

DESCRIPTION

SPUTTERING TARGET FOR FORMING MAGNETIC RECORDING FILM AND
METHOD FOR PRODUCING SAME

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[Technical Field]

[0001] The present invention relates to a ferromagnetic material sputtering target that is used for the deposition of a magnetic thin film of a magnetic recording media, particularly for the deposition of a magnetic recording layer of a thermally assisted magnetic recording media, and to an FePt-based sintered sputtering target capable of achieving a stable discharge and reducing the generation of particles when sputtered with a magnetron sputtering device.

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[Background Art]

15 [0002] In the field of magnetic recording mediums as represