected from hydrogen, nitrogen, carbon and phosphorus, M is at least one element selected from Fe and Co, x, y, z, u and v are atomic percent individually defined as 2.ltoreq.x, 0.01.ltoreq.y, 4.ltoreq.x+y.ltoreq.20, 0.001.ltoreq.z.ltoreq.10, 0.01.ltoreq.u.ltoreq.2, 0<v.ltoreq.10, and a principal phase has a TbCu.sub.7 crystal structure. We claim: 1. A permanent magnetic material ***[composition of matter]*** which is expressed in a general formula: R1.sub.X R2.sub.y A.sub.z O.sub.u B.sub.v M.sub.100-x-y-z-u-v wherein R1 is at least one element selected from the rare earth elements including Y, R2 is at least one element selected from Zr, Hf and Sc, A is at least one element selected from hydrogen, nitrogen, carbon and phosphorus, M is at least one element selected from Fe and Co, x, y, z, u and v are atomic percent individually defined as 2≦x, 0.01.ltoreq.y, 4≦x+y≦20, 0.001.ltoreq.z.ltoreq.10, 0.01.ltoreq.u.ltoreq.2, 0<v≦10, and a principal phase has a TbCu.sub.7 crystal structure. 12. A bond magnet comprising ***[composition of matter]***: permanent magnetic material expressed in a general formula: R1.sub.X R2.sub.y A.sub.z O.sub.u B.sub.v M.sub.100-x-y-z-u-v wherein R1 is at least one element selected from the rare earth elements including Y, R2 is at least one element selected from Zr, Hf and Sc, A is at least one element selected from hydrogen, nitrogen, carbon and phosphorus, M is at least one element selected from Fe and Co, x, y, z, u and v are atomic percent individually defined as 2≦x, 0.01.ltoreq.y, 4≦x+y≦20,

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			0.001.ltoreq.z.ltoreq.10, 0.01.ltoreq.u.ltoreq.2, 0<v≦10, and a principal phase has a TbCu.sub.7 crystal structure; and a binder.
Filed: April 24, 1998 Issued: October 5, 1999 Expires: April 2018	5,963,774	Assignee: Showa Denko K.K. (Tokyo, JAPAN)	Method for producing cast alloy and magnet Abstract The magnetic properties of rare earth magnet are improved by means of forming a novel structure of the cast alloy used for the production of a rare earth magnet, which contains from 27 to 34% by weight of at least one rare earth element (R) including yttrium, from 0.7 to 1.4% by weight of boron, and the balance being essentially iron and, occasionally any other transition element, and comprises an R.sub.2 T.sub.14 B phase, an R-rich phase and optionally at least one ternary phase except for the R.sub.2 T.sub.14 B phase and the R-rich phase. The novel structure is that the volume fraction (V) in percentage of said R.sub.2 T.sub.14 B phase and said at least one ternary phase is more than 138-1.6r (with the proviso that r is the content of R), the average grain size of the R.sub.2 T.sub.14 B phases is from 10 to 100 .mu.m and, further, the average spacing between the adjacent R-rich phases is from 3 to 15 .mu.m. The novel structure can be formed by by means of feeding alloy melt onto a rotary casting roll, cooling in a temperature range of from melting point to 1000.degree. C. at a cooling rate of 300.degree. C. per second or more, and further cooling in a temperature range of from 800 to 600.degree. C. at a cooling rate of 1.degree. C./second or less. We claim: 1. A method of producing ***[process/method]***a cast alloy, comprising: feeding a melt onto a rotary casting roll, the melt comprising from 27 to 34% by weight of at least one element selected from the group consisting of the rare

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			earth elements (R) and yttrium, from 0.7 to 1.4% by weight of boron, with the balance being essentially iron, and optionally other transition elements; cooling the melt in a temperature range of from melting point to 1000.degree. C. at a cooling rate of 300.degree. C. per second or more; and further cooling in a temperature range of from 800.degree. C. to 600.degree. C. at a cooling rate of 0.80.degree. C./second or less. 2. A method ***[process/method]*** according to claim 1, wherein the cooling rate in the temperature range of from melting point to 1000.degree. C. is 500.degree. C. per second or more, and, further the cooling rate in the temperature range of from 800.degree. C. to 600.degree. C. is 0.75.degree. C. per second or less. 3. A method for producing a magnet, comprising: crushing and pulyerizing a cast alloy into powder; compacting the powder under a magnetic field; and sintering the compacted power, wherein the cast alloy is obtained by: feeding a melt onto a rotary casting roll, the melt comprising from 27 to 34% by weight of at least one element selected from the group consisting of the rare earth elements (R) and yttrium, from 0.7 to 1.4% by weight of boron, with the balance being essentially iron, and optionally other transition elements; cooling the melt in a temperature range of from melting point to 1000.degree. C. at a cooling rate of 300.degree. C. per second or more; and

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			further cooling in a temperature range of from 800.degree. C. to 600.degree. C. at a cooling rate of 0.80.degree. C./second or less.
Filed: June 3, 1998 Issued: August 24, 1999 Expires: June 2018	5,942,053	Assignee: Sanei Kasei Co., Ltd. (Tokyo, JAPAN)	Composition for permanent magnet Abstract The object of the invention is to provide a composition for permanent magnet with excellent magnetic properties exhibiting well the latent ability of the RFeB system tetragonal compounds. The composition for permanent magnet according to the present invention is a complex of (1) a crystalline RFeB or RFeCoB system compound having a tetragonal crystal structure with lattice constants of a.sub.o about 8.8 .ANG. and c.sub.o about 12 .ANG., in which R is at least one of rare earth elements, and (2) a crystalline neodymium oxide having a cubic crystal structure, in which both crystal grains are epitaxially connected and the RFeB or RFeCoB crystal grains are oriented to the c.sub.o direction. The lattice constant a.sub.o of the cubic Nd.sub.2 O.sub.3 is about 4.4 .ANG. which is the half length of the lattice constant a.sub.o about 8.8 .ANG. for the RFeB or RFeCoB tetragonal crystal, and the epitaxial connection is achieved, and the RFeB or RFeCoB crystal grains are oriented to the c.sub.o direction. What is claimed is: 1. A permanent magnet comprising ***[composition of matter]*** a complex of: (1) a crystalline RFeB or RFeCoB compound having a tetragonal crystal structure with lattice constants of a.sub.o about 8.8 .ANG. and c.sub.o about 12 .ANG., in which R is at least one of rare earth elements, and (2) a crystalline neodymium oxide having a cubic crystal structure, wherein

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			both crystal grains of (1) and (2) are epitaxially connected and the RFeB or RFeCoB crystal grains are oriented to the c.sub.o direction. 5. A method for ***[process/method]*** preparing a permanent magnet comprising a complex of (1) a crystalline RFeB or RFeCoB compound having a tetragonal crystal structure with lattice constants of a.sub.o about 8.8 .ANG. and c.sub.o about 12 .ANG., in which R is at least one of rare earth elements, and (2) a crystalline neodymium oxide having a cubic crystal structure, wherein both crystal grains of (1) and (2) are epitaxially connected and the RFeB or RFeCoB crystal grains are oriented to the c.sub.o direction, comprising the following steps: mixing precursor, selected from the group consisting of RFeB powder and RFeCoB powder, with Zn powder in an organic solvent; crushing the mixed powders in the solvent under an inert gas atmosphere containing up to 1 volume percent oxygen, said Zn acting as a catalyst to oxidize R to form R-oxide cubic crystals of R.sub.2 O.sub.3 and RO.sub.x, x=1, 1.5 or 2, in epitaxial connection with the tetragonal crystals of RFeB or RFeCoB; drying the crushed powders in an inert gas; compacting the dried powders under a magnetic field; and sintering the compacted powder and evaporating the Zn under pressure in an inert gas.

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Filed: December 4, 1997 Issued: June 29, 1999 Expires: Dec 2017	5,916,376	Assignee: TDK Corporation (Tokyo, JAPAN)	Preparation of magnet Abstract An object of the invention is to provide an inexpensive magnet having a high coercivity, high squareness ratio and high maximum energy product. According to the invention, a magnet containing R, T, N, and M wherein R is at least one rare earth element with essential samarium, T is iron or iron and cobalt, and M is at least one element of Ti, V, Cr, Nb, Hf, Ta, Mo, W, Al, C, and P, with essential zirconium, in amounts of 4-8 at % of R, 10-20 at % of N, 2-10 at % of M, and having a hard magnetic phase (TbCu.sub.7 type crystalline phase) and a soft magnetic phase (which is a bcc structured T phase, has an average grain diameter of 5-60 nm, and accounts for 10 to 60% by volume of the entirety), the atomic ratio (R+M)/(R+T+M) in the hard magnetic phase being in excess of 12.5%, is prepared utilizing a single roll technique. In the single roll technique, the peripheral speed of a chill roll is at least 50 m/s, and the discharge pressure of the molten alloy is 0.3-2 kgf/cm.sup.2. Following quenching, the quenched alloy is subjected to heat treatment at 600-800.degree. C. and then to nitriding treatment. We claim: 1. A method ***[process/method]*** for preparing a magnet containing R, T, nitrogen, and M, wherein R is at least one rare earth element, wherein R contains at least 50 at % of samarium, T is iron or iron and cobalt, and M is zirconium with or without partial replacement by at least one element selected from the group consisting of Ti, V, Cr, Nb, Hf, Ta, Mo, W, Al, C, and

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			P, wherein said magnet consists essentially of 4 to 8 at % of R, 10 to 20 at % of nitrogen, 2 to 10 at % of M, and the balance of T, and has a hard magnetic phase and a soft magnetic phase, wherein the hard magnetic phase is based on R, T, and nitrogen and has a TbCu.sub.7 crystal structure, wherein the soft magnetic phase consists of a phase of T having bcc structure, the soft magnetic phase has an average grain diameter of 5 to 60 nm, the content of the soft magnetic phase is 10 to 60% by volume, and wherein the atomic ratio (R+M)/(R+T+M) in the hard magnetic phase is in excess of 0.125, said method comprising: quenching a melt containing R, T and M by a single roll technique of injecting a molten alloy from a nozzle against the peripheral surface of a chill roll to obtain a quenched molten alloy in the form of a thin ribbon containing a crystalline phase having a TbCu.sub.7 crystal structure and an amorphous phase, heat treating the quenched alloy in vacuum or in an inert gas atmosphere, and nitriding the heat treated and quenched alloy, wherein the peripheral speed of the chill roll in said quenching step is at least 50 m/s, the discharge pressure of the molten alloy in said quenching step is 0.3 to 2 kgf/cm.sup.2, and the treating temperature in said heat treatment step is

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			600 to 800.degree. C.
Filed: April 10, 1997 Issued: June 1, 1999 Expires: April 2017	5,908,513	Assignee: Showa Denko K.K. (Tokyo, JAPAN)	Cast alloy used for production of rare earth magnet and method for producing cast alloy and magnet Abstract The magnetic properties of rare earth magnet are improved by means of forming a novel structure of the cast alloy used for the production of a rare earth magnet, which contains from 27 to 34% by weight of at least one rare earth element (R) including yttrium, from 07 to 1.4% by weight of boron, and the balance being essentially iron and, occasionally any other transition element, and comprises an R.sub.2 T.sub.14 B phase, an R-rich phase and optionally at least one ternary phase except for the R.sub.2 T.sub.14 B phase and the R-rich phase. The novel structure is that the volume fraction (V) in percentage of said R.sub.2 T.sub.14 B phase and said at least one ternary phase is more than 138-1.6r (with the proviso that r is the content of R), the average grain size of the R.sub.2 T.sub.14 B phases is from 10 to 100 .mu.m and, further, the average spacing between the adjacent R-rich phases is from 3 to 15 .mu.m. The novel structure can be formed by by means of feeding alloy melt onto a rotary casting roll, cooling in a temperature range of from melting point to 1000.degree. C. at a cooling rate of 300.degree. C. per second or more, and further cooling in a temperature range of from 800 to 600.degree. C. at a cooling rate of 1.degree. C./second or less. We claim: 1. A cast alloy used for the production of a rare earth magnet, which ***[composition of matter]*** : (a) contains from 27 to 34% by weight of at least one member selected from yttrium and rare earth elements, from 0.7 to 1.4% by weight of boron, and the

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			balance being essentially iron and, optionally any other transition element, and (b) a R.sub.2 T.sub.14 B phase, an R-rich phase and optionally at least one ternary phase other than the R.sub.2 T.sub.14 B phase and the R-rich phase, characterized in that the volume fraction (V), in percent, of said R.sub.2 T.sub.14 B phase and said at least one ternary phase is more than 138-1.6r, with the proviso that r is the content of R, the average grain size of the R.sub.2 T.sub.14 B phases is from 10 to 100 .mu.m is greater than the average spacing between the adjacent R-rich phases in a range from 3 to 15 .mu.m. 2. A cast alloy used for the production of a rare earth magnet according to claim 1, which contains ***[composition of matter]*** from 28 to 33% by weight of at least one rare earth element (R) including yttrium, from 0.95 to 1.1% by weight of boron, and the balance being essentially iron and, occasionally any other transition element, characterized in that the volume fraction (V') in percent of said R.sub.2 T.sub.14 B phase is in the range of from 138-1.6r<V'<95, the average grain size of the R.sub.2 T.sub.14 B phases is from 10 to 50 .mu.m and, further, the average spacing between the adjacent R-rich phases is from 3 to 10 .mu.m.
Filed: August 6, 1997 Issued: February 16, 1999 Expires: Aug 2017	5,872,501	Assignee: Toda Kogyo Corporation (JAPAN)	Rare earth bonded magnet and rare earth-iron-boron type magnet alloy Abstract A rare earth bonded magnet obtained by mixing two types of magnetic powders (A) and (B) in the present invention has a high residual magnetic flux density (Br), a large intrinsic coercive force (iHc) and a large maximum energy product ((BH)max) in spite of a low rare earth element content, and shows an excellent rust preventability. A rare earth-iron-boron type magnet alloy of the present invention has a residual magnetic flux density (Br) as high as not less than 10 kG, an intrinsic coercive force (iHc) as large as not less than 3.5 kOe

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			and a large maximum energy product ((BH)max) and which has an excellent rust preventability What is claimed is: 1. A rare earth bonded magnet having a maximum energy product ((BH)max) of not less than 11 MGOe, comprising ***[composition of matter]*** : a magnet powder (A) represented by the following formula (1), which comprises Nd.sub.2 Fe.sub.14 B.sub.1 type crystals, which has an intrinsic coercive force (iHc) of not less than 7 kOe and which has an average particle diameter of not less than 100 .mu.m: wherein M.sup.1 is at least one element selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W, Mn, Cu and Ni, R is a least one element selected from the group consisting of Nd, Pr, Dy, Tb and Ce, a is 8 to 11, b is 0.1 to 10, c is 2 to 10 and d is 0 to 0.2; a magnetic powder (B) represented by the following formula (2), which has an average particle diameter of not more than 50 .mu.m: wherein M.sup.2 is at least one element selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W, Mn, Cu, Ga, Zn, In, Sn, Bi, Ag and Si, R is one element selected from the group consisting of Nd, Pr, Dy, Tb and Ce, x is 5 to 10, y is 1 to 9, z is 0.1 to 5, w is 2 to 7, and x+w is not less than 9; and a binder resin, said rare earth bonded magnet being produced by compounding magnet powder (A), magnet powder (B) and binder resin, and molding the obtained mixture.

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			20. A process ***[process/method]*** for producing a rare earth-iron-boron type magnet alloy as defined in claim 15, comprising the steps of: producing a mixture having a composition represented by the following formula (5): R.sub.x Fe.sub.(100-w-x-y-z) Co.sub.y M.sup.3.sub.z B.sub.w(5) wherein R is one element selected from the group consisting of Nd, Pr, Dy, Tb and Ce, M.sup.4 is at least one element selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W, Mn, Cu, Ga, Ag and Si, x is 5 to 10, y is 1.0 to 9.0, z is 0.1 to 5, w is 2 to 7, (x+w) is not less than 9 and (y+z) is not less than 5; melting said obtained mixture under heating to produce a molten alloy; quenching and solidifying said molten alloy; and heat-treating the quenched and solidified alloy in the temperature range of 600
Filed: October 30, 1996 Issued: January 12, 1999 Expiration: October 2016	5,858,124	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Rare earth magnet of high electrical resistance and production method thereof Abstract A high-resistance rare earth magnet having a metal structure in which a rare earth magnet phase is dispersed throughout a compound phase comprising at least one compound selected from the group consisting of fluorides and oxides of Li, Na, Mg, Ca, Ba and Sr. The fluorides and oxides are effective for increasing the electrical resistance of a rare earth magnet to a level sufficient for practical use while maintaining high magnetic properties of the magnet. What is claimed is: 1. A high-resistance rare earth magnet ***[composition of matter]*** comprising an R--Fe--B-based magnet phase wherein R is at least one rare earth element including Y and a compound phase comprising at least one compound selected from the group consisting of fluorides of Li, Na, Mg, Ca, Ba and Sr, said R--

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			Fe--B-based magnet phase being dispersed throughout said compound phase. 2. The high-resistance rare earth magnet according to claim 1, wherein said R--Fe--B-based magnet comprises 10-40 weight % of R, 0.5-5 weight % of B and the balance of Fe, each percentage being based on a total amount of said R--Fe--B-based magnet. 8. A process ***[process/method]*** for producing a high-resistance rare earth magnet according to claim 1, comprising the steps of: mixing an R--Fe--B-based magnet powder wherein R is at least one rare earth element including Y, with at least one powder selected from the group consisting of powders of fluorides of Li, Na, Mg, Ca, Ba and Sr; compacting the resultant powder mixture to form a green body; and subjecting said green body to a sintering.
Filed: November 29, 1995 Issued: September 8, 1998 Expires: Nov 2015	5,803,992	Assignee: Iowa State University Research Foundation, Inc. (Ames, IA USA)	Carbide/nitride grain refined rare earth-iron-boron permanent magnet and method of making Abstract A method of making a permanent magnet wherein 1) a melt is formed having a base alloy composition comprising RE, Fe and/or Co, and B (where RE is one or more rare earth elements) and 2) TR (where TR is a transition metal selected from at least one of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Al) and at least one of C and N are provided in the base alloy composition melt in substantially stoichiometric amounts to form a thermodynamically stable compound (e.g. TR carbide, nitride or carbonitride). The melt is rapidly solidified in a manner to form particulates having a substantially amorphous (metallic glass) structure and a dispersion of primary TRC, TRN and/or TRC/N precipitates. The

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			amorphous particulates are heated above the crystallization temperature of the base alloy composition to nucleate and grow a hard magnetic phase to an optimum grain size and to form secondary TRC, TRN and/or TRC/N precipitates dispersed at grain boundaries. The crystallized particulates are consolidated at an elevated temperature to form a shape. During elevated temperature consolidation, the primary and secondary precipitates act to pin the grain boundaries and minimize deleterious grain growth that is harmful to magnetic properties. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. Rapidly solidified particulates ***[composition of matter]*** comprising RE, at least one of Fe and Co, and B, where RE is one or more rare earth elements, in proportions for forming a hard magnetic phase, said particulates having an amorphous or microcrystalline structure and having precipitates comprising at least one of a carbide, nitride and carbonitride of a transition metal dispersed throughout the structure. 2. The particulates of claim 1 which have been heat treated to have a hard magnetic phase microstructure and precipitates comprising at least one of a carbide, nitride and carbonitride of a transition metal dispersed throughout the microstructure.
Filed: April 29, 1997 Issued: June 16, 1998	5,766,372	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Method of making magnetic precursor for permanent magnets Abstract Magnetic materials comprising Fe, B, R (rare earth elements) and Co having a major phase of Fe--CO--B--R intermetallic compound(s) of tetragonal system, and sintered anisotropic permanent magnets consisting essentially of, by atomic percent, 8-30% R (at least one of rare earth elements inclusive of Y), 2-

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Expires: April 2017			28% B, no less than 50% Co, and the balance being Fe with impurities. Those may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf) providing Fe--Co--B--R--M type materials and magnets. The magnetic materials and permanent magnets according to the present invention are essentially formed of alloys comprising novel intermetallic compounds, and are crystalline, said intermetallic compounds being characterized at least by new Curie points Tc. What is claimed is: 1. A process for ***[process/method]*** producing a crystalline R(Fe,Co)BXAM compound having a stable tetragonal crystal structure having lattice constants of a.sub.o about 8.8 angstroms and c.sub.o about 12 angstroms, in which R is at least one element selected from the group consisting of Nd, Pr, Tb, Dy, Ho, Er, Eu, Sm, Gd, Pm, Tm, Yb, Lu and Y, X is at least one element selected from the group consisting of S, C, P and Cu, A is at least one element selected from the group consisting of H, Li, Na, K, Be, Sr, Ba, Ag, Zn, N, F, Se, Te and Pb, and M is at least one element selected from the group consisting of Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf and Si, comprising: preparing a melt of R(Fe,Co)BXAM; and allowing the melt to solidify under a condition such that said fully crystalline R(Fe,Co)BXAM compound having a stable tetragonal crystal structure is formed.
Filed: July 11, 1995	5,750,044	Assignee: TDK Corporation	Magnet and bonded magnet Abstract A magnet consists essentially of 4-8 at % of R, 10-20 at % of N, 2-10 at % of

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Issued: May 12, 1998 Expires: July 2015		(Tokyo, JAPAN)	M, and the balance of T wherein R is at least one rare earth element, Sm being present in R in a proportion of at least 50 at %, T is Fe or Fe and Co, M is Zr with or without partial replacement by at least one element of Ti, V, Cr, Nb, Hf, Ta, Mo, W, Al, C, and P. Contained in the magnet are a hard magnetic phase based on R, T, and N and containing at least one crystalline phase selected from TbCu.sub.7, Th.sub.2 Zn.sub.17, and Th.sub.2 Ni.sub.17 types and a soft magnetic phase consisting of a T phase having a bcc structure, the soft magnetic phase having a mean grain size of 5-60 nm and being present in a proportion of 10-60% by volume. This construction ensures high coercivity, high squareness ratio, and high maximum energy product. We claim: 1. A magnet consisting ***[composition of matter]*** essentially of 4 to 8 at % of R, 10 to 20 at % of nitrogen, 2 to 20 at % of M, and the balance of T wherein R is at least one rare earth element, Sm being present in R in a proportion of at least 50 at %, T is Fe or Fe and Co, M is Zr with or without partial replacement by at least one element selected from the group consisting of Ti, V, Cr, Nb, Hf, Ta, Mo, W, Al, C, and P, said magnet comprising a hard magnetic phase based on R, T and nitrogen and containing at least one crystalline phase selected from the group consisting of TbCu.sub.7 structure, Th.sub.2 Zn17 structure, and Th.sub.2 Ni.sub.17 structure and a soft magnetic phase consisting of a T phase having a bcc structure, said soft magnetic phase having a mean grain size of 5 to 60 nm and being present in a proportion of 10 to 60% by volume. 3. The magnet of claim 1 which is prepared by forming ***[process/method]*** a quenched alloy by a liquid quenching technique and subjecting the quenched alloy to nitriding treatment.
Filed:	5,725,792	Assignee:	Bonded magnet with low losses and easy saturation

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April 10, 1996 Issued: March 10, 1998 Expires: April 2016		Magnequench International, Inc. (Anderson, IN USA)	Abstract The present invention provides a bonded isotropic magnet containing a composition comprising from about 5 to 25% rare earth metal, from about 0.5 to about 4.5% boron, from about 0.5 to about 3.0% niobium, and the balance principally of iron. Such a magnet exhibits low coercivity and low loss upon aging. I claim: 1. A bonded isotropic magnet comprising ***[composition of matter]*** a bonding agent and melt spun crystalline particles formed from a composition comprising, on a weight basis, from about 5 to about 25 % rare earth metal, from about 0.5 to about 4.5 % boron wherein the total of said rare earth metal and said boron ranges from about 9 to about 26 %, from about 0.5 to about 3.0% niobium, and the balance principally of iron, said magnet having a coercivity of less than 10 kOe. 2. The magnet of claim 1 wherein the composition comprises up to about 16% of Co.
Filed: June 28, 1996 Issued: February 10, 1998 Expires: June 2016	5,716,462	Assignee: Kabushiki Kaisha Toshiba (Kawasaki, JAPAN)	Magnetic material and bonded magnet Abstract There is provided a magnetic material having a TbCu.sub.7 phase as a principal phase and excellent in residual magnetic flux density. This magnetic material is formed of a composition represented by a general formula: wherein R1 is at least one element selected from rare earth elements including Y; R2 is at least one element selected from Zr, Hf and Sc; A is at least one element selected from H, N, C and P; M is at least one element selected from Fe and Co; x, y, z and u represent are atomic percent individually defined as

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			2.ltoreq.x, 2.ltoreq.x+y.ltoreq.20, 0.001.ltoreq.z.ltoreq.10, 0.ltoreq.u.ltoreq.20; and a principal phase of the magnetic material having a TbCu.sub.7 type crystal structure. What is claimed is: 1. A magnetic material ***[composition of matter]*** having a composition represented by the formula: R1.sub.x R2.sub.y B.sub.z A.sub.u M.sub.100-x-y-z-u wherein R1 is at least one element selected from the group consisting of rare earth elements; R2 is at least one element selected from the group consisting of Zr, Hf and Sc; A is at least one element selected from the group consisting of H, N, C and P; M is at least one element selected from the group consisting of Fe and Co; x, y, z and u are atomic percent individually defined as 2≦x, 0.1.ltoreq.y.ltoreq.10, 2≦x+y≦20, 0.001.ltoreq.z.ltoreq.10, and 0≦u≦20; and a principle phase of said magnetic material having a TbCu.sub.7 crystal structure. 9. A bonded magnet, ***[composition of matter]*** comprising: a magnetic material powder having a composition represented by the formula: R1.sub.x R2.sub.y B.sub.z A.sub.u M.sub.100-x-y-z-u wherein R1 is at least one element selected from the group consisting of rare earth elements; R2 is at least one element selected from the group consisting of Zr, Hf and Sc; A is at least one element selected from the group consisting of H, N, C and P; M is at least one element selected from the group consisting of Fe and Co; x, y, z and u are atomic percent individually defined as 2≦x, 0.1.ltoreq.y.ltoreq.10, 2≦x+y≦20, 0.001.ltoreq.z.ltoreq.10, and 0≦u≦20; and a principle phase of said magnetic material having a TbCu.sub.7 crystal structure; and a binder.
Filed:	5690752	Assignee:	Permanent magnet containing rare earth metal, boron and iron

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July 27, 1995 Issued: November 25, 1997 Expires: July 2015		Santoku Metal Industry Co., Ltd. (JAPAN)	Abstract A permanent magnet is obtained by pulverizing, molding and sintering a starting material containing an alloy ingot. The alloy ingot contains not less than 90% by volume of columnar crystals each having a columnar crystal grain size of 0.1 to 50 .mu.m along a short axis thereof and a columnar crystal grain size of larger than 100 .mu.m and not larger than 300 .mu.m along a long axis thereof, and is obtained by uniformly solidifying by a single roll method a molten alloy containing 25 to 31% by weight of a rare earth metal, 0.5 to 1.5% by weight of boron and iron under cooling conditions of a cooling rate of higher than 500.degree. C./sec. and not higher than 10,000.degree. C./sec. and a supercooling degree of 50.degree. to 500.degree. C. What is claimed is: 1. A permanent magnet obtained by ***[process/method]*** pulverizing, molding and sintering a starting material comprising 70 to 99.9 vol. % of an alloy ingot, said alloy ingot containing not less than 90% by volume of columnar crystals each having a columnar crystal grain size of 0.1 to 50 .mu.m along a short axis thereof and a columnar crystal grain size of larger than 100 .mu.m and not larger than 300 .mu.m along a long axis thereof, said alloy ingot having been obtained by uniformly solidifying by a single roll method a molten alloy containing 25 to 31% by weight of a rare earth metal, 0.5 to 1.5% by weight of boron and iron under cooling conditions of a cooling rate of higher than 500.degree. C./sec. and not higher than 10,000.degree. C./sec. and a supercooling degree of 50.degree. to 500.degree. C. 2. The permanent magnet as claimed in claim 1 wherein said rare earth metal is ***[composition of matter]*** selected from the group consisting of lanthanum, cerium, praseodymium, neodymium, yttrium, dysprosium, and mixtures thereof.

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Filed: April 19, 1996 Issued: October 7, 1997 Expires: April 2016	5,674,327	Assignee: Santoku Metal Industry Co., Ltd. (Hyogo-ken, JAPAN)	Alloy ingot for permanent magnet, anisotropic powders for permanent magnet, method for producing same and permanent magnet Abstract An alloy ingot for permanent magnet consists essentially of rare earth metal and iron and optionally boron. The two-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 100 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The three-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 50 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The alloy ingot is produced by solidifying the molten alloy uniformly at a cooling rate of 10.degree. to 1000.degree. C./sec. at a sub-cooling degree of 10.degree. to 500.degree. C. A permanent magnet and anisotropic powders are produced from the alloy ingot What is claimed is: 1. An alloy ingot for permanent magnet consisting ***[composition of matter]*** essentially of rare earth metal and iron, wherein a proportion of said rare earth metal to said iron is 23 to 28: 77 to 72 by weight, said alloy ingot containing 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 100 .mu.m and that along a long axis of 0.1 to 100 .mu.m, said crystals are free of peritectic nuclei selected from the group consisting of .alpha.-Fe, .gamma.-Fe, and mixtures thereof having a grain size of not less than 20 .mu.m, said alloy ingot having been produced by a strip casting method, and said alloy ingot having a thickness of 0.05 to 20 mm. 5. A rare earth metal-iron permanent magnet obtained by magnetizing the alloy ingot as claimed in claim 1 wherein the magnet contains atoms selected from the group consisting of carbon atoms, oxygen atoms, nitrogen atoms, and

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			mixtures thereof.
Filed: April 18, 1996 Issued: August 12, 1997 Expires: April 2016	5,656,100	Assignee: Santoku Metal Industry Co., Ltd. (Hyogo-ken, JAPAN)	Alloy ingot for permanent magnet, anisotropic powders for permanent magnet, method for producing same and permanent magnet Abstract An alloy ingot for permanent magnet consists essentially of rare earth metal and iron and optionally boron. The two-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 100 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The three-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 50 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The alloy ingot is produced by solidifying the molten alloy uniformly at a cooling rate of 10.degree. to 1000.degree. C./sec. at a sub-cooling degree of 10.degree. to 500.degree. C. A permanent magnet and anisotropic powders are produced from the alloy ingot. What is claimed is: 1. Rare earth metal-iron-boron anisotropic powders for use in a permanent magnet obtained by ***[process/method]*** hydrogenating and dehydrogenating an alloy ingot consisting essentially of rare earth metal, iron and boron, said alloy ingot containing 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 50 .mu.m and along a long axis of 0.1 to 100 .mu.m, said crystals being free of peritectic nuclei selected from the group consisting of .alpha.-Fe, .gamma.-Fe, and mixtures thereof.
Filed: June 7, 1995	5645651 **Note: many claims of**	Assignee: Sumitomo Special Metals Co., Ltd.	Magnetic materials and permanent magnets Abstract Magnetic materials comprising Fe, B, R (rare earth elements) and Co having a

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Issued: July 8, 1997 Expires: July, 2015	**infringement**	(Osaka, JAPAN)	major phase of Fe--Co--B--R intermetallic compound(s) of tetragonal systems and sintered anisotropic permanent magnets consisting essentially of, by atomic percent, 8-30% R (at least one of rare earth elements inclusive of Y), 2-28% B, no less than 50% Co, and the balance being Fe with impurities. Those may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf) providing Fe--Co--B--R--M type materials and magnets. What is claimed is: 1. A crystalline R(Fe,Co)BXAM compound ***[composition of matter]*** having a stable tetragonal crystal structure having lattice constants of a.sub.o about 8.8 angstroms and c.sub.o about 12 angstroms, in which R is at least one element selected from the group consisting of Nd, Pr, La, Ce, Tb, Dy, Ho, Er, Eu, Sm, Gd, Pm, Tm, Yb, Lu and Y, X is at least one element selected from the group consisting of S, C, P and Cu, A is at least one element selected from the group consisting of H, Li, Na, K, Be, Sr, Ba, Ag, Zn, N, F, Se, Te and Pb, and M is at least one element selected from the group consisting of Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf and Si. 3. The crystalline compound of claim 1, wherein (Fe,Co) comprises ***[composition of matter]*** Fe and Co, provided that Co is present in an amount up to 100 atomic % of the sum of Fe and Co.
Filed: August 17, 1994 Issued: July 1, 1997	5,643,491	Assignee: Aichi Steel Works, Ltd. (JAPAN)	Rare earth magnetic powder, its fabrication method, and resin bonded magnet Abstract In a method of fabricating an R--Fe--B based alloy magnetic powder excellent in magnetic anisotropy, and an R--Fe--B--Co based alloy magnetic powder excellent in magnetic anisotropy and temperature characteristic an R--Fe--B based alloy is subjected to hydrogenation under pressurized hydrogen gas and to dehydrogenation. Excellent magnetic properties and stable with less

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Expires: Aug 2014			variation in range can be attained in an industrial fabrication by using a plurality of divided reaction tubes. Moreover, the R--Fe--B--Co based alloy magnetic powder is constituted of an aggregate structure including, as a main phase, a recrystallized structure of an extremely fine R.sub.2 Fe.sub.14 B type phase with an average grain size of 0.05 to 3 .mu.m, and has excellent magnetic anisotropy and temperature characteristic. Additionally, a resin bonded magnet excellent in magnetic properties and temperature characteristic is fabricated by injection molding or compression molding using the above R--Fe--B--Co based alloy magnetic powder. What is claimed is: 1. A method of fabricating ***[process/method]*** a rare earth-iron-boron based alloy magnetic powder excellent in magnetic anisotropy comprising the steps of: homogenizing an ingot of an alloy mainly containing R, Fe and B at a temperature ranging from 800.degree. to 1200.degree. C. in an inert gas atmosphere, wherein R represents a rare earth element including Y; crushing said homogenized ingot into fragments; subjecting said fragments to hydrogenation while holding said fragments in a hydrogen gas atmosphere pressurized to a hydrogen gas pressure of from about 1.2 to 1.6 kgf/cm.sup.2 at a temperature ranging from 750.degree. to 950.degree. C.; subjecting said hydrogenated fragments to dehydrogenation while holding said hydrogenated fragments at a temperature ranging from 500.degree. to 800.degree. C. in a vacuum atmosphere until the pressure of the hydrogen gas becomes to the extent of 1.times.10.sup.-4 Torr or less; and

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			rapidly cooling said dehydrogenated fragments. 9. A rare earth-iron-boron-cobalt based resin bonded magnet excellent in magnetic anisotropy and temperature characteristic, wherein said resin bonded magnet is formed by ***[process/method]*** molding a mixture of a resin binder and said R--Fe--B--Co based alloy magnetic powder fabricated by the method claimed in claim 8 or said Nd--Fe--B--Co based alloy magnetic powder fabricated by the method claimed in claim 8 by way of an injection molding process.
Filed: August 28, 1995 Issued: May 6, 1997 Expires: Aug 2015	5,626,690	Assignee: Kawasaki Steel Corporation (JAPAN)	Low boron amorphous alloy having excellent soft magnetic characteristics Abstract A low boron amorphous alloy having excellent soft magnetic characteristics, composed of B: about 6-10 at %, Si: about 10-17 at %, P: about 0.02-2 at % and the balance Fe and incidental impurities. The invention lowers production costs because the content of expensive boron is reduced. What is claimed is: 1. A low boron amorphous alloy having excellent soft magnetic characteristics, consisting of ***[composition of matter]*** : about 6-10 at % B; about 10-17 at % Si; about 0.02-2 at % P; and the balance Fe and incidental impurities.

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			2. A low boron amorphous alloy having excellent soft magnetic characteristics, consisting of ***[composition of matter]*** : about 6-10 at % B; about 10-17 at % Si; about 0.02-2 at % P; about 0.1-2 at % C; and the balance Fe and incidental impurities.
Filed: Nov 2, 1994 Issued: Jan 21, 1997 Expires: Nov 2014	5,595,608	Assignee: TDK Corporation (Tokyo, JAPAN)	Preparation of permanent magnet Abstract A permanent magnet which contains R, T and B as main ingredients wherein R is Y or a rare earth element and T is Fe or Fe and Co and has a primary phase of R.sub.2 T.sub.14 B is produced by compacting a mixture of 60 to 95 wt % of a primary phase-forming master alloy and a grain boundary phase-forming master alloy both in powder form and sintering the compact. The primary phase-forming master alloy has columnar crystal grains of R.sub.2 T.sub.14 B with a mean grain size of 3-50 .mu.m and grain boundaries of an R rich phase and contains 26-32 wt % of R. The grain boundary phase-forming master alloy is a crystalline alloy consisting essentially of 32-60 wt % of R and the balance of Co or Co and Fe. In anther form, a permanent magnet which contains R, T and B as main ingredients wherein R is yttrium or a rare earth element, T is Fe or Fe+Co/Ni and has a primary phase of R.sub.2 T.sub.14 B is produced by compacting a mixture of a primary phase-forming master alloy and a grain boundary-forming master alloy both in powder form and sintering the compact.

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			The primary phase-forming master alloy has a primary phase of R.sub.2 T.sub.14 B and grain boundaries of an R rich phase. The grain boundary-forming master alloy contains 40-65 wt % of R, 30-60 wt % of Fe, Co or Ni and 1-12 wt % of Sn, In or Ga. We claim: 1. A method for ***[process/method]*** preparing a permanent magnet which contains R, T and B as main ingredients wherein R is at least one element selected from yttrium or rare earth elements, T is iron or a mixture of iron and cobalt, and B is boron and has a primary phase consisting essentially of R.sub.2 T.sub.14 B, said method comprising the steps of compacting to obtain a compact a mixture of a primary phase-forming master alloy and a grain boundary phase-forming master alloy both in powder form and sintering the compact, wherein said primary phase-forming master alloy contains 90 to 100% by volume columnar crystal grains consisting essentially of R.sub.2 T.sub.14 B and having a mean grain size of 3 to 50 .mu.m produced by cooling an alloy melt from one direction or two directions., and grain boundaries composed primarily of an R rich phase having an R content higher than R.sub.2 T.sub.14 B, said primary phase-forming master alloy consisting essentially of 26 to 32% by weight of R, 0.9 to 2% by weight of B, and the balance of T, said grain boundary phase-forming master alloy is a crystalline alloy consisting essentially of 32 to 60% by weight of R and the balance of cobalt or a mixture of cobalt and iron, and said mixture contains 60 to 95% by weight of said primary phase-forming master alloy.

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Filed: May 8, 1995 Issued: October 22, 1996 Expires: May 2015	5,567,891	Assignee: YBM Technologies, Inc. (Newtown, PA USA)	Rare earth element-metal-hydrogen-boron permanent magnet Abstract A permanent magnet is provided which is comprised of, by atomic percent: 10-24% R; 2-28% boron, 0.1-18.12% hydrogen; and balance being M. R is at least one element selected from La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y and Sc, and M is at least one metal selected from Fe, Co, Ni, Li, Be, Mg, Rs, Si, Ti, V, Cr, Mn, Cu, Zn, Ga Ge, Zn, Nb, Mo, Ru, Rh, Pd, Ag, Sb, Te, Hf, Ta, W, Re, Os, Ir, Pt, Au, and Bi. A process for producing the rare earth element-metal-hydrogen boron magnets is also disclosed wherein the magnetic materials are treated in an atmosphere having partial pressures of hydrogen containing gas at temperatures below the phase transformation temperature of the rare earth element-metal hydrides prior to sintering. We claim: 1. A permanent magnet comprising ***[composition of matter]*** , by atomic percent: 10-24% R; 2-28% boron; greater than 0.3%-18.12% hydrogen; and balance being M, wherein R is at least one element selected from group consisting of: La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y and Sc, and

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			wherein M is at least one metal selected from group consisting of: Fe, Co, Ni, Li, Be, Mg, As, Si, Ti, V, Cr, Mn, Cu, Zn, Ga Ge, Zn, Nb, Mo, Ru, Rh, Pd, Ag, Sb, Te, Hf, Ta, W, Re, Os, Ir, Pt, Au, and Bi.
Filed: June 7, 1995 Issued: July 8, 1997 Expires: June 2015	5,645,651	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Magnetic materials and permanent magnets Abstract Magnetic materials comprising Fe, B, R (rare earth elements) and Co having a major phase of Fe--Co--B--R intermetallic compound(s) of tetragonal systems and sintered anisotropic permanent magnets consisting essentially of, by atomic percent, 8-30% R (at least one of rare earth elements inclusive of Y), 2-28% B, no less than 50% Co, and the balance being Fe with impurities. Those may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf) providing Fe--Co--B--R--M type materials and magnets. What is claimed is: 1. A crystalline R(Fe,Co)BXAM compound ***[composition of matter]*** having a stable tetragonal crystal structure having lattice constants of a.sub.o about 8.8 angstroms and c.sub.o about 12 angstroms, in which R is at least one element selected from the group consisting of Nd, Pr, La, Ce, Tb, Dy, Ho, Er, Eu, Sm, Gd, Pm, Tm, Yb, Lu and Y, X is at least one element selected from the group consisting of S, C, P and Cu, A is at least one element selected from the group consisting of H, Li, Na, K, Be, Sr, Ba, Ag, Zn, N, F, Se, Te and Pb, and M is at least one element selected from the group consisting of Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf and Si. 3. The crystalline compound of claim 1, wherein (Fe,Co) comprises Fe and Co, provided that Co is present in an amount up to 100 atomic % of the sum of Fe and Co.

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Filed: April 5, 1995 Issued: June 3, 1997 Expires: April 2015	5,634,987	Assignee: The University of Sheffield (Sheffield, Great Britain)	Magnetic materials and method of making them Abstract A method for the preparation of a two-phase magnetic material that includes as the major phase a crystalline alloy of one or more rare earth metals, boron and iron, substantially all of the crystallites of which have a size of less than 35 nanometers, and as the minor phase .alpha.-Fe, involves the steps of (i) melt spinning an alloy consisting of up to 12 atomic percent of one or more rare earth metals, 3 to 7 atomic percent of boron and the balance iron or a mixture of iron and cobalt; (ii) quenching the melt spun alloy form step (i) under conditions such that a mixture of crystalline and amorphous material is produced, (iii) subjecting the material from step (ii) to an annealing treatment under conditions such that controlled crystal growth occurs to provide the crystalline alloy phase, substantially all of which has a particle size of less than 35 nanometers, the resulting materials having a remanence in excess of the theoretical value of 0.8 Tesla. We claim: 1. A method for the preparation ***[process/method]*** of a two-phase magnetic material comprising as the major phase a crystalline alloy of at least one rare earth metal, boron and iron, substantially all of the crystallites of which have a size of less than 35 nanometers, and as the minor phase .alpha.-Fe, which method comprises the steps of: i) melt spinning an alloy consisting of up to 12 atomic percent of at least one rare earth metal, 3 to 7 atomic percent of boron and the balance iron or a mixture of iron and cobalt; ii) quenching the melt spun alloy from step (i) under conditions such that a mixture of crystalline and amorphous material is produced;

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			iii) subjecting the material from step (ii) to an annealing treatment under conditions such that controlled crystal growth occurs to provide the crystalline alloy phase, substantially all of which has a crystallite size of less than 35 nanometers, the resulting materials having a remanence in excess of the theoretical value of 0.8 Tesla. 2. A method as claimed in claim 1 wherein the rare earth metal of the alloy is neodymium.
Filed: April 4, 1996 Issued: May 20, 1997 Expires: May 2026	5,630,885	Assignee: Santoku Metal Industry, Co., Ltd. (Kobe, JAPAN)	Alloy ingot for permanent magnet, anisotropic powders for permanent magnet, method for producing same and permanent magnet Abstract An alloy ingot for permanent magnet consists essentially of rare earth metal and iron and optionally boron. The two-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 100 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The three-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 50 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The alloy ingot is produced by solidifying the molten alloy uniformly at a cooling rate of 10.degree. to 1000.degree. C./sec. at a sub-cooling degree of 10.degree. to 500.degree. C. A permanent magnet and anisotropic powders are produced from the alloy ingot. What is claimed is: 1. A method ***[process/method]*** of producing anisotropic powders for permanent magnet comprising: melting a rare earth metal-iron-boron alloy to obtain a molten alloy,

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			solidifying the molten alloy uniformly by controlling the cooling rate of said molten alloy to be between 10.degree. and 1000.degree. C./sec. and controlling the sub-cooling degree of said molten alloy to be between 10.degree. and 500.degree. C. to obtain an alloy ingot consisting essentially of rare earth metal, iron, and boron, said alloy ingot containing 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 50 .mu.m and that along a long axis of 0.1 to 100 .mu.m; and subjecting said alloy ingot to hydrogenating treatment, said hydrogenating treatment further comprising: heating said alloy ingot in a hydrogen gas atmosphere to hydrogenate said alloy ingot; rapidly reducing the hydrogen gas pressure to which said alloy ingot is exposed to dehydrogenate said ingot, thereby recrystallizing said alloy ingot; rapidly quenching said dehydrogenated alloy ingot; and pulverizing said recrystallized alloy ingot.
Filed: August 28, 1995 Issued: May 6, 1997 Expires: Aug 2015	5,626,690	Assignee: Kawasaki Steel Corporation (JAPAN)	Low boron amorphous alloy having excellent soft magnetic characteristics Abstract A low boron amorphous alloy having excellent soft magnetic characteristics, composed of B: about 6-10 at %, Si: about 10-17 at %, P: about 0.02-2 at % and the balance Fe and incidental impurities. The invention lowers production costs because the content of expensive boron is reduced. What is claimed is:

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			1. A low boron amorphous alloy ***[composition of matter]*** having excellent soft magnetic characteristics, consisting of: about 6-10 at % B; about 10-17 at % Si; about 0.02-2 at % P; and the balance Fe and incidental impurities. 2. A low boron amorphous alloy having excellent soft magnetic characteristics, consisting of: about 6-10 at % B; about 10-17 at % Si; about 0.02-2 at % P; about 0.1-2 at % C; and the balance Fe and incidental impurities.
Filed: June 7, 1995 Issued: January 28, 1997	5,597,425	Assignee: Seiko Epson Corporation (Tokyo, JAPAN)	Rare earth cast alloy permanent magnets and methods of preparation Abstract A rare earth iron permanent magnet including at least one rare earth element, iron and boron as primary ingredients. The magnet can have an average grain diameter of less than or equal to about 150 .mu.m and a carbon content of less than or equal to about 400 ppm and a oxygen content of less than or equal to

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Expires: June 2015			about 1000 ppm. The permanent magnet is prepared by casting a molten alloy. In one embodiment, the cast body is heat treated at a temperature of greater than or equal to about 250.degree. C. Alternatively, the material can be cast and hot worked at a temperature of greater than or equal to about 500.degree. C. Finally, the material can be cast, hot worked at a temperature of greater than or equal to about 500.degree. C. and then heat treated at a temperature of greater than or equal to about 250.degree. C. The magnets provided in accordance with the invention are relatively inexpensive to produce an have excellent performance characteristics. We claim: 1. A rare earth permanent magnet prepared by a preparation process ***[process/method]*** , comprising: melting a rare earth-iron alloy comprising between about 8 and 30 atomic percent of at least one rare earth element, between about 2 and 28 atomic percent boron, iron and other impurities that are inevitably included during the preparation process; casting the alloy to obtain a cast ingot; and hot working the ingot at a temperature greater than about 500.degree. C. to make the ingot magnetically anisotropic.
Filed: June 24, 1994 Issued: October	5,565,043	Assignee: Seiko Epson Corporation (Tokyo, JAPAN)	Rare earth cast alloy permanent magnets and methods of preparation Abstract A rare earth iron permanent magnet including at least one rare earth element, iron and boron as primary ingredients. The magnet can have an average grain diameter of less than or equal to about 150 .mu.m and a carbon content of less

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15, 1996 Expires: June 2015			than or equal to about 400 ppm and a oxygen content of less than or equal to about 1000 ppm. The permanent magnet is prepared by casting a molten alloy. In one embodiment, the cast body is heat treated at a temperature of greater than or equal to about 250.degree. C. Alternatively, the material can be cast and hot worked at a temperature of greater than or equal to about 500.degree. C. Finally, the material can be cast, hot worked at a temperature of greater than or equal to about 500.degree. C. and then heat treated at a temperature of greater than or equal to about 250.degree. C. The magnets provided in accordance with the invention are relatively inexpensive to produce an have excellent performance characteristics. We claim: 1. A rare earth-iron permanent magnet comprising ***[composition of matter]*** a cast alloy ingot of between about 8 to 30 atomic percent of at least one rare earth element, between about 2 and 8 atomic percent boron and the balance iron, the alloy prepared by melting the components and forming a cast alloy ingot and then performing at least one of heat treating at a temperature above about 250.degree. C. and hot working the ingot at a temperature above about 500.degree. C., the ingot having an average grain diameter of from about 3 to about 150 microns, a carbon content of less than or equal to about 400 ppm and an oxygen content of less than or equal to about 1000 ppm. 2. The rare earth-iron permanent magnet of claim 1, wherein the rare earth element is selected from the group consisting of yttrium, lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium and mixtures thereof. 3. The rare earth-iron permanent magnet of claim 2, further including an effective amount of at least one member selected from the group of aluminum,

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			chromium, molybdenum, tungsten, niobium, tantalum, zirconium, hafnium, titanium and mixtures thereof for enhancing the coercive force of the magnet.
Filed: November 28, 1995 Issued: April 29, 1997 Expires: Nov 2015	5,624,503	Assignee: Matsushita Electric Industrial Co., Ltd (Tokyo, JAPAN)	Process for producing Nd-Fe-B magnet Abstract A process for producing a magnet in which the content of anisotropic magnet powder is from 95 to 50% by weight. The process includes the following steps. A powder mixture composed of the anisotropic magnet powder and solder powder containing isotropic magnet powder as a main constituent thereof is charged in a compacting mold. The powder mixture in a cavity is orientated in a magnetic field. It is compressed and Joule heated. Thus, the powder mixture is fixed. When the powder mixture is fixed into a magnet, the ratio (Po/Lo) of the average grain size Po of the anisotropic magnet powder to the size of the magnet Lo which size is measured in the orientation direction is preferably 0.6 or more. What is claimed is: 1. A process ***[process/method]*** for producing a Nd-Fe-B magnet in which a content of anisotropic Nd-Fe-B magnet powder is from 95 to 50% by weight, said process comprising the steps of: charging a powder mixture in a compacting mold, said powder mixture comprising said anisotropic Nd-Fe-B magnet powder and a powder containing a mixture of isotropic Nd-Fe-B magnet powder and solder powder which softens or melts when said solder powder is compressively heated; magnetically orientating said powder mixture in a cavity in a magnetic field; and

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			compressing and Joule heating the orientated powder mixture so that said powder mixture is fixed to thereby obtain said magnet. 6. A process as set forth in claim 5, wherein said solder powder comprises Ag-Cu-Zn-Cd-Ni powder. ***]***
Filed: June 7, 1995 Issued: October 1, 1996 Expires: June 2015	5,560,784	Assignee: Seiko Epson Corporation (Tokyo, JAPAN)	Rare earth cast alloy permanent magnets and methods of preparation Abstract A rare earth iron permanent magnet including at least one rare earth element, iron and boron as primary ingredients. The magnet can have an average grain diameter of less than or equal to about 150 .mu.m and a carbon content of less than or equal to about 400 ppm and content of less than or equal to about 1000 ppm. The permanent magnet is prepared by casting a molten alloy. In one embodiment, the cast body is heat treated at a temperature of greater than or equal to about 250.degree. C. Alternatively, the material can be cast and hot worked at a temperature of greater than or equal to about 500.degree. C. Finally, the material can be cast, hot worked at a temperature of greater than or equal to about 500.degree. C. and then heat treated at a temperature of greater than or equal to about 250.degree. C. The magnets provided in accordance with the invention are relatively inexpensive to produce an have excellent performance characteristics We claim: 1. A method of ***[process/method*** producing a permanent magnet, comprising the steps of: preparing a molten alloy composition by melting at one rare earth element component, boron and iron;

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			casting the molten alloy composition into a cast alloy ingot having crystals with a crystal grain axis; and hot working the cast alloy ingot at a temperature greater than 500.degree. C. and aligning the axis of the crystal grains in a selected direction.
Filed: August 12, 1994 Issued: August 27, 1996 Expires: Aug 2014	5,549,766	Assignee: Kabushiki Kaisha Toshiba (Kanagawa-ken, JAPAN)	Magnetic material Abstract A permanent magnet is composed of a magnetic material which is represented by a general formula R1.sub.x R2.sub.y A.sub.z Co.sub.u Fe.sub.100-x-y-z-u (where R1 is at least one element selected from rare earth elements, R2 is at least one element selected from the group consisting of Sc, Zr and Hf, A is at least one element selected from the group of C, N and P, and x,y,z and u are atomic percent defined as 2.ltoreq.x, 4.ltoreq.x+y.ltoreq.20, 0.ltoreq.z.ltoreq.20, 0.ltoreq.u.ltoreq.70), wherein the material includes a principal phase of TbCu.sub.7 structure and .alpha.-Fe, a peak width at half height of the main peak of X-ray diffraction of the principal phase obtained by using Cu-K.alpha. X-rays with the resolution of 0.02.degree. or less is about 0.8.degree. or less, and a ratio of peak intensity between the principal phase and .alpha.-Fe satisfies a relation that the value of I.sub.Fe /(I.sub.p +I.sub.Fe) is about 0.4 or less where I.sub.p is the peak intensity of main peak of X-ray diffraction of the principal phase obtained by using Cu-K.alpha. X-rays and I.sub.Fe is that of .alpha.-Fe. What is claimed is: 1. A magnetic material ***[composition of matter]*** which is represented by a formula: R1.sub.x R2.sub.y A.sub.z Co.sub.u Fe.sub.100-x-y-z-u

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			where R1 is at least one element selected from rare earth elements, R2 is at least one element selected from the group consisting of Sc, Zr and Hf, A is at least one element selected from the group of C, N and P, x,y,z and u are atomic percent defined as 2≦x, 4≦x+y≦20, 0.01.ltoreq.z.ltoreq.20, 0≦u≦70, wherein the crystal structure of a principal phase is TbCu.sub.7 structure, and a peak width at half height of the main peak of X-ray diffraction of the principal phase using Cu-Kα X-rays with a resolution of 0.02.degree. or less is about 0.8.degree. or less. 10. A magnetic material produced ***[process/method]*** by a method comprising the steps of: melting a raw material having a ratio of components represented by: R1.sub.x R2.sub.y A.sub.z Co.sub.u Fe.sub.100-x-y-z-u where R1 is at least one element selected from rare earth elements, R2 is at least one element selected from the group consisting of Sc, Zr and Hf, A is at least one element selected from the group of C, N and P, x,y,z and u are atomic percent defined as 2≦x, 4≦x+y≦20, 0.01.ltoreq.z.ltoreq.20, 0≦u≦70; quenching the melted raw material to obtain a material comprising a principal phase of TbCu.sub.7 crystal structure; and heat treating the quenched material at a temperature selected to provide a peak width of about 0.8.degree. or less at half height of the main peak of X-ray diffraction of the principal phase obtained by using Cu-Kα X-rays with a resolution of 0.02.degree. or less, and to provide a value of I.sub.Fe /(I.sub.p +I.sub.Fe) to be about 0.4 or less where I.sub.p is the peak intensity of the main peak of X-ray diffraction of the principal phase obtained by using Cu-Kα X-rays and I.sub.Fe is that of α-Fe.

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Filed: April 25, 1994 Issued: January 23, 1996 Expires: April 2014	5,486,240	Assignee: Iowa State University Research Foundation, Inc. (Ames, IA USA)	Carbide/nitride grain refined rare earth-iron-boron permanent magnet and method of making Abstract A method of making a permanent magnet wherein 1) a melt is formed having a base alloy composition comprising RE, Fe and/or Co, and B (where RE is one or more rare earth elements) and 2) TR (where TR is a transition metal selected from at least one of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Al) and at least one of C and N are provided in the base alloy composition melt in substantially stoichiometric amounts to form a thermodynamically stable compound (e.g. TR carbide, nitride or carbonitride). The melt is rapidly solidified in a manner to form particulates having a substantially amorphous (metallic glass) structure and a dispersion of primary TRC, TRN and/or TRC/N precipitates. The amorphous particulates are heated above the crystallization temperature of the base alloy composition to nucleate and grow a hard magnetic phase to an optimum grain size and to form secondary TRC, TRN and/or TRC/N precipitates dispersed at grain boundaries. The crystallized particulates are consolidated at an elevated temperature to form a shape. During elevated temperature consolidation, the primary and secondary precipitates act to pin the grain boundaries and minimize deleterious grain growth that is harmful to magnetic properties. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method of making ***[process/method]*** a permanent magnet having a base alloy composition comprising RE, at least one of Fe and Co, and B wherein RE is one or more rare earth elements, comprising: a) forming a melt having said base alloy composition in which TR, where TR

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			is a transition metal selected from the group consisting of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, and Al and at least one of C and N are provided as additives to form upon melt solidification a compound that is more thermodynamically stable than a compound otherwise formable between the additives and the base alloy components, whereby the base alloy components are not involved in formation of said compound, b) rapidly solidifying the melt in a manner to form particulates having at least one of a substantially amorphous structure and micro-crystalline structure, including forming primary precipitates comprising said compound by reaction of said TR and said at least one of said C and N, said precipitates being dispersed in said structure, c) heating the solidified particulates above the crystallization temperature of the base alloy composition to improve a magnetic property of said structure, including forming secondary precipitates comprising said compound at grain boundaries by reaction of said TR and said at least one of said C and N, and d) consolidating the particulates at an elevated temperature, said precipitates resisting grain growth in said structure at said elevated temperature. 2. The method of claim 1 wherein the TR and C additives are introduced in elemental form to the melt having the base alloy composition.
Filed: November 30, 1994 Issued: August 13, 1996	5,545,266	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Rare earth magnets and alloy powder for rare earth magnets and their manufacturing methods Abstract For the purpose of establishing the manufacturing method to obtain the Fe.sub.3 B type Fe--Co--B--R--M system high performance resin bonded magnet which possesses improved iHc and (BH)max and can be reliably mass

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Expires: Nov 2014			produced, the specific composition of Fe--Co--B--R (Pr, Nd)--M(Ag, Al, Si, Ga, Cu, Au) type molten alloy was rapidly solidified by the melt-quenching or atomization methods, or a combination of the two methods to obtain more than 90% of the solid in an essentially amorphous structure. After the temperature was raised at the rate of 1.degree..about.15.degree. C./min., the alloy was heat treated at 550.degree..about.730.degree. C. for 5 minutes.about.6 hours to obtain Fe-rich the boron compound phase, which crystallizes the body centered tetragonal Fe.sub.3 P type crystalline structure, and the Nd.sub.2 Fe.sub.14 B type crystalline structure phase both coexisting as fine crystalline clusters of the average crystalline diameter of 5 nm.about.100 nm. The alloy powder which contains the ferromagnetic phase, where the boron compound phase and the Nd.sub.2 Fe.sub.14 B type phase coexist, is combined with resin to produce the high performance resin bonded magnet with iHc.gtoreq.3 kOe, Br.gtoreq.5 kG, and (BH)max.gtoreq.3 MGO What is claimed is: 1. A rare earth magnet having a compositional formula ***[composition of matter]*** of Fe.sub.100-x-y-z Co.sub.x B.sub.y R.sub.z M.sub.w wherein R is at least one of Pr and Nd, M is one or two of Al, Si, Cu, Ga, Ag, and Au, symbols x, y, z and w each indicating a limit of composition range and respectively falling within the ranges of 0.05.ltoreq.x.ltoreq.15 at. %, 16≦y≦22 at. %, 3≦z≦6 at. %, and 0.1.ltoreq.w.ltoreq.3 at. %, said rare earth magnet including an iron-rich boron compound phase having a body-centered tetragonal Fe.sub.3 B crystalline structure and a phase of Nd.sub.2 Fe.sub.14 B crystalline structure and said rare earth magnet comprising a crystallite aggregate having an average crystalline particle diameter of 5 nm to 100 nm, said crystallite aggregate having been formed by rapidly solidifying a molten alloy by a melt quenching or gas atomizing method to cause substantially more

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			than 90% of the solidified alloy to be amorphous, and heat-treating the rapidly solidifying alloy by raising its temperature from 500 C./min and maintaining a temperature of from 550 C. for a period of from5 minutes to 360 minutes, the rare earth magnet of which displays magnetic properties of iHc≧3 kOe, Br≧9 kG and (BH) max≧10 MGOe.
Filed: June 24, 1993 Issued: July 23, 1996 Expires: June 2013	5,538,565	Assignee: Seiko Epson Corporation (Tokyo, JAPAN)	Rare earth cast alloy permanent magnets and methods of preparation Abstract A rare earth iron permanent magnet including at least one rare earth element, iron and boron as primary ingredients. The magnet can have an average grain diameter of less than or equal to about 150 .mu.m and a carbon content of less than or equal to about 400 ppm and an oxygen content of less than or equal to about 1000 ppm. The permanent magnet is prepared by casting a molten alloy. In one embodiment, the cast body is heat treated at a temperature of greater than or equal to about 250.degree. C. Alternatively, the material can be cast and hot worked at a temperature of greater than or equal to about 500.degree. C. Finally, the material can be cast, hot worked at a temperature of greater than or equal to about 500.degree. C. and then heat treated at a temperature of greater than or equal to about 250.degree. C. The magnets provided in accordance with the invention are relatively inexpensive to produce an have excellent performance characteristics. We claim: 1. A method of forming ***[process/method]*** a rare earth-iron permanent magnet, comprising: melting a rare earth alloy composition including between about 8 and 30 atomic percent of at least one rare earth element, between about 2 and 28 atomic percent boron and iron;

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			casting the melted alloy composition to obtain a cast alloy ingot; hot working the cast alloy ingot at a temperature greater than about 500.degree. C. in order to make the ingot magnetically anisotropic. 8. The method of claim 3, wherein the alloy includes an effective amount of at least one member selected from the group consisting of Al, Co, Mo, W, Nb, Ta, Zr, Ha, Ti and mixtures thereof for enhancing the coercive force of the magnet.
Filed: Nov 5, 1993 Issued: May 7, 1996 Expires: Nov 2013	5,514,224	Assignee: Magnequench International, Inc. (Anderson, IN USA)	High remanence hot pressed magnets Abstract Isotropic hot pressed iron-rare earth metal permanent magnets are provided wherein the hot pressed permanent magnet exhibits magnetic remanences of at least about 9 kG, and most typically about 10 kG. Preferred compositions include a relatively low rare earth content coupled with an optimal amount of boron. The preferred composition is, on a weight percent basis, from about 5 to about 25 percent rare earth, most preferably about 10 to about 20 percent rare earth, from about 0.5 to about 4.5 percent boron, most preferably from about 0.8 to about 4.0 percent boron, wherein the total combination of the rare earths and boron ranges from about 9 percent to about 26 percent, most preferably from about 12 percent to about 22 percent, and optionally from about 2 percent to about 16 percent cobalt, with the balance being essentially iron. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method for forming ***[process/method]*** a hot pressed iron-rare earth-boron permanent magnet, the method comprising the step of;

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			providing a quality of isotropic iron-rare earth-boron metal particles having a grain size of not more than about 500 nanometers, wherein said quality of isotropic iron-rare earth-boron metal particles are formed from a composition comprising, on a weight percent basis, from about 10 to about 20 percent rare earth metal, from about 0.8 to about 4.0 percent boron, and wherein the total of said rare earth metal and said boron ranges from about 12 to about 22 percent, with the balance being principally iron; and hot pressing said quality of isotropic iron-rare earth-boron metal particles at a temperature of about 750.degree. C. to about 800.degree. C. and for a duration sufficient to form a hot pressed isotropic iron-rare earth-boron metal permanent magnet characterized by the uniform presence of both the hard magnetic phase Nd.sub.2 Fe.sub.14 B and the soft magnetic phases Fe.sub.3 B and .alpha.-Fe, and a magnetic remanence of at least about 9 kiloGauss. 2. A method for forming a hot pressed iron-rare earth-boron permanent magnet as recited in claim 1 wherein the majority of said rare earth metal is neodymium. 3. A method for forming a hot pressed iron-rare earth-boron permanent magnet as recited in claim 1 further comprising from about 2 to about 16 percent cobalt.
Filed: October 25, 1993 Issued: February 20, 1996	5,492,571	Assignee: General Motors Corporation (Detroit, MI)	Thermomagnetic encoding method and articles Abstract An article comprising first and second bodies of permanent magnet material, each of said first and second bodies consisting substantially of a substrate of permanent magnet material being magnetized substantially uniformly to a predetermined flux density in a range from zero flux to 100% flux saturation of

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Expires: Oct. 2013			the permanent magnet material; each of the first and second bodies also comprising a pattern of at least one affected volume in a surface of the body, wherein each affected volume has a magnetic flux density that varies from the substantially uniform predetermined flux density and wherein the first and second bodies are stacked and fixedly attached so that the pattern on each body aligns with the pattern on the other body, wherein at least one affected volume on the first body is aligned with at least one affected volume on the second body and wherein the aligned affected volumes comprise a pole detectable by a magnetic sensor. We claim: 1. A method for ***[process/method]*** forming an article with a magnetic pattern thereon, comprising the steps of: (a) directing energy in a pattern onto a first base of permanent magnet material having a first volume to heat a plurality of at least two second volumes of the first base of permanent magnet material to a threshold temperature to lower a coercivity thereof, the first base of permanent magnet material having a permanent magnetic field flux density value in a range from zero flux to a flux density of 100% saturation of the base permanent magnet material; (b) imposing a magnetic field on the heated second volumes greater than the coercivity of the heated second volumes, wherein the second volumes are treated and the first volume remains untreated, wherein the treated second volumes comprise a treated pattern on the untreated first volume that generates a flux density lower or higher than that of the untreated first volume of the first base of permanent magnet material; (c) and allowing the heated second volumes to cool in the imposed field, wherein the treated pattern has a magnetic characteristic sufficiently different

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			from the first volume of the first base of permanent magnet material that the treated pattern comprises at least two poles that are readily detected by a magnetic sensor; (d) repeating steps (a), (b) and (c) on a second base of permanent magnet material; and (e) stacking and attaching the two bases of permanent magnet material so that the treated pattern of the first base of permanent magnet material aligns with the treated pattern of the second base of permanent magnet material, wherein the at least two poles of the first base of permanent magnet material align and act together with the at least two poles of the second base of permanent magnet material, wherein the detectability of said two poles of said treated pattern of the first base of permanent magnet material by said magnetic sensor is increased without decreasing a spatial density of said two poles of said treated pattern of the first base of permanent magnet material. 2. The method of claim 1, also comprising the step of (f) repeating steps (d) and (e) for additional bases of permanent magnet material to form an article comprising a stack of three or more bases of permanent magnet material.
Filed: January 28, 1994 Issued: December 5, 1995 Expiration: January	5,472,525	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Nd-Fe-B system permanent magnet Abstract Disclosed is a Nd-Fe-B system magnet having coercive force iHc of 12 KOe or more and high maximum energy product (BH)max of 42 MGOe or more. The permanent magnet consists of 28 to 32 wt. % of Nd and Dy (Dy ranges from 0.4 to 3 wt. %), 6 wt. % or less of Co, 0.5 wt. % or less of Al, 0.9 to 1.3 wt. % of B, at least one of 0.05 to 2.0 wt. % of Nb and 0.05 to 2.0 wt. % of V, 0.02 to 0.5 wt. % of Ga, Fe and unavoidable impurities, having coercive force iHc of 12 KOe or more and maximum energy product (BH)max of 42 MGOe or

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2014			more. What is claimed is: 1. A Nd-Fe-B permanent magnet comprising 28 to 32 wt. % of Nd and Dy, wherein Dy ranges from 0.4 to 3 wt. %, 6 wt. % or less of Co, 0.5 wt. % or less of Al, 0.9 to 1.3 wt. % of B, at least one of 0.05 to 2.0 wt. % of Nb and 0.05 to 2.0 wt. % of V, 0.02 to 0.5 wt. % of Ga, and Fe, and having a coercive force iHc of 12 KOe or more and a maximum energy product (BH)max of 42 MGOe or more, and wherein the Ga content in an Nd phase is two times or more of the added amount of Ga in the entire magnet.
Filed: February 10, 1994 Issued: November 14, 1995 Expires: Feb 2014	5,466,308	Assignee: Sumitomo Special Metals Co. Ltd. (Osaka, JAPAN)	Magnetic precursor materials for making permanent magnets Abstract Magnetic materials comprising Fe, B, R (rare earth elements) and Co having a major phase of Fe-Co-B-R intermetallic compound(s) of tetragonal systems and sintered anisotropic permanent magnets consisting essentially of, by atomic percent, 8-30% R (at least one of rare earth elements inclusive of Y), 2-28% B, no less than 50% Co, and the balance being Fe with impurities. Those may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf) providing Fe-Co-B-R-M type materials and magnets. What is claimed is: 1. A crystalline permanent magnet alloy pre-cursor material ***[composition of matter]*** for making permanent magnets comprising a major phase of an (Fe,Co)-B-R compound wherein R is one or two of Nd and Pr, and wherein the (Fe,Co)-B-R compound is formed by substituting Co for a part of Fe in a base Fe-B-R compound containing no Co, said (Fe,Co)-B-R compound being stable at room temperature or above, having a Curie temperature higher than room

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			temperature and higher than that of the base Fe-B-R compound and having magnetic anisotropy, and the alloy consisting essentially of, by atomic percent of the entire alloy, 8-30 percent R, 2-28 percent B and the balance being Fe and Co, provided that at least 42 percent of the entire alloy is Fe, wherein crystal grains of said (Fe, Co)-B-R compound are isolated by a nonmagnetic boundary phase. 2. A crystalline permanent magnet alloy pre-cursor material ***[composition of matter]*** for making permanent magnets comprising a major phase of an (Fe,Co)-B-R compound wherein R is at least one selected from the group consisting of Nd, Pr, La, Ce, Tb, Dy, Ho, Er, Eu, Sm, Gd, Pm, Tm, Yb, Lu and Y and wherein at least 50 atomic percent of R consists of Nd and/or Pr, and wherein the (Fe,Co)-B-R compound is formed by substituting Co for a part of Fe in a base Fe-B-R compound containing no Co, said (Fe,Co)-B-R compound being stable at room temperature or above, having a Curie temperature higher than room temperature and higher than that of the base Fe-B-R compound and having magnetic anisotropy, and the alloy consisting essentially of, by atomic percent of the entire alloy, 8-30 percent R, 2-28 percent B and the balance being Fe and Co, provided that at least 42 percent of the entire alloy is Fe, wherein crystal grains of said (Fe, Co)-B-R compound are isolated by a nonmagnetic boundary phase
Filed: February 4, 1994 Issued: October 3, 1995	5,454,998	Assignee: YBM Technologies, Inc. (Hatboro, PA USA)	Method for producing permanent magnet Abstract A permanent magnet is provided which is comprised of, by atomic percent: 10-24% R; 2-28% boron, 0.1-18.12% hydrogen; and balance being M. R is at least one element selected from La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y and Sc, and M is at least one metal selected from Fe, Co, Ni,

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Expires: Feb 2014			Li, Be, Mg, As, Si, Ti, V, Cr, Mn, Cu, Zn, Ga Ge, Zn, Nb, Mo, Ru, Rh, Pd, Ag, Sb, Te, Hf, Ta, W, Re, Os, Ir, Pt, Au, and Bi. A process for producing the rare earth element-metal-hydrogen boron magnets is also disclosed wherein the magnetic materials are treated in an atmosphere having partial pressures of hydrogen containing gas at temperatures below the phase transformation temperature of the rare earth element-metal hydrides prior to sintering. We claim: 1. A method of producing ***[process/method]*** a permanent magnet comprising the steps of: providing, in compacted form from powders, green compact or permanent magnets, a sample comprising at least one rare earth element, at least one metal and boron; heating the compacted sample in a vacuum to a temperataure sufficient to outgass the sample; after outgassing, supplying a partial pressure of hydrogen containing gas to the sample; heating the sample in said hydrogen containing gas to a temperature below the phase transformation temperature of the metal hydride until the required hydrogen concentration in the sample is attained; replacing the hydrogen containing gas with argon, and thereafter sintering the sample for the time necessary to obtain the desired density of the magnet; and after sintering, reducing the partial pressure of argon and lowering the temperature surrounding the magnet to 300.degree.-900.degree. C. for 1-3

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			hours, whereby formation and treatment of the hydrogen containing permanent magnet is complete.
Filed: May 13, 1994 Issued: September 12, 1995 Expires: May 2014	5,449,417	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	R-Fe-B magnet alloy, isotropic bonded magnet and method of producing same Abstract A rare earth-iron-boron permanent magnet alloy having a composition represented by the formula: wherein R represents one or more rare earth elements, M represents at least one element selected from the group consisting of Al, Si, Cu, Nb, W, V, Mo and Ta, 20% or less of Fe may be substituted by Co, and a, b, c and d are atomic % satisfying a: 10-15, b: balance, c: 4-8, and d: 10 or less, the magnet alloy having an average crystal grain size of 0.01-0.2 .mu.m (0.2 .mu.m or less in 90% or more by area of the crystal grains). This magnet alloy can be used to provide an isotropic bonded magnets which may be used of PM motors. What is claimed is: 1. A bonded magnet having improved magnetizability and heat resistance comprising ***[composition of matter]*** (a) magnetically isotropic magnetic powder composed of an R--Fe--B--M magnet alloy, wherein R represents at least one rare earth element including Y in the range of 12.5-15 atomic %, B represents boron in the range of 4-8 atomic %, Fe represents iron in a balance amount, 20% or less of said iron being substituted by Co, and M represents at least one element selected from the group consisting of Nb, W, V, Mo and Ta in the range of 0.05-3 atomic %, and having an average crystal grain size of 0.01-0.15 .mu.m, a crystal grain size of 0.2 .mu.m or less in 90% or more by area of said crystal grains, and an average particle size of 1-1000 .mu.m; and (b) 5-40 volume % of a binder, said bonded magnet having an irreversible loss of flux which is lower than 5% at an ambient temperature of 140.degree. C.

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			and at a permeance coefficient, Pc, equal to 2, said R--Fe--B--M magnet alloy being produced by forming from an alloy melt having said composition a thin ribbon having an initial coercive force of 2000 Oe or less by a rapid quenching and subjecting said thin ribbon to a heat treatment at 800.degree. C. or lower. 2. The bonded magnet according to claim 1, wherein said M is Nb.
1995: patent term and patent expiration dates change	**1995: patent system changes**	**1995: patent system changes**	1)For applications filed **on or after June 8, 1995:** **the patent term is 20 years from the filing date** of the earliest U.S. application to which priority is claimed (excluding provisional applications). 2) For **applications filed before June 8, 1995** and for patents that were still in force on June 8, 1995: the patent term is **either** 17 years from the issue date **or** 20 years from the filing date of the earliest U.S. or international (PCT) application to which priority is claimed (excluding provisional applications), **the longer term applying**
Filed: Nov 29, 1993 Issued: May 2, 1995 Expires: Nov, 2013	5411608	Original Assignee: Kollmorgen Corp. USA	Performance light rare earth, iron, and boron magnetic alloys ABSTRACT This invention relates to improved performance light rare earth, iron and boron magnetic alloys containing a small amount of cobalt. What is claimed is: 1. A permanent magnetic alloy ***[composition of matter]*** containing a 2:14:1 rare earth:iron:boron phase and consisting essentially of 12 to 40 atomic % of a light rare earth selected from the group consisting of praseodymium, neodymium and mixtures thereof, an effective amount up to about 10 atomic %

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			of Co to increase the Curie temperature of said alloy, about 3 to about 8 atomic % boron, and the balance iron. 12. A permanent magnetic alloy having a chemical composition consisting essentially ***[composition of matter]*** of: Fe.sub.100-x-y-z R.sub.x Co.sub.y B.sub.z, wherein Fe is iron, R is a light rare earth selected from the group consisting of praseodymium, neodymium and mixtures thereof, Co is cobalt, B is boron, and x, y, and z represent atomic percentages, wherein x is between about 12 and about 40, y is an effective amount up to about 10 to increase the Curie temperature of said alloy, and z is about 3 to about 8.
Filed: Sept 13, 1993 Issued: April 11, 1995 Expired: Sept 2013	5,405,455	Assignee: Shin-Etsu Chemical Co. Ltd. (Tokyo, JAPAN)	Rare earth-based permanent magnet Abstract Disclosed is a novel method for the preparation of a rare earth-based permanent magnet by the so-called two-alloy process in which powders of two kinds of rare earth-containing magnetic alloys each having a different composition from the other are blended together in a specified proportion and the powder blend is shaped in a magnetic field into a green body which is sintered. In the invention, the first magnetic alloy has a composition of the formula R.sub.2 T.sub.14 B, in which R is a rare earth element selected from the group consisting of neodymium, praseodymium, dysprosium and terbium and T is iron or a combination of iron and cobalt, while the second alloy has a composition of the formula R.sub.a Fe.sub.b Co.sub.c B.sub.d M.sub.e, in which R has the same meaning as defined above, M is an element selected from the group consisting of gallium, aluminum, copper, zinc, indium, silicon, phosphorus, sulfur, titanium, vanadium, chromium, manganese, germanium, zirconium, niobium, molybdenum, palladium, silver, cadmium, tin, antimony, hafnium, tantalum and tungsten, the subscript a is a positive number in the range from 15 to 40, b is zero or a positive number not exceeding 80, c is a positive number in the range from 5 to 85, d is a positive number not

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			exceeding 20 and e is zero or a positive number not exceeding 20 with the proviso that a+b+c+d+e is 100, and the powders are blended in a weight proportion of 99:1 to 70:30. What is claimed is: 1. A method for the preparation ***[process/method]*** of a rare earth-based permanent magnet which comprises the steps of: (a1) melting together, at a temperature of 1000.degree. C. or higher in an inert atmosphere, a rare earth metal, metallic iron or a combination of metallic iron and metallic cobalt and elementary boron in such a proportion represented by the formula in which R is a rare earth element and T is iron or a combination of iron and cobalt in such a proportion that the amount of cobalt does not exceed 40% by weight of the total amount of iron and cobalt to form a melt of a first magnetic alloy; (b1) cooling the melt of the first magnetic alloy in a casting mold at a rate of temperature decrease not exceeding 850.degree. C. per minute but not lower than 1.degree. C. per minute at least until the temperature of the melt reaches 200.degree. C. to form an ingot of the first magnetic alloy; (a2) melting together, at a temperature of 1000.degree. C. or higher in an inert atmosphere, a rare earth element, iron and cobalt, elementary boron and the elementary form of an element M defined below in such a proportion represented by the formula in which R has the same meaning as defined above, M is an element selected from the group consisting of gallium, aluminum, copper, zinc, indium, silicon,

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			phosphorus, sulfur, titanium, vanadium, chromium, manganese, germanium, zirconium, niobium, molybdenum, palladium, silver, cadmium, tin, antimony, hafnium, tantalum and tungsten, the subscript a is a positive number in the range from 15 to 40, b is zero or a positive number not exceeding 80, c is a positive number in the range from 5 to 85, d is a positive number not exceeding 20 and e is zero or a positive number not exceeding 20 with the proviso that a+b+c+d+e is 100 to form a melt of a second magnetic alloy; (b2) cooling the melt of the second magnetic alloy in a casting mold at a rate of temperature decrease not exceeding 850.degree. C. per minute at least until the temperature of the melt reaches 200.degree. C. to form an ingot of the second magnetic alloy; (c) crushing and pulverizing the ingots of the first and second magnetic alloys either together or separately in an inert atmosphere into particles having an average particle diameter in the range from 1 to 20 .mu.m; (d) uniformly mixing the particles of the first and second magnetic alloys in a weight proportion in the range from 99:1 to 70:30 in an inert atmosphere to form a powder mixture; (e) shaping the powder mixture into a powder compact having a form of a magnet by compression molding in a magnetic field; (f) sintering the shaped form of the powder compact by heating in vacuum or in an atmosphere of an inert gas at a temperature in the range from 900.degree. C. to 1250.degree. C. for a length of time in the range from 30 minutes to 10 hours; and (g) subjecting the sintered body to an aging treatment at a temperature not exceeding 900.degree. C. for at least 30 minutes.

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Filed: Oct 19, 1992 Issued: April 4, 1995 Expires: Oct 2012	[5,403,408]()	Assignee: Inland Steel Company (Chicago, IL USA)	Non-uniaxial permanent magnet material Abstract A permanent magnet material having the formula, in atomic %: wherein -3.3.ltoreq.z<3.3 and -2.0.ltoreq.w<2.0; or wherein -2.5.ltoreq.y<2.5 and -2.7.ltoreq.x.ltoreq.2.7; or wherein -1.5.ltoreq.r.ltoreq.1.5 and 0.ltoreq.q<6.5-r; and wherein TM is a transition metal, RE is a rare earth metal, and B is boron or a combination of boron and carbon. The permanent magnet materials include at least weight percent non-uniaxial material and possess a coactivity of at least 1,000 Oersteds. We claim: 1. A permanent magnet material comprising ***[composition of matter]*** a transition metal, a rare earth metal and a boron component, said magnet material including at least 10 weight percent of a material having more than one easy axis of magnetization and having a coercivity of at least about 1,000 Oersteds, said magnet material having the formula, in atomic %: wherein -3.3.ltoreq.z<3.3 and -2.0.ltoreq.w<2.0; or wherein -2.5.ltoreq.y<2.5 and -2.7.ltoreq.x.ltoreq.2.7; or wherein -1.5.ltoreq.r.ltoreq.1.5 and 0.ltoreq.q<6.5-r, wherein TM is a transition metal; RE is a rare earth metal; and B is boron or a combination of boron and carbon.
Filed: February	[5,383,978]()	Assignee:	Alloy ingot for permanent magnet, anisotropic powders for permanent magnet, method for producing same and permanent magnet

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12, 1993 Issued: January 24, 1995 Expired: Feb 2013		Santoku Metal Industry Co., Ltd. (Hyogo, JAPAN)	Abstract An alloy ingot for permanent magnet consists essentially of rare earth metal and iron and optionally boron. The two-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 100 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The three-component alloy ingot contains 90 vol % or more of crystals having a crystal grain size along a short axis of 0.1 to 50 .mu.m and that along a long axis of 0.1 to 100 .mu.m. The alloy ingot is produced by solidifying the molten alloy uniformly at a cooling rate of 10.degree. to 1000.degree. C./sec. at a sub-cooling degree of 10.degree. to 500.degree. C. A permanent magnet and anisotropic powders are produced from the alloy ingot. 1. A method for ***[process/method]*** producing an alloy ingot comprising melting a rare earth metal-iron alloy to obtain a molten alloy and solidifying the molten alloy uniformly at a cooling rate of 10.degree. to 1000.degree. C./sec. and at a sub-cooling degree of 10.degree. to 500.degree. C. 2. The method for producing the alloy ingot as claimed in claim 1 wherein said molten alloy is solidified by a strip casting method. 4. A method for producing an alloy ingot comprising melting a rare earth metal-iron alloy to obtain a molten alloy, and solidifying the molten alloy uniformly by controlling the cooling rate of said molten alloy to be between 10.degree. and 1000.degree. C./sec. and controlling the sub-cooling degree of said molten alloy to be between 10.degree. and 500.degree. C.
Filed:	5,352,301	Assignee:	Hot pressed magnets formed from anisotropic powders

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November 20, 1992 Issued: October 4, 1994 Expired: Nov 2012		General Motors Corporation (Detroit, MI USA)	Abstract A method is provided for forming a high energy product, anisotropic, hot pressed iron-rare earth metal permanent magnet without the requirement for magnetic alignment during pressing or additional hot working steps. The method of this invention includes providing a quantity of anisotropic iron-rare earth metal particles and hot pressing the particles so as to form a substantially anisotropic permanent magnet. The pressed permanent magnet of this invention permits a greater variety of shapes as compared to conventional hot worked anisotropic permanent magnets. As a result, the magnetic properties and shape of the permanent magnet of this invention can be tailored to meet the particular needs of a given application. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method for forming ***[process/method]*** a hot pressed iron-rare earth metal permanent magnet, the method comprising the steps of: providing platelet-shaped anisotropic iron-rare earth metal particles, wherein the anisotropic iron-rare earth metal particles are formed from a composition comprising, on an atomic percent basis, about 40 to about 90 percent iron or a mixture of cobalt and iron, about 10 to about 40 percent rare earth, and at least about 0.5 percent boron; and hot pressing a quantity of the anisotropic iron-rare earth metal particles in the absence of a magnetic alignment field such that the anisotropic iron-rare earth metal particles are substantially magnetically nonaligned during the hot pressing step, the hot pressing step forming the hot pressed anisotropic iron-rare earth metal permanent magnet, the hot pressed iron-rare earth metal permanent magnet having platelet-shaped grains and exhibiting a magnetic

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			anisotropy and an energy product which is greater than that of a hot pressed isotropic magnet having a substantially similar composition, and which is less than that of a hot worked anisotropic magnet having a substantially similar composition; wherein the hot pressed anisotropic iron-rare earth metal permanent magnet exhibits an energy product of at least about 15 megaGaussOersteds. 10. A method for forming a hot pressed iron-rare earth metal permanent magnet comprising, on a weight percent basis, about 26 to 32 percent rare earth wherein at least about 90 percent of this constituent is neodymium, about 0.7 to about 1.1 percent boron, and the balance being essentially iron, the method comprising the steps of: melt spinning a hot pressed iron-rare earth metal composition to form overquenched ribbons; forming isotropic iron-rare earth particles from the ribbons; hot pressing the isotropic iron-rare earth metal particles to form an isotropic magnet body; hot working the isotropic magnetic body so as to plastically deform the iron-rare earth metal particles of the isotropic magnet body, so as to form an anisotropic magnet body; comminuting the anisotropic magnet body so as to form platelet-shaped anisotropic iron-rare earth metal particles from the anisotropic magnet body; and hot pressing a quantity of the anisotropic iron-rare earth metal particles in the

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			absence of a magnetic alignment field such that the anisotropic iron-rare earth metal particles are substantially magnetically nonaligned during the hot pressing step, the hot pressing step forming the hot pressed iron-rare earth metal permanent magnet; whereby the iron-rare earth metal permanent magnet exhibits an energy product of at least about 15 megaGaussOersteds.
Filed: December 3, 1992 Issued: August 16, 1994 Expired: Dec 2012	5,338,372	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Anisotropic rare-earth permanent magnets and method for making same, and metal mold for molding anisotropic permanent magnets Abstract Anisotropic rare-earth permanent magnets characterized in that an aggregate of a plurality of blocks, to each of which anisotropy is imparted, is formed using powders of magnetic material containing rare-earth elements, and the adjoining blocks are powder-metallurgically bonded together under pressure into one piece; a method of making anisotropic rare-earth permanent magnets by molding anisotropic blocks by magnetic-field molding, arranging, aggregating and sealing a plurality of blocks in a bag, and cold hydrostatic pressing the aggregate of blocks in the absence of magnetic field; and a suitable metal mold for magnetic-field molding anisotropic permanent magnets of a relatively large size. What is claimed is: 1. A method of manufacturing ***[process/method]*** anisotropic rare-earth permanent magnets wherein said manufacturing method includes a process of molding powders of permanent magnet materials containing rare-earth elements by means of a metal mold disposed in a magnetic field into an anisotropic block by exerting a molding pressure of more than 0.6 t/cm.sup.2, a process of aggregating and arranging a plurality of said blocks into an

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			aggregate having a shape and sealing said aggregate in a bag impermeable to a hydrostatic medium, and a process of cold hydrostatic pressing said aggregate of blocks sealed in said bag in the absence of magnetic field by applying a pressure exceeding said molding pressure. 2. A method of manufacturing ***[process/method]*** anisotropic rare-earth permanent magnets, comprising: employing a metal mold disposed in a magnetic field; disposing molding powders of permanent magnet materials containing rare-earth elements in said metal mold; exerting a mold pressure of more than 0.6 t/cm.sup.2 on said permanent magnet materials to form an anisotropic block; aggregating and arranging a plurality of said anisotropic blocks into an aggregate having a predetermined shape; sealing said aggregate in a bag impermeable to a hydrostatic medium; cold hydrostatically pressing said aggregate of block sealed in said bag in the absence of a magnetic field by applying a pressure exceeding said molding pressure.
Filed: Nov 19, 1992 Issued: August 16,	5,338,371	Assignee: Mitsubishi Metal Corporation (Tokyo, JAPAN)	Rare earth permanent magnet powder, method for producing same and bonded magnet Abstract There is disclosed a R--Fe--B or R--Fe--Co--B alloy permanent magnet powder which may contain Ga, Zr or Hf, or may further contain Al, Si or V.

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1994 Expires: Aug 2012			Each individual particle of the powder includes a structure of recrystallized grains containing a R.sub.2 Fe.sub.14 B or R.sub.2 (Fe,Co).sub.14 B intermetallic compound phase. The intermetallic compound phase has recrystallized grains of a tetragonal crystal structure having an average crystal grain size of 0.05 to 20 .mu.m. At least 50% by volume of the recrystallized grains of the aggregated structure are formed so that a ratio of the greatest dimension to the smallest dimension is less than 2 for each recrystallized grain. In order to manufacture the magnet powder, regenerative material and alloy material are prepared and their temperature is elevated in a hydrogen atmosphere. Then, the alloy material and the regenerative material are held in the same atmosphere at a temperature or 750.degree. C. to 950.degree. C., and then held in a vacuum at 750.degree. C. to 950.degree. C., and cooled and crushed. A bonded magnet produced using the above magnet powder is also disclosed. What is claimed is: 1. A method for producing ***[process/method]*** a rare earth iron-boron permanent magnet powder comprising the steps of: (a) plasma-melting and casting a rare earth alloy material which contains 8 to 30 atomic percent of at least one rare earth elements, 3 to 15 atomic percent of B, and the balance Fe and unavoidable impurities; which may optionally include 0.01 to 40 atomic percent Co; 0.01 to 5.0 atomic percent of at least one element selected from the group consisting of Ga, Al, Si and V; or 0.01 to 3.0 atomic percent of at least one element selected from the group

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			consisting of Zr and Hf; (b) adding a regenerative material to the alloy material prepared in step (a) to provide a mixture; (c) subsequently elevating the temperature of said alloy material and said regenerative material in a hydrogen atmosphere and holding the same in said atmosphere at a temperature of 750.degree. C. to 950.degree. C. whereby a hydrogenation mixture is produced; (d) subsequently dehydrogenating said hydrogenated mixture by exposing said mixture to a temperature of 750.degree. C. to 950.degree. C. in a vacuum, wherein the temperature drop caused by the dehydrogenation of the alloy material is prevented by the regenerative material; and (e) subsequently cooling and crushing said alloy.
Filed: June 22, 1992 Issued: May 24, 1994 Expired: June 2012	5,314,548	Assignee: General Motors Corporation (Detroit, MI USA)	Fine grained anisotropic powder from melt-spun ribbons Abstract A method is disclosed for producing a rapidly solidified, fine grained, magnetically anisotropic powder of the RE-Fe-B type. The rapidly solidified material is optimally quenched or slightly overquenched and is subjected to a hydrogen absorption-hydrogen desorption process that produces a fine grained material containing the essential magnetic phase RE.sub.2 TM.sub.14 B and an intergranular phase and is magnetically anisotropic. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method of making ***[process/method]*** fine grained, magnetically

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			anisotropic permanent magnet powder particles consisting essentially of grains of the tetragonal crystal phase RE.sub.2 (Fe.sub.x Co.sub.1-x).sub.14 B.sub.1 with an intergranular phase surrounding the grains, where RE represents one or more rare earth elements including at least 60 percent neodymium and/or praseodymium, the value of x is in the range of 0.6 to 1, and the composition of the intergranular phase is richer in rare earth element content than the tetragonal crystal phase, the composition of said powder being further characterized in that in molten precursor form, it is susceptible to being rapidly cooled to solidification over a determinable and controllable range of cooling rates within which range a series of fine grained crystalline products is formed that respectively display (a) values of magnetic coercivity that continually increase toward a maximum value and decrease from such value as the cooling rate is increased and (b) values of magnetic remanence that increase over at least a part of such range as the cooling rate is increased, said method comprising rapidly solidifying a said molten precursor composition at a maximum coercivity value cooling rate or greater to form fine-grained particles in which the average grain size is no greater than about 100 nanometers, heating said rapidly solidified particles in a hydrogen atmosphere at a pressure no greater than atmospheric pressure at a temperature for forming metal hydrides in the particles, and thereafter removing hydrogen from the particles and cooling the particles to provide said magnetically anisotropic powder, the time and temperature of hydrogen treatment and removal being such that the average grain size of the 2-14-1 phase is no greater than 500 nanometers.
Filed: Feb 4,	5,300,156	Assignee:	Bonded rare earth magnet and a process for manufacturing the same

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1993 Issued: April 5, 1994 Expired: Feb 2013		Kanegafuchi Kagaku Kogyo Kabushiki Kaisha (Osaka, JAPAN)	Abstract A highly rustproof resin-bonded magnet made by using a specific rustproofing resin for coating the particles of a magnetic powder, bonding them to form a molded body, or coating its surface, or for two or all of those purposes. The specific resin is selected from ones containing groups of atoms having a power of forming a coordinate bond and a reducing action. More specifically, it is (a) a high molecular compound produced by reacting with an epoxy resin one or more of a polyhydric phenol having adjacent hydroxyls, a polyhydric phenolic carboxylic acid having adjacent hydroxyls, an ester of a polyhydric phenol and a polyhydric alcohol having adjacent hydroxyls, and a polycyclic and polyhydric phenol having adjacent hydroxyls, (b) a redox resin as a reduction agent, or (c) a high molecular compound produced by curing a mixture of ascorbic acid, or a derivative thereof, and an epoxy resin. What is claimed is: 1. A process for manufacturing ***[process/method]*** a bonded rare earth magnet comprising coating the particles of a powder of a magnetic material containing at least 50 atom % of iron with a compound produced by reacting with an epoxy resin one or more of a polyhydric phenol having adjacent hydroxyls, a polyhydric phenolic carboxylic acid having adjacent hydroxyls, an ester of a polyhydric phenol and a polyhydric alcohol having adjacent hydroxyls, and a polycyclic and polyhydric phenol having adjacent hydroxyls, or coating said particles with a mixture of said compound and another resin, or coating said particles with said compound and then with another resin to form a double resin coating on the surfaces of said particles; and molding said coated powder by using another synthetic resin as a binder.
Filed: November 6, 1991	5,283,130	Assignee: General Motors	Thermomagnetically patterned magnets and method of making same Abstract

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Issued: February 1, 1994 Expired: Nov 2011		Corporation (Detroit, MI USA)	A permanent magnet is heated in a pattern by a laser beam to a localized temperature above the Curie point or a temperature sufficient to reduce the magnet coercivity sufficiently for the field of the magnet or an external field to remagnetize the pattern in the reverse direction. Magnets so produced can have very high pole density, digital encoding and analog patterns having gradually varying local field strength. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A patterned magnet comprising a magnetized substrate of a permanent magnet material at least one millimeter in thickness and a magnetized pattern extending to a controlled depth from the substrate surface, the patterned region within said substrate having a lower flux density than the original substrate material as detectable by a magnetic sensor; and made by the process of ***[process/method]*** : directing energy onto the magnetized substrate surface in a pattern to heat a volume of the material to lower the coercivity to the controlled depth; imposing a magnetic field on the heated pattern wherein the field imposed on the heated pattern emanates at least partially from the magnetized base material, whereby the treated pattern generates a lower flux density than the base material; and cooling the treated pattern in the imposed field.
Filed: February 27, 1992	5,269,855	Assignee: Dowa Mining Co., Ltd.	Permanent magnet alloy having improved resistance Abstract A permanent magnet made of an R--Fe--B--C or R--Fe--Co--B--C based alloy,

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Issued: December 14, 1993 Expired: Feb 2012		(Tokyo, JAPAN)	where R is at least one rare-earth element, comprising individual magnetic crystal grains that are covered with an oxidation-resistant protective film. The protective film surrounding the individual magnetic crystal grains having a thickness of 0.001-30 .mu.m and 0.05-16 wt. % of the protective film comprising C. What is claimed is: 1. A permanent magnet ***[composition of matter]*** R--Fe--B--C alloy, R being at least one of the rare-earth elements including Y, comprising individual magnetic crystal grains having a particle size of 0.3 to 150 .mu.m and which are covered with an oxidation-resistant protective film having a thickness of 0.001-30 .mu.m, with 0.05-16 wt. % of said protective film comprising C, wherein the R content is higher in said protective film than in said crystal grains. 22. A permanent magnet R--Fe--Co--B--C alloy, R being at least one of the rare-earth elements including Y, comprising ***[composition of matter]*** individual magnetic crystal grains having a particle size of 0.3 to 150 .mu.m and which are covered with an oxidation-resistant protective film having thickness of 0.001-30 .mu.m, with 0.05-16 wt. % of said protective film comprising C and up to 30 wt. %, not inclusive of zero wt. %, of said protective film comprising Co, wherein the R content is higher in said protective film than in said crystal grains.
Filed: September 19, 1991 Issued: October 5,	5,250,206	Assignee: Mitsubishi Materials Corporation (Tokyo, JAPAN)	Rare earth element-Fe-B or rare earth element-Fe-Co-B permanent magnet powder excellent in magnetic anisotropy and corrosion resistivity and bonded magnet manufactured therefrom Abstract A R-Fe-B or R-Fe-Co-B permanent magnet powder excellent in magnetic

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1993 Expired: Sept 2011			anisotropy and corrosion resistivity, having powder particles. The powder particles each consist essentially of, in atomic percentage: R: 10-20% B: 3-20%; at least one element selected from the group consisting of Ti, V, Nb, Ta, Al, and Si: 0.001-5.0%; and Fe and inevitable impurities: the balance, The R-Fe-Co-B magnet powder further contains 0.1-50% Co. The powder particles each have an aggregated recrystallized structure having a main phase thereof formed by a R.sub.2 Fe.sub.14 B or R.sub.2 (Co,Fe).sub.14 B type intermetallic compound phase having a tetragonal structure. The intermetallic compound phase is formed of recrystallized grains aggregated therein and includes at least 50 volumetric % of recrystallized grains having a ratio b/a smaller than 2 provided that a is designated by the smallest diameter of each of the recrystallized grains, and b is by the largest diameter thereof. The recrystallized grains form the aggregated recrystallized structure having an average grain size within a range of 0.05-20 .mu.m. What is claimed is: 1. A rare earth element-Fe-B permanent magnet power excellent in magnetic anisotropy and corrosion resistivity, consisting essentially of powder particles, wherein said powder particles each consist essentially of ***[composition of matter]*** in atomic percentage: at least one element selected from the group consisting of yttrium and rare earth elements: 10-20%; B: 3-20%; at least one element selected from the group consisting of Ti, V, Nb, Ta, Al and Si: 0.001-5.0%; and Fe and inevitable impurities: the balance,

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			said powder particles each having an aggregated recrystallized structure having a main phase thereof formed of a R.sub.2 Fe.sub.14 B intermetallic compound phase having a tetragonal structure, wherein R is a rare earth element, said intermetallic compound phase being formed of recrystallized grains aggregated therein and including at least 50 volumetric % of recrystallized grains having a ratio of b/a smaller than 2, provided that a is the smallest diameter of each of said recrystallized grains, and b is the largest diameter thereof, said recrystallized grains forming said aggregated recrystallized structure having an average grain size of 0.05-20 .mu.m.
Filed: August 22, 1991 Issued: August 31, 1993 Expired: Aug 2011	5,240,627	Assignee: Kanegafuchi Kagaku Kogyo Kabushiki Kaisha (Osaka, JAPAN)	Bonded rare earth magnet and a process for manufacturing the same Abstract A highly rustproof resin-bonded magnet made by using a specific rustproofing resin for coating the particles of a magnetic powder, bonding them to form a molded body, or coating its surface, or for two or all of those purposes. The specific resin is selected from ones containing groups of atoms having a power of forming a coordinate bond and a reducing action. More specifically, it is (a) a high molecular compound produced by reacting with an epoxy resin one or more of a polyhydric phenol having adjacent hydroxyls, a polyhydric phenolic carboxylic acid having adjacent hydroxyls, an ester of a polyhydric phenol and a polyhydric alcohol having adjacent hydroxyls, and a polycyclic and polyhydric phenol having adjacent hydroxyls, (b) a redox resin as a reduction agent or (c) a high molecular compound produced by curing a mixture of ascorbic acid, or a derivative thereof, and an epoxy resin. What is claimed is: 1. A bonded rare earth magnet composed ***[composition of matter]*** mainly of a powder of a magnetic material containing at least 50 atom % of a iron, and a

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			high molecular compound produced by ***[process/method]*** reacting with an epoxy resin one or more of a polyhydric phenol having adjacent hydroxyls, a polyhydric phenolic carboxylic acid having adjacent hydroxyls, an ester of a polyhydric phenol and a polyhydric alcohol having adjacent hydroxyls, and a polycyclic and polyhydric phenol having adjacent hydroxyls, or composed mainly of said powder, said compound and a resin. 2. A magnet as set forth in claim 1, wherein said powder is of Nd.sub.2 Fe.sub.14 B, an alloy of SmFe.sub.12 or an alloy of Fe.sub.16 N.sub.2. 3. A bonded rare earth magnet made by molding a powder of a magnetic material containing at least 50 atoms % of iron with a binder of a redox resin as a reduction agent.
Filed: Jun e 4, 1991 Issued: July 27, 1993 Expired: July 2011	5,230,751	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Permanent magnet with good thermal stability Abstract A permanent magnet having good thermal stability, consisting essentially of the composition represented by the general formula: wherein R is Nd alone or one or more rare earth elements mainly composed of Nd, Pr or Ce, 0.ltoreq..times..ltoreq.0.7, 0.02.ltoreq.y.ltoreq.0.3, 0.001.ltoreq.z.ltoreq.0.15 and 4.0.ltoreq.A.ltoreq.7.5. This permanent magnet may contain one or more additional elements selected from Nb, W, V, Ta and Mo. This permanent magnet has high coercive force and Curie temperature and thus highly improved thermal stability. What is claimed is: 1. A sintered permanent magnet having good thermal stability, consisting essentially of the composition ***[composition of matter]*** represented by the general formula:

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			R(Fe.sub.1-x-y-z Co.sub.x B.sub.y Ga.sub.z).sub.A wherein R is Nd, part of which may be substituted by one or more elements elected from the group consisting of Pr and Ce, 0≦x≦0.7, 0.02.ltoreq.y.ltoreq□3, 0.001.ltoreq.z.ltoreq□15 and 4□ltoreq.A.ltoreq.7.5. 2. The sintered permanent magent having good thermal stability according to claim 1, wherein 0.01.ltoreq.x.ltoreq□4, 0.03.ltoreq.y.ltoreq□2, 0.002.ltoreq.z.ltoreq□1 and 4.5.ltoreq.A.ltoreq.7.0.
Filed: July 31, 1990 Issued: July 20, 1993 Expired: July 2010	5,228,930	Assignee: Mitsubishi Materials Corporation (Tokyo, JAPAN)	Rare earth permanent magnet power, method for producing same and bonded magnet Abstract There is disclosed a R-Fe-B or R-Fe-Co-B alloy permanent magnet powder which may contain Ga, Zr or Hf, or may further contain Al, Si or V. Each individual particle of the powder includes a structure of recrystallized grains containing a R.sub.2 Fe.sub.14 B or R.sub.2 (Fe,Co).sub.14 B intermetallic compound phase. The intermetallic compound phase has recrystallized grains of a tetragonal crystal structure having an average crystal grain size of 0.05 to 20 .mu.m. At least 50% by volume of the recrystallized grains of the aggregated structure are formed so that a ratio of the greatest dimension to the smallest dimension is less than 2 for each recrystallized grain. In order to manufacture the magnet powder, regenerative material and alloy material are prepared and their temperature is elevated in a hydrogen atmosphere. Then, the alloy material and the regenerative material are held in the same atmosphere at a temperature of 750.degree. C. to 950.degree. C., and then held in a vacuum at 750.degree. C. to 950.degree. C., and cooled and crushed. A bonded magnet produced using the above magnet powder is also disclosed. What is claimed is:

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			1. A rare earth permanent magnet powder which exhibits superior magnetic anisotropy and high resistance to corrosion comprising particles each containing***[composition of matter]*** : a) 10 to 20 atomic percent of R; b) 3 to 20 atomic percent of B; c) 0.001 to 5.0 atomic percent of at least one element selected from the group consisting of Ga, Zr and Hf; d) and the balance Fe and unavoidable impurities, wherein R represents a rare earth element, said individual particle comprises an aggregated structure of recrystallized grains which consist essentially of an R.sub.2 Fe.sub.14 B intermetallic compound phase of a tetragonal crystal structure as a principal phase and have an average alloy crystal grain size of 0.05 to 20 .mu.m, wherein at least 50% by volume of said recrystallized grains are formed so that a ratio of the greatest dimension to the smallest dimension is less than 2 for each recrystallized grain. 8. A bonded magnet produced by the steps of ***[process/method]***: a) preparing an R-Fe-B permanent magnet powder which comprises particles each containing 10 to 20 atomic percent of R, 3 to 20 atomic percent of B, 0.001 to 5.0 atomic percent of at least one element selected from the group consisting of Ga, Zr and Hf, and the balance Fe and unavoidable impurities, wherein R represents a rare each element, said individual particle comprises an aggregated structure of recrystallized grains which consist essentially of an R.sub.2 Fe.sub.14 B intermetallic compound phase of a tetragonal crystal structure as a principal phase and have an average alloy crystal grain size of

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			0.05 to 20 .mu.m, wherein at least 50% by volume of said recrystallized grains are formed so that a ratio of the greatest dimension to the smallest dimension is less than 2 for each recrystallized grain; b) blending said magnetic powder with a resin; and c) pressing the blended powder of step b to provide the bonded magnet.
Filed: June 4, 1991 Issued: June 29, 1993 Expired: June 2011	5,223,047	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Permanent magnet with good thermal stability Abstract A permanent magnet having good thermal stability, consisting essentially of the composition represented by the general formula: wherein R is Nd alone or one or more rare earth elements mainly composed of Nd, Pr or Ce, 0.ltoreq.x.ltoreq.0.7, 0.02.ltoreq.y.ltoreq.0.3, 0.001.ltoreq.z.ltoreq.0.15 and 4.0.ltoreq.A.ltoreq.7.5. This permanent magnet may contain one or more additional elements selected from Nb, W, V, Ta and Mo. This permanent magnet has high coercive force and Curie temperature and thus highly improved thermal stability. What is claimed is: 1. In sintered magnets having a composition of ***[composition of matter]:*** (R.sub.1-a R*.sub.a)(Fe.sub.1-x-y-u Co.sub.x B.sub.y M.sub.u).sub.A where R and R* are light and heavy rare earth elements, respectively, the improvement comprising selecting M to be Nb, R to be Nd or a mixture of Nd and Pr, R* to be Dy, ≦ a≦0.25, 0≦x≦0.4,

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			0.02.ltoreq.y.ltoreq□3, 0.001.ltoreq.u.ltoreq□1, and 4□ltoreq.A.ltoreq.7.5, the improvement further comprising the substitution of 0.001 to 0.15 of Fe with Ga for increasing the intrinsic coercivity and decreasing the irreversible loss of flux at elevated temperature, and wherein the intrinsic coercivity of the improved magnet is equal to or greater than 16.0 kOe.
Filed: May 8, 1992 Issued: June 8, 1993 Expired: May 2012	5,217,543	Assignee: Seiko Instruments Inc (JAPAN)	Rare earth-iron magnet Abstract A rare earth-iron magnet consisting of, by atomic percent, 10 to 16% Nd, 5 to 10% B, 0.1 to 1% V, 0.1 to 1% oxygen and the balance being Fe. What is claimed is: 1. A rare earth-iron magnet consisting of ***[composition of matter]*** , by atomic percent, 10 to 16% Nd, 5 to 10% B, 0.1 to 1% V, 0.1 to 1% Cr, 0.1 to 1% oxygen and the balance being Fe. 2. A rare earth-iron magnet as claimed in claim 1; wherein the magnet is produced by ***[process/method]*** sintering molded metal powder. 3. A rare earth-iron magnet as claimed in claim 2; wherein the molded metal powder is an anisotropic permanent magnet.
Filed: September 30, 1991 Issued:	5,213,631	Assignee: Seiko Epson Corporation	Rare earth-iron system permanent magnet and process for producing the same Abstract A rare earth-iron permanent magnet which is formed from an ingot of an alloy composed of at least one rare earth element represented by R, Fe, B and Cu, by

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May 25, 1993 Expired: Sept 2011		(Tokyo, JAPAN)	the hot working at 500.degree. C. or above which refines the crystal grains and make them magnetically anisotropic. A process for producing a rare earth-iron permanent magnet by subjecting the ingot of said alloy to hot working at 500.degree. C. or above. The permanent magnet is equal or superior in magnetic performance to conventional permanent magnets produced by sintering method. The process is simple and able to provides permanent magnets of low price and high performance. In addition, an isotropic rare earth-iron permanent magnet is obtained if said ingot undergoes heat treatment at 250.degree. C. or above. We claim: 1. A rare earth-iron permanent magnet, comprising ***[composition of matter]*** a cast ingot of an alloy consisting essentially of at least one rare earth element represented by R, and Fe, B, and Cu which has been subjected to hot working at 500.degree. C. or above which finely refines the crystal grains and makes them magnetically anisotropic. 2. A rare earth-iron permanent magnet as claimed in claim 1, which has been subjected to heat treatment ***[process/method]*** at 250.degree. C. or above before and/or after the hot working.
Filed: April 30, 1992 Issued: March 16, 1993 Expired:	5,194,098	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Magnetic materials Abstract Magnetic materials comprising Fe, B and R (rare earth elements) having a major phase of an Fe-B-R intermetallic compound which may be a tetragonal system, wherein at least 50 at % of R consists of Nd and/or Pr, and anisotropic sintered permanent magnets consisting essentially of 8-30 at % R, 2028 at %, B and the balance being Fe with impurities. These magnetic materials and permanent magnets may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta,

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April 2012			Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf), thus providing Fe-B-R-M type materials and magnets. We claim: 1. A crystalline precursor material f ***[composition of matter]*** or making permanent magnets comprising a major phase of an Fe-B-R compound wherein R is at least one selected from the group consisting of Nd, Pr, La, Ce, Tb, Dy, Ho, Er, Eu, Sm, Gd, Pm, Tm, Yb, Lu and Y, said Fe-B-R compound being stable at room temperature or above, having a Curie temperature higher than room temperature and having magnetic anisotropy, wherein crystal grains of said Fe-B-R compound are isolated by a nonmagnetic boundary phase, the precursor material consisting essentially of, by atomic percent of the entire precursor material, 8-30 percent R, 2-28 percent B and the balance being Fe, provided that at least 42 percent of the entire precursor material is Fe.
Filed: January 7, 1991 Issued: March 2, 1993 Expired: Jan 2011	5,190,684	Assignee: Matsushita Electric Industrial Co., Ltd (Osaka, JAPAN)	Rare earth containing resin-bonded magnet and its production Abstract A resin bonded magnet which comprises a resinous binder and melt quenched magnetically isotropic ferromagnetic alloy particles having a coercive force of 8 to 12 KOe of the formula: Fe.sub.100-x-y-z Co.sub.x R.sub.y B.sub.z wherein R is at least one of Nd and Pr, x is an atomic % of not less than 15 and not more than 30, y is an atomic % of not less 10 and not more than 13 and z is an atomic % of not less than 5 and not more than 8; the ferromagnetic alloy particles uniformly dispersed in the binder. What is claimed is: 1. A resin-bonded magnet for use in a permanent motor which comprises ***[composition of matter]*** a resinous binder and melt quenched magnetically

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			isotropic ferromagnetic alloy particles having a coercive force of 8 to 12 kOe of the formula: Fe.sub.100-x-y-z Co.sub.x R.sub.y B.sub.z wherein R is at least one of Nd and Pr, x is an atomic % of not less than 15 and not more than 30, y is an atomic % of not less than 10 and not more than 13 and z is an atomic % of not less than 5 and not more than 8; said ferromagnetic alloy particles uniformly dispersed in said binder. 4. A process ***[process/method]*** for producing the magnet according to claim 1, which comprises shaping a granular complex material comprising a heat-polymerizable resin as a resinous binder and ferromagnetic alloy particles having a coercive force of 8 to 12 KOe of the formula: Fe.sub.100-x-y-z Co.sub.x R.sub.y B.sub.z wherein R is at least one of Nd and Pr, x is an atomic % of not less than 15 and not more than 30, y is an atomic % of not less than 10 and not more than 13 and z is an atomic % of not less than 5 and not more than 8, said ferromagnetic alloy particles being uniformly dispersed in said binder to make a green body and heating the green body at a temperature to polymerize the heat-polymerizable resin.
Filed: June 4, 1991 Issued: February 2, 1993 Expired: June 2011	5,183,630	Assignee: Dowa Mining Co., Ltd. (Tokyo, JAPAN)	Process for production of permanent magnet alloy having improved resistence to oxidation Abstract A process for producing a permanent magnet alloy based on a R--Fe--B--C system wherein R is at least one of the rare earth elements including Y, comprising the steps of preparing a molten crude alloy, producing a powder directly therefrom or after casting it into an alloy ingot and then grinding it into the powder, compacting the thus obtained powder and sintering the compacted product, the ingot or powder of the alloy before being sent to the compacting step being subjected to a heat treatment which is carried out at a temperature of

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			500.degree.-1,100.degree. C. for a period of 0.5 hour or more so as to produce a permanent magnet alloy based on an a R--Fe--B--C system whose individual magnetic crystal grains are covered with an oxidation-resistant protective film which has a C content higher than that of the individual crystal grains. What is claimed is: 1. In a process for producing ***[process/method]*** a permanent magnet alloy based on a R--Fe--B--C system where R is at least one of the rare earth elements including Y, comprising the steps of preparing a molten crude alloy, producing a powder directly therefrom or by casting it into an alloy ingot and then grinding it into the powder, compacting the thus obtained powder and sintering the compacted product, the improvement comprising the ingot or powder of the alloy before being sent to the compacting step being subjected to a heat treatment which is carried out at a temperature of 500.degree.-1,100.degree. C. for a period of up to 24 hours so as to produce a permanent magnet alloy based on a R--Fe--B--C system whose individual magnetic crystal grains are covered with an oxidation-resistant protective film which has a C content of 0.05-16 wt % and higher than that of said individual crystal grains and wherein the composition of said magnet alloy as the sum of the magnetic crystal grains and the oxidation-resistant protective film comprises 10-30% R, less than 2%, not inclusive of zero percent, of B, 0.1-20% C, all percentages being on an atomic basis, with the balance being Fe and incidental impurities. 40. In a process ***[process/method]*** for producing a permanent magnet alloy based on a R--Fe--Co--B--C system where R is at least one of the rare earth elements including Y, comprising the steps of preparing a molten crude alloy, producing a powder directly therefrom or by casting it into an alloy ingot and then grinding it into the powder, compacting the thus obtained powder and sintering the compacted product, the improvement comprising part or all of a C

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			source material and/or a Co source material being added to a raw material mixture in a step which is after said step of preparing a molten crude alloy, but before said step of compacting the powder, and in that the alloy ingot or powder obtained in the step before said compacting step being subjected to a heat treatment which is carried out at a temperature of 500.degree.-1,100.degree. C. for a period of 0.5 hour or more so as to produce a permanent magnet alloy based on a R--Fe--Co--B--C system whose individual magnetic crystal grains are covered with an oxidation-resistant protective film which has a C content of 0.05 to 16 wt % and higher than that of said individual crystal grains and wherein the composition of said magnet alloy comprises 10-30% R, less than 4%, not inclusive of 0 atom %, of B, 0.1-20% C, up to 40%, not inclusive of 0 atom %, of Co, all percentages being on an atomic basis, with the balance being Fe and incidental impurities.
Filed: April 30, 1992 Issued: February 2, 1993 Expired: April 2012	5,183,516	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Magnetic materials and permanent magnets Abstract Magnetic materials comprising Fe, B and R (rare earth elements) having a major phase of an Fe-B-R intermetallic compound which may be a tetragonal system, wherein at least 50 at % of R consists of Nd and/or Pr, and anisotropic sintered permanent magnets consisting essentially of 8-30 at % R, 2-28 at %, B and the balance being Fe with impurities. These magnetic materials and permanent magnets may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf), thus providing Fe-B-R-M type materials and magnets. We claim: 1. A permanent magnet alloy ***[composition of matter]*** consisting essentially of, in atomic percent, 12-20% R, 4-24% B and the balance Fe, wherein R is selected from the group of at least one of mischmetal and didymium, wherein

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			the alloy has a major phase of an Fe-B-R compound of a substantially tetragonal crystal structure, said compound being stable at room temperature and above, having a Curie temperature higher than room temperature and having magnetic anisotropy, and in which crystal grains of said Fe-B-R compound are isolated by a nonmagnetic boundary phase. 5. A crystalline permanent magnet alloy comprising ***[composition of matter]*** a major phase of an Fe-B-R compound of a substantially tetragonal crystal structure wherein R is a combination of Nd and/or Pr and mischmetal and/or didymium, said Fe-B-R compound being stable at room temperature or above, having a Curie temperature higher than room temperature and having magnetic anisotropy, and the alloy consisting essentially of, by atomic percent of the entire alloy, 8-30 percent R, 2-28 percent B and the balance being Fe, provided that at least 42 percent of the entire alloy is Fe, and in which crystal grains of said Fe-B-R compound are isolated by a nonmagnetic boundary phase.
Filed: January 13, 1992 Issued: January 12, 1993 Expired: Jan 2012	5,178,692	Assignee: General Motors Corporation (Detroit, MI USA)	Anisotropic neodymium-iron-boron powder with high coercivity and method for forming same Abstract The magnetic coercivity of magnetically anisotropic powder containing the magnetic phase Nd.sub.2 Fe.sub.14 B, which already has appreciable magnetic coercivity, is enhanced by the method of this invention. The powder is produced by melt spinning an appropriate composition to form amorphous or extremely finely crystalline particles, hot working the particles to produce grains containing the Nd.sub.2 Fe.sub.14 B phase and having dimensions in the range of about 20 to about 500 nonometers, comminuting the worked body to a powder, and then appropriately heating the powder to a temperature of between about 550.degree. C. to about 675.degree. C. followed by a normal cooling in the protective atmosphere of the furnace. The heat-treated powder exhibits magnetic anisotropy and magnetic coercivity of at least about 5,000

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			Oersteds at room temperature. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method for forming ***[process/method]*** magnetically anisotropic particles of a composition that has as its magnetic constituent the tetragonal crystal phase RE.sub.2 TM.sub.14 B, wherein the particles have an intrinsic coercivity at room temperature of at least about 5,000 Oersteds, comprising the steps of: providing a hot-worked body comprising plastically deformed, platelet-shaped grains of said phase wherein said grains are aligned and have an average largest dimension no greater than about 500 nanometers, the composition of said body comprising, on an atomic percent basis, about 40 to 90 percent transition metal (TM) taken from the group consisting of iron and mixtures of iron and cobalt wherein iron makes up at least 40 percent of the total composition, about 10 to 40 percent rare earth metal (RE) wherein at least about 6 percent of the total composition is neodymium and/or praseodymium, and at least about 0.5 percent boron; and comminuting said body to form a powder, the individual particles of said powder each comprise a multitude of said aligned grains, said particles thereby being magnetically anisotropic and having a first intrinsic magnetic coercivity, wherein the improvement comprises the further step of: heating the individual particles of said powder at a temperature and for a duration sufficient to effect a second intrinsic magnetic coercivity within said particles which is greater than said first magnetic coercivity. ***[composition of matter]*** ***[process/method]***
Filed: August 13,	5,174,362	Assignee:	High-energy product rare earth-iron magnet alloys

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1985 Issued: December 29, 1992 Expired: Dec 2009		General Motors Corporation (Detroit, MI USA)	Abstract The hard magnetic properties, including intrinsic coercivity, remanence and energy product of rapidly quenched, rare earth-transition metal alloys has been substantially increased by the addition of suitable amounts of the element boron. The preferred rare earth constituent elements are neodymium and praseodymium, and the preferred transition metal element is iron. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method of making ***[process/method]*** a composition having permanent magnet properties at room temperature comprising preparing a melt of a composition comprising, on an atomic percentage basis of the total composition, at least about 0.5 percent boron, about 10 to 50 percent of one or more rare earth elements taken from the group consisting of neodymium and praseodymium, and one or more transition metal elements taken from the group consisting of iron and mixtures of iron and cobalt where iron constitutes at least about 50 percent of the total composition, such molten composition being susceptible to being rapidly cooled to solidification over a determinable and controllable range of cooling rates within which range a series of fine grained crystalline products are formed that respectively display (a) values of magnetic coercivity that continually increase toward a maximum value and decrease from such value as the cooling rate is increased, and (b) values of magnetic remanence that increase over at least a part of such range as the cooling rate is increased, and continually rapidly cooling portions of the melt by ejecting them onto a moving quench surface to form a fine grained crystalline product while controlling the cooling rate within said cooling range by a method comprising controlling the velocity of the quench surface such that the product has a

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			desired combination of magnetic coercivity and remanence. 2. A method of making ***[process/method]*** a composition having permanent magnet properties at room temperature in accordance with claim 1 where the melt is rapidly cooled by continually expressing a portion of the melt through an orifice onto a quench surface of a spinning wheel and the cooling rate is controlled by a method comprising controlling the velocity of the quench surface of the spinning wheel.
Filed: July 16, 1987 Issued: December 22, 1992 Expired: Dec 2012	5,172,751	Assignee: General Motors Corporation (Detroit, MI USA)	High energy product rare earth-iron magnet alloys Abstract Magnetically hard compositions having high values of coercivity, remanence and energy product contain rare earth elements, transition metal elements and boron in suitable proportions. The preferred rare earth elements are neodymium and praseodymium, and the preferred transition metal element is iron. The magnetic alloys have characteristic very finely crystalline microstructures. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows: 1. A method of making ***[process/method]*** a composition having permanent magnet properties at room temperature comprising preparing a melt of a composition comprising, on an atomic percentage basis of the total composition, 0.5 to 10 percent boron, 10 to 50 percent of one or more rare earth metals (RE) where neodymium or praseodymium or a mixture thereof constitutes at least 60 percent of the total rare earth element content, and 50 to 90 percent of one or more transition metals (TM) taken from the

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			group consisting of iron and mixtures of iron and cobalt where iron constitutes at least 60 percent of the total transition metal, such molten composition being susceptible to being rapidly cooled to solidification over a determinable and controllable range of cooling rates within which range a series of fine grained crystalline products are formed containing the phase RE.sub.2 TM.sub.14 B.sub.1 that respectively display (a) values of magnetic coercivity that continually increase toward a maximum value and decrease from such value as the cooling rate is increased, and (b) values of magnetic remanence that increase over at least a part of such range as the cooling rate is increased, and continually rapidly cooling portions of the melt by ejecting them onto a moving quench surface to form a fine grained crystalline product containing the phase RE.sub.2 TM.sub.14 B.sub.1 while controlling the cooling rate within said cooling range by a method comprising controlling the velocity of the quench surface such that the product has a desired combination of magnetic coercivity and remanence. 6. A method of making ***[process/method]*** a composition having permanent magnet properties at room temperature comprising preparing a melt of a composition comprising, on an atomic percentage basis of the total composition, 0.5 to 10 percent boron, 10 to 50 percent of one or more rare earth metals (RE) where neodymium or praseodymium or a mixture thereof constitutes at least 60 percent of the total rare earth element content, and 50 to 90 percent of one or more transition metals (TM) taken from the group consisting of iron and mixtures of iron and cobalt where iron constitutes at least 60 percent of the total transition metal, such molten composition being susceptible to being rapidly cooled to solidification over a determinable and controllable range of cooling rates within which range a series of fine grained crystalline products are formed containing the phase RE.sub.2 TM.sub.14 B.sub.1 that respectively display (a) values of magnetic coercivity that

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			continually increase toward a maximum value and decrease from such valve as the cooling rate is increased, and (b) values of magnetic remanence that increase over at least a part of such range as the cooling rate is increased, and continually rapidly cooling portions of the melt by ejecting them onto a moving quench surface to form a fine grained crystalline product containing the phase RE.sub.2 TM.sub.14 B.sub.1 while controlling the cooling rate within said cooling range by a method comprising controlling the velocity of the quench surface to form a product having a fine grained crystalline microstructure of average grain size less than about 50 nanometers, said product being suitable for annealing to increase its magnetic remanence and coercivity, and thereafter heating the product at a temperature to cause crystal growth for a period of no more than 30 minutes to form a product having an average grain size no greater than about 400 nanometers in largest dimension and thereafter rapidly cooling the product.
Filed: May 22, 1991 Issued: December 1, 1992 Expired: May 2011	5,167,914	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Rare earth magnet having excellent corrosion resistance Abstract An (Fe, Co)-B-R tetragonal type magnet having a high corrosion resistance, which has a boundary phase stabilized by Co and Al against corrosion, and which consists essentially of: 0.2-3.0 at % Dy and 12-17 at % of the sum of Nd and Dy; 5-10 at % B; 0.5-13 at % Co; 0.5-4 at % Al; and the balance being at least 65 at % Fe. 0.1-1.0 at % of Ti and/or Nb may be present. Alloy powders therefor can be also stabilized. What is claimed is: 1. A process for producing ***[process/method]*** an (Fe, Co)-B-R tetragonal type

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			magnet having high corrosion resistance wherein R is a rare earth metal and which has a boundary phase stabilized by Co and Al against corrosion, comprising: providing an ingot of an alloy consisting essentially of 12-14.5 at% Nd and 0.2-3.0 at % Dy, so that the sum of Nd and Dy is 12.5-15 at%; - 8at %B; 0.5-8 at % Co; 0.5-3 at % Al; and not exceeding 1000 ppm C; and the balance being at least 68 at % Fe, pulverizing said ingot to a powder by wet milling using an organic compound containing chlorine as solvent under the condition that the resultant powder does not contain Cl in an amount exceeding 15000 ppm, and sintering the powder under the conditions that the resultant sintered body does not include C in an amount exceeding 1000 ppm or Cl in an amount exceeding 1500 ppm in the sintered body to provide a boundary phase stabilized by Co and Al against corrosion. 2. The process as defined in claim 1, wherein the pulverizing and sintering are conducted under conditions that Cl in the sintered body does not exceed 1000 ppm.
Filed: May 21, 1991 Issued: November 17, 1992 Expired:	5,164,023	Assignee: Hitachi Metals Ltd (Tokyo, JAPAN)	Rare earth permanent magnet, method of heat treatment of same, and magnet body Abstract There is disclosed a rare earth permanent magnet composed of a sintered product consisting of R and M where R represents at least one rare earth, and M represents Co or a combination of Co and at least one kind selected from the group consisting of Fe, Ni and Cu, the sintered product being of such a composition that a RM.sub.5 phase and a R.sub.2 M.sub.7 phase occur in the

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May 2011			sintered product. The sintered product contains 63 to 65 wt. % of M, and the sintered product has a coercive force iHc of not less than 13,000 Oe. The permanent magnet can have a disk-shape, a ring-shape or a cylindrical shape. A method of heat treatment of the permanent magnet is also disclosed. What is claimed is: 1. A method of ***[process/method]*** heat-treating a rare earth permanent magnet composed of a sintered product consisting of R and M where R represents at least one rare earth element, and M represents Co or a combination of Co and at least one element selected from the group consisting of Fe, Ni and Cu, said sintered product containing 63 to 65 wt. % of M and consisting essentially of a RM.sub.5 phase and a R.sub.2 M.sub.7 phase, said method comprising the steps of: maintaining said sintered product at a temperature region T1 for not less than 10 minutes, and said temperature region T1 being not more than a sintering temperature, and the difference between said temperature region T1 and the sintering temperature being within 300.degree. C.; subsequently cooling said sintered product at a rate of 0.03.degree. to 3.degree. C./min. in a furnace; and subsequently maintaining said sintered product for not less than one hour at a low temperature region T2 which is lower than said temperature region T1, the difference between said low temperature region T2 and the sintering temperature being within 500.degree. C. so as to produce a heat-treated rare earth permanent magnet having a maximum energy product of at least 17.8 MGOe. 2. A method ***[process/method]*** according to claim 1, further including the step

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			of gradually cooling said sintered product from said low temperature region T2 to a temperature of not more than 400.degree. C. at a rate of 5.degree. to 50.degree. C./min.
Filed: August 9, 1990 Issued: September 15, 1992 Expired: Aug 2010	5,147,473	Assignee: Dowa Mining Co., Ltd. (Tokyo, JAPAN)	Permanent magnet alloy having improved resistance to oxidation and process for production thereof Abstract A permanent magnet made of an R-Fe-B-C or R-Fe-Co-B-C based alloy (where R is at least one rare-earth element) consisting of its individual magnetic crystal grains that are covered with an oxidation-resistant protective film is promising as a practicable next-generation magnet because of its having not only excellent magnetic properties inclusive of magnetic force that surpasses Sm-Co based magnets but also such highly improved oxidation resistance that may withstand use in practical applications for a prolonged time period without being coated on its outermost exposed surface with an oxidation-resistant protective film. Said protective film surrounding the individual magnetic crystal grains contains at least one, preferably substantially all, of the alloying elements of which said magnetic crystal grains are made, with 0.05-16 wt. %, preferably 0.1-16 wt. % of said protective film being composed of C. What is claimed is: 1. A permanent magnet alloy ***[composition of matter]*** which is based on a R-Fe-B-C system, R being at least one of the rare-earth elements including Y, comprising individual magnetic crystal grains having a particle size of 0.3-150 .mu.m and which are covered with an oxidation-resistant protective film, with 0.05-16 wt % of said protective film comprising C, and the composition of said magnet alloy as the sum of the magnetic crystal grains and the oxidation-resistant protective film comprising 10-30% R, less than 2%, not inclusive of zero percent, of B, 0.1-20% C, all percentages being on an atomic basis, with

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			the balance being Fe and incidental impurities. 2. The permanent magnet alloy according to claim 1 wherein said magnetic crystal grains have a particle size of 0.5-50 .mu.m. 3. The permanent magnet alloy according to claim 2, wherein the rare-earth element is Nd; said oxidation-resistant protective film has a thickness of 0.001-15 .mu.m. 28. In an improved permanent magnet ***[composition of matter]***made of a R-Fe-B-C system alloy, R being at least one of the rare-earth elements including Y, the improvement comprising said alloy comprising individual magnetic crystal grains having a particle size of 0.3-150 .mu.m and which are covered with an oxidation-resistant protective film, with 0.05-16 wt % of said protective film comprising C, the composition of said magnet alloy as the sum of the magnetic crystal grains and the oxidation-resistant protective film comprising 10-30% R, less than 2%, not inclusive of zero percent, of B, 0.1-20% C, all percentages being on an atomic basis, with the balance being Fe and incidental impurities.
Filed: July 26, 1988 Issued: March 17, 1992 Expired: March 2009	5,096,512	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Magnetic materials and permanent magnets Abstract Magnetic materials comprising Fe, B and R (rare earth elements) having a major phase of an Fe-B-R intermetallic compound which may be a tetragonal system, wherein at least 50 at % of R consists of Nd and/or Pr, and anisotropic sintered permanent magnets consisting essentially of 8-30 at % R, 2028 at %, B and the balance being Fe with impurities. These magnetic materials and permanent magnets may contain additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn,_Al, Sb, Ge, Sn, Zr, Hf), thus providing Fe-B-R-M type materials and magnets.

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			We claim: 1. A crystalline permanent magnet alloy ***[composition of matter]*** in which the major phase is an Fe-B-R compound wherein R is one or two of Nd and Pr, said compound being stable at room temperature or above, having a Curie temperature higher than room temperature and having magnetic anisotropy, the alloy consisting essentially of, by atomic percent of the entire alloy, 8-30 percent R, 2-28 percent B and the balance being at least 42 percent Fe. 2. A crystalline permanent magnet alloy ***[composition of matter]*** comprising a major phase of an Fe-B-R compoud wherein R is at least one of Nd, Pr, Dy, Ho, Tb, La, Ce, Gd and Y, and wherein at least 50 atomic percent of R consists of Nd and/or Pr, said compound being stable at room temperature or above, having a Curie temperature higher than room temperature and having magnetic anisotropy, the alloy consisting essentially of, by atomic percent of the entire alloy, 8-30 percent R, 2-28 percent B and the balance being at least 42 percent Fe.
Filed: September 28, 1990 Issued: February 18, 1992 Expired: Sept 2010	5,089,060	Assignee: General Motors Corporation (Detroit, MI USA)	Thermomagnetically patterned magnets and method of making same Abstract A permanent magnet is heated in a pattern by a laser beam to a localized temperature above the Curie point or a temperature sufficient to reduce the magnet coercivity sufficiently for the field of the magnet or an external field to remagnetize the pattern in the reverse direction. Magnets so produced can have very high pole density, digital encoding and analog patterns having gradually varying local field strength. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

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			1. A method of imparting a magnetic pattern ***[process/method]*** to a magnetized bulk permanent magnet material comprising the steps of: directing energy in a pattern onto base permanent magnet bulk material to heat a volume of the material to a threshold temperature to lower the coercivity thereof; imposing a magnetic field on the heated pattern greater than the coercivity of the heated volume, wherein the field imposed on the heated pattern emanates at least partially from the magnetized base material, whereby the treated pattern generates a lower flux density than the base material; and allowing the material to cool in the imposed field, whereby the treated pattern has a magnetic characteristic sufficiently different from the base material to be readily detected by a magnetic sensor. 2. The invention as defined in claim 1 wherein the magnetic field imposed on the pattern emanates solely from the magnetized base material. 3. The invention as defined in claim 1 wherein the step of imposing a magnetic field on the heated pattern includes the step of establishing an external magnetic field in opposition to the field of the base material so that the magnetic field imposed on the pattern emanates partially from the magnetized base material and partially from the external magnetic field.
Filed: January 26, 1990 Issued:	5,071,493	Assignee: Kabushiki Kaisha Toshiba	Rare earth-iron-boron-based permanent magnet Abstract There is disclosed a permanent magnet comprising a sintered alloy composed of rare earth elements (R), boron and iron. This permanent magnet is

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December 10, 1991 Expired: Jan 2010		(Kawasaki, JAPAN)	substantially constituted by 2-phase systems, i.e. a ferromagnetic Fe-rich phase (Nd.sub.2 Fe.sub.14 B) and a nonmagnetic R-rich phase (Nd.sub.97 Fe.sub.3), and has BH.sub.max of more than 38.0 MGOe. The rare earth-iron-boron-based permanent magnet of this invention is a substantially only 2-phase system, composed of a tetragonal ferromagnetic Fe-rich phase of intermetallic Nd.sub.2 Fe.sub.14 B compound and a cubic nonmagnetic R-rich phase having R value of over 90%, for example, Nd.sub.97 Fe.sub.3. Namely, the rare earth-iron-boron based permanent magnet of the present invention has a tetragonal system substantially free from a tetragonal R-rich phase (Nd.sub.2 Fe.sub.7 B.sub.6). This also applies to the case where the R component is formed of any other rare earth elements than Nd. What is claimed is: 1. A permanent magnet formed of a sintered alloy, comprising ***[composition of matter]***: (i) 10 to 40% by weight of at least one metal element selected from the group consisting of the rare earth elements (R) and yttrium, (ii) 0.8 to 1.1% by weight boron and (iii) the balance iron, wherein said sintered alloy consists essentially of a ferromagnetic Fe-rich phase as the main phase, 2.5 to 5.0% by volume of a R-rich phase and less than 1% by volume of a B-rich phase, said alloy having a maximum energy product (BH.sub.max) of at least 38.0 MGOe. 21. A permanent magnet having a maximum energy product (BH.sub.max) of at least 38.0 MGOe, comprising at least 96.5% by volume of a ferromagnetic Fe-rich phase as the main phase, at least 2.5% by volume of an R-rich phase and less than 1% by volume of a B-rich phase, manufactured by a process ***[process/method]*** comprising the steps of:

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			(i) preparing an alloy consisting essentially of about 10-40% by weight of R, about 0.8 to 1.1% by weight of boron with the balance being iron, wherein R is at least one element selected from the group consisting of yttrium and the rare earth elements; (ii) pulverizing the alloy into a powder; (iii) molding said powder in a magnetic field thereby obtaining a molded mass; and (iv) sintering the molded mass at a temperature of about 1000.degree.-1200.degree. C. in an atmosphere of 5.times.10.sup.-1 Torr or less to obtain said permanent magnet.
Filed: August 12, 1985 Issued: October 15, 1991 Expired: Oct 2008	5,056,585	Assignee: General Motors Corporation (Detroit, MI USA)	High energy product rare earth-iron magnet alloys Abstract Magnetically hard compositions having high values of coercivity, remanence and energy product contain rare earth elements, transition metal elements and boron in suitable proportions. The preferred rare earth elements are neodymium and praseodymium, and the preferred transition metal element is iron. The magnetic alloys have characteristic very finely crystalline microstructures. This invention relates to making improved magnetically hard rare earth-transition metal compositions by incorporating small amounts of the element boron and quenching molten mixtures of the constituents at a rate between that which yields an amorphous magnetically soft material or a magnetically soft crystalline material. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

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			1. A method of making a composition ***[process/method]*** having permanent magnet properties at room temperature comprising preparing a melt of a composition comprising, on an atomic percentage basis of the total composition, 0.5 to 10 percent boron, 10 to 50 percent of one or more rare earth elements where neodymium or praseodymium or a mixture thereof constitutes at least 60 percent of the total rare earth element content, and one or more transition metal elements taken from the group consisting of iron and mixtures of iron and cobalt where iron constitutes at least 60 percent of the total transition metal, such molten composition being susceptible to being rapidly cooled to solidification over a determinable and controllable range of cooling rates within which range a series of fine grained crystalline products are formed that respectively display (a) values of magnetic coercivity that continually increase toward a maximum value and decrease from such value as the cooling rate is increased, and (b) values of magnetic remanence that increase over at least a part of such range as the cooling rate is increased, and continually rapidly cooling portions of the melt by ejecting them onto a moving quench surface to form a fine grained crystalline product while controlling the cooling rate within said cooling range by a method comprising controlling the rate of movement of such surface such that the product has a desired combination of magnetic coercivity and remanence. 2. A method for making a composition ***[process/method]*** having permanent magnet properties at room temperature in accordance with claim 1 where the melt is rapidly cooled by continually expressing a portion of the melt through an orifice onto a quench surface of a spinning wheel and the cooling rate is controlled by a method comprising controlling the velocity of the quench surface of the spinning wheel to form a fine grained product having an average crystal size in the range of 20 to 400 nm.

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Filed: Jul y 29, 1988 Issued: September 17, 1991 Expired: Sept 2008	5,049,208	Assignee: TDK Corporation (Tokyo, JAPAN)	Permanent magnets Abstract A permanent magnet having high coercivity and energy product contains rare earth elements, boron, at least one element of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta and W, and a blance of Fe or Fe and Co, and consists of a primary phase of substantially tetragonal grain structure, or a mixture of such a primary phase and an amorphous or crystalline rare earth element-poor auxiliary phase wherein the volume ratio of auxiliary phase to primary phase is smaller than a specific value. What is claimed is: 1. A permanent magnet formed from a magnetically hard material having a composition ***[composition of matter]*** represented by the formula: R_x T.sub.(100-x-y-z) B_y M_z where R is at least one member selected from the rare earth elements including Y, T is Fe or a mixture of Fe and Co, B is boron, M is at least one member selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta and W, $5.5 \leqq x < 11.76$, $2 \leqq y < 15$, and $0 < z \leqq 10$, and wherein said permanent magnet is obtained by rapid quenching from a molten alloy having said composition and wherein said permanent magnet comprises a primary phase of substantially tetragonal grain structure and at least one auxiliary phase selected from amorphous and crystalline R-poor auxiliary phases, said auxiliary phase being present as a grain boundary layer, wherein the volume ratio of auxiliary phase to primary phase, v, is smaller than the

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			value given by the formula: [0.1176/(100-z)-x]/x. 17. A permanent magnet formed from a magnetically hard material having a composition ***[composition of matter]*** represented by the formula: R_x T.sub.(100-x-y-z) B_y M_z where R is at least one member selected from the rare earth elements including Y, T is Fe or a mixture of Fe and Co, B is boron, M is a mixture of at least one member selected from the group consisting of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta and W, and at least one member selected from the group consisting of Cu, Ni, Mn and Ag, $5.5 \leqq x < 11.76$, $2 \leqq y < 15$, and $0 < z \leqq 10$, and wherein said permanent magnet is obtained by rapid quenching from a molten alloy having said composition and wherein said permanent magnet consists of a primary phase of substantially tetragonal grain structure and at least one auxiliary phase selected from amorphous and crystalline R-poor auxiliary phases, said auxiliary phase being present as a grain boundary layer, wherein the volume ratio of auxiliary phase to primary phase, v, is smaller than the value given by the formula: ps [0.1176/(100-z)-x]/x
Filed: June 21, 1990 Issued: August 20, 1991	5,041,172	Assignee: Hitachi Metals, Ltd. (Tokyo, JAPAN)	Permanent magnet having good thermal stability and method for manufacturing same Abstract A thermally stable permanent magnet with reduced irreversible loss of flux and improved intrinsic coercivity iHc of 15 KOe or more having the following compositon: wherein M represents at least one element selected from the group

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Expired: June 2010			consisting of Nb, Mo, Al, Si, P, Zr, Cu, V, W, Ti, Ni, Cr, Hf, Mn, Bi, Sn, Sb and Ge, 0.01.ltoreq.x .ltoreq.0.4, 0.04.ltoreq.y.ltoreq.0.20, 0.ltoreq.z.ltoreq.0.03, 4.ltoreq.a.ltoreq.7.5 and 0.03.ltoreq..alpha..ltoreq.0.40. This can be manufactured by (a) sintering an alloy having the above composition by a powder metallurgy method, (b) heating the sintered body at 750.degree.-1000.degree. C. for 0.2-5 hours, (c) slowing cooling it at a cooling rate of 0.3.degree.-5.degree. C./min to temperatures between room temperature and 600.degree. C., (d) heating it at 540.degree.-640.degree. C. for 0.2-3 hours, and (e) rapidly cooling it at a cooling rate of 20.degree.-400.degree. C./min. What is claimed is: 1. A thermally stable permanent magnet with reduced irreversible loss of flux and improved intrinsic coercivity iHc of about 20.5 KOe or more having the following ***[composition of matter]*** composition: $(Nd_{1-\alpha}$ Dy.sub.α$)(Fe_{1-x-y-z}$ Co_x B_y $M_z)_a$ wherein M represents at least one element selected from the group consisting of Nb, Mo, Al, Si, P, Zr, Cu, V, W, Ti, Ni, Cr, Hf, Mn, Bi, Sn, Sb and Ge, 0.01≦x≦0.4, 0.04≦y≦0.20, 0≦z≦0.03, 4≦a≦7.5, and 0.03≦α≦0.40 wherein the irreversible loss of flux is 10% or less at 200° C. and Pc=2. 2. A thermally stable permanent magnet with reduced irreversible loss of flux of less than 3.0% at 200° C. and Pc=2 and improved intrinsic coercivity of 23 KOe or more having the following ***[composition of matter]*** composition: $(Nd_{1-\alpha}$ Dy.sub.α$)(Fe_{1-x-y-z}$ Co_x B_y $M_z)_a$ wherein M represents at least one element selected from the group consisting of Nb, Mo, P and V, and wherein 0.01≦x≦0.4, 0.04≦y≦0.20, 0≦z≦0.03, 4≦a≦7.5, and 0.03≦α≦0.40.
Filed: Jun	5,041,171	Assignee:	Hard magnetic material

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e 23, 1987 Issued: August 20, 1991 Expired: Aug 2008		U.S. Philips Corporation (New York, NY USA)	Abstract The invention relates to new hard magnetic materials which have an intermetallic compound of tetragonal crystal structure of the ThMn.sub.12 type. The intermetallic compound has the gross formula ZA(Me.sup.I.sub.1-x Me.sup.II.sub.x).sub.12, wherein ZA is a rare earth metal from the group Sm, Er, Tm. Me.sup.I is Fe, Co or a mixture of the two, Me.sup.II is Ti, V, Cr or Si and x=0.1-0.2, preferably 0.12-0.17. What is claimed is: 1. A boron-free hard magnetic material comprising an intermetallic compound ***[composition of matter]*** of the formula RE(Me^{I}_{1-x} Me^{II}_{x})12, which compound has a $ThMn_{12}$ tetragonal structure, wherein RE is at least one rare earth metal selected from the group consisting of Sm, Er and Tm, and up to 50 atomic percent of any of the other rare earth metals including La and Y, Me^{I} is at least one metal selected from the group consisting of Fe and Co, Me^{II} is an element selected from the group consisting of Ti, V, Cr, Si, W and Mo and x is between 0.1 and 0.35.
Filed: May 2, 1989 Issued: June 11, 1991 Expired: June 2008	5,022,939	Assignee: TDK Corporation (Tokyo, JAPAN)	Permanent magnets Abstract A permanent magnet material having high coercivity and energy product is provided which contains rare earth elements, boron, at least one element of Ti, V, Cr, Zr, Nb, Mo, Hf, Ta and W, optional nickel, and a balance of Fe or Fe and Co, and consists of a primary phase of substantially tetragonal grain structure, or a mixture of such a primary phase and an amorphous or crystalline rare earth element-poor auxiliary phase wherein the volume ratio of auxiliary phase to primary phase has a specific relationship to other parameters. What is claimed is: 1. A permanent magnet material which is prepared by ***[process/method]*** rapid

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			quenching from a molten alloy having a composition represented by the formula ***[composition of matter]*** : R_x T.sub.(100-x-y-z-w) B_y M_z Ni_w wherein R is at least one member selected from the rare earth elements including Y, T is Fe or a mixture of Fe and Co, M is at least one member selected from the group consisting of T, V, Cr, Zr, Nb, Hf, Ta and W, letters x,y,z, and w represent atom percents of the corresponding elements and have positive values with the proviso that w can be equal to zero, $5.5 \leqq x < 11.76$, $2 \leqq y < 15$, $0 < z \leqq 15$, and $0 < z+w \leqq 30$, and consisting essentially of a primary phase of substantially tetragonal grain structure and at least one auxiliary phase selected from amorphous and crystalline R-poor auxiliary phases, said auxiliary phase being present as a grain boundary layer, the atomic ratio of the R content of the auxiliary phase to that of the primary phase being up to 9/10.
Filed: May 19, 1987 Issued: December 4, 1990 Expired: Dec 2007	4,975,130	Assignee: Sumitomo Special Metals Co., Ltd. (Osaka, JAPAN)	Permanent magnet materials Abstract Permanent magnet materials of the Fe--B--R type are produced by: preparing a metallic powder having a mean particle size of 0.3-80 microns and a composition of 8-30 at % R, 2-28 at % B, and the balance Fe, compacting, and sintering, at a temperature of 900-1200 degrees C. Co up to 50 at % may be present. Additional elements M (Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr, Hf) may be present. The process is applicable for anisotropic and isotropic magnet materials.

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			We claim: 1. A sintered permanent magnetic material, said sintered permanent magnetic material having been prepared from ***[composition of matter]*** a compacted metallic powder having a particle size of 0.3-80 microns and a composition consisting essentially of by atomic percent, 12.5-20% R wherein R is at least one rare earth element including Y and at least 50% of R consists of Nd and/or Pr, 4-20% B, and the balance being at least 60% Fe wherein Co is substituted for Fe in an amount of more than zero and no more than 35 atomic % of the entire material provided that Fe is present in the amount of at least 40% and wherein the sintered permanent magnetic material has a maximum energy product of at least 20 MGOe and has a density which is at least 95% of the theoretical density of the material. 2. A sintered permanent magnetic material, said sintered permanent magnetic material having been prepared from a compacted metallic powder having a particle size of 0.3-8 microns and a composition ***[composition of matter]*** consisting essentially of by atomic percent, 12.5-20% R wherein R is at least one rare earth element including Y and at least 50% of R consists of Nd and/or Pr, 4-20% B, at least one of additional elements M in amount(s) not exceeding the values by atomic percent as specified hereinbelow provided that, when two or more elements M are added, the total amount thereof shall not exceed the largest value among said specified values of the elements actually added: ______________________________________3.0% Ti, 6.5% Ni, 5.0% Bi,5.3% V, 9.0% Nb, 7.0% Ta,4.7% Cr, 5.2% Mo, 5.0% W,6.0% Mn, 5.2% Al, 1.0% Sb,3.5% Ge, 1.5% Sn, 3.2% Zr, and3.2% Hf,______________________________________ and the balance being at least 60% Fe wherein Co is substituted for Fe in an amount of more than zero and no more than 35 atomic % of the entire material provided that Fe is present in an amount of at least 40% and wherein the sintered permanent magnetic material has a maximum energy product of at least 20 MGOe and has a density which is at least 95% of the theoretical

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			density of the material.
Filed: No v 22, 1988 Issued: November 6, 1990 Expired: Nov 2007	4,968,347	Assignee: The United States of America (Washington, DC USA) under, Contract No. DE-AC03-76SF00098 between the United States Department of Energy and the University of California	High energy product permanent magnet having improved intrinsic coercivity and method of making same Abstract A high energy rare earth-ferromagnetic metal permanent magnet is disclosed which is characterized by improved intrinsic coercivity and is made by forming a particulate mixture of a permanent magnet alloy comprising one or more rare earth elements and one or more ferromagnetic metals and forming a second particulate mixture of a sintering alloy consisting essentially of 92-98 wt. % of one or more rare earth elements selected from the class consisting of Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and mixtures of two or more of such rare earth elements, and 2-8 wt. % of one or more alloying metals selected from the class consisting of Al, Nb, Zr, V, Ta, Mo, and mixtures of two or more of such metals. The permanent magnet alloy particles and sintering aid alloy are mixed together and magnetically oriented by immersing the mixture in an axially aligned magnetic field while cold pressing the mixture. The compressed mixture is then sintered at a temperature above the melting point of the sintering aid and below the melting point of the permanent magnet alloy to thereby coat the particle surfaces of the permanent magnetic alloy particles with the sintering aid while inhibiting migration of the rare earth element in the sintering aid into the permanent magnet alloy particles to thereby raise the intrinsic coercivity of the permanent magnet alloy without substantially lowering the high energy of the permanent magnet alloy. What is claimed is: 1. A method of making ***[process/method]*** a high energy permanent magnet characterized by improved intrinsic coercivity which comprises:

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			(a) forming a particulate mixture of a permanent magnet alloy comprising one or more rare earth elements and one or more ferromagnetic metals; (b) forming a particulate mixture of a sintering alloy consisting essentially of: (i) 92-98 wt.% of one or more rare earth elements selected from the class consisting of Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and mixtures of two or more of such rare earth elements, and; (ii) 2-8 wt.% of one or more alloying metals selected from the class consisting of Al, Nb, Zr, V, Ta, Mo, and mixtures of two or more of such metals; (c) forming a particulate mixture of said particulate permanent magnet alloy and said particulate sintering aid alloy; (d) magnetically orienting said particulate mixture by immersing the mixture in an axially aligned magnetic field; and (e) sintering the magnetically aligned particulate mixture at a temperature above the melting point of said sintering aid and below the melting point of said permanent magnet alloy; to thereby coat the particle surfaces of said permanent magnetic alloy particles with said sintering aid while inhibiting migration of the rare earth element in said sintering aid into said permanent magnet alloy particles to thereby raise the intrinsic coercivity of said permanent magnet alloy without substantially lowering the high energy of said permanent magnet alloy. 2. The method of ***[process/method]*** claim 1 wherein said step of forming a particulate mixture of said particulate permanent magnet alloy and said particulate sintering aid alloy further comprises mixing together from about 92

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			to about 99 wt.% permanent magnet alloy and from about 1 to about 8 wt.% of said sintering aid alloy.
Filed: Feb 16, 1989 Issued: June 19, 1990 Expired: June 2007	4,935,075	Assignee: Kabushiki Kaisha Toshiba (Kawasaki, JAPAN)	Permanent magnet Abstract A permanent magnet essentially consists of 10 to 40% by weight of R, 0.1 to 8% by weight of boron, 13% by weight or less of gallium and iron, where R is at least one component selected from the group consisting of yttrium and the rare-earth elements. The magnet having this composition has a high coercive force iHC and a high residual magnetic flux density and therefore has a high maximum energy product. What the claim is: 1. A permanent magnet consisting ***[composition of matter]*** essentially of a sintered 10-40% by weight of material R consisting of at least one element from the group consisting of yttrium and rare-earth elements and wherein at least 90% by atom of material R consists, of neodymium, 0.1-8% by weight of boron and, 0.1-13% by weight of gallium and the balance of iron. 7. A permanent magnet manufactured by a process ***[process/method]*** , comprising the steps of: melting a raw material consisting essentially of 10-40% by weight of material R consisting of at least one element from the group consisting of yttrium and rare-earth elements, and wherein at least 90% by atom of material R consists of neodymium 0.1-8% by weight of boron 0.1-13% by weight of gallium, 0.005-0.03% by weight of oxygen and the balance of iron; casting a melt of the raw material to obtain a block;

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			pulverizing the block to a powder having an average particle size of 2 to 10 .mu.m; compressing the powder while applying a magnetic field to obtain a compacted material; and sintering the compacted material at a temperature of 1,000.degree. to 1,200.degree. C. for 0.5 to 5 hours to obtain a sintered body.
Filed: Oct 11, 1989 Issued: June 19, 1990 Expired: 2009	4,935,074	Assignee: U.S. Philips Corporation (New York, NY USA)	Magnetic material comprising iron, boron and a rare earth metal Abstract A magnetic material of the composition Fe.sub.79-x-y B.sub.21+x R.sub.y in which R is a rare earth element or a mixture of such elements and wherein -5<x<5 and <y.ltoreq.+4.8 The preferred rare earth element is neodymium and/or praseodymium. The invention is based on the discovery that materials having approximately the gross composition Fe.sub.3 B which in themselves are soft magnetic and in the equilibrium condition at room temperature consist of .alpha.-Fe and Fe.sub.2 B (see, for example, GB No. 1,598,886) can obtain permanent magnetic properties by comparatively small additions of rare earth elements. What is claimed is: 1. A magnetic material comprising ***[composition of matter]*** iron, boron and at least one rare earth element, characterized in that the magnetic material has the composition $Fe_{79-x-y} B_{21+x} R_y$ wherein R is at least one rare earth element and wherein -5<x<+5 and +1<y≦+4.8. 2. A magnetic material as claimed in claim 1, characterized in that R is

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			[composition of matter] Nd and/or Pr. 3. A magnetic material comprising ***[composition of matter]*** iron, boron and at least one rare earth element, characterized in that the magnetic material has the composition Fe_{79-x-y} B_{21+x} R_y, wherein R is at least one rare earth element comprising at least one member selected from the group consisting of Nd and Pr and wherein -5<x<+5 and y=3.8-4.1.
Filed: Oct 28, 1988 Issued: February 20, 1990 Expired: Oct 2010	4,902,360	Assignee: Crucible Materials Corp (Pittsburgh, PA USA)	Permanent magnet alloy for elevated temperature applications Abstract A permanent magnet alloy consisting essentially of R.sub.2 Fe.sub.14 B, wherein, R is a combination of rare earth elements consisting essentially of, in atomic percent, neodymium 3 to 11 and balance holmium. The alloy may include optional additions of the rare earth elements gadolinium up to 10%, terbium up to 15%, dysprosium up to 16%, erbium up to 18% and thulium up to 12%. What is claimed is: 1. A permanent magnet alloy consisting ***[composition of matter]*** essentially of R_2 Fe_{14} B, wherein R is a combination of rare earth elements consisting essentially of, in atomic percent, Nd 3 to 11 and balance Ho, said alloy exhibiting in combination α less than -0.01% per °C. over the temperature range of -50° C. to 250° C. and M_s greater than 7500 Gauss at room temperature. 2. The alloy of claim 1 wherein R includes up to 10% Gd. 3. The alloy of claim 1 wherein R includes up to 15% Tb. 4. The alloy of claim 1 wherein R includes up to 10% Dy. 5. The alloy of claim 1 wherein R includes up to 18% Er. 6. The alloy of claim 1 wherein R includes up to 12% Tm. 7. A permanent magnet alloy consisting essentially of ***[composition of matter]***

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			$R_2 Fe_{14} B$, wherein R is a combination of rare earth elements consisitng essentially of, in atomic percent, Nd 3 to 11, at least one optional heavy rare earth element selected from the group consisting of Gd up to 10, Tb up to 15, Dy up to 16, Er up to 18 and Tm up to 12 and balance Ho, said alloy exhibiting in combination α less than -0.01% per °C. over the temperature range of -50° C. to 250° C. and M_s greater than 7500 Gauss at room temperature. 8. The alloy of claim 1, or claim 2, or claim 3, or claim 4, or claim 5, or claim 6 or claim 7 wherein Ho is 75 to 92%

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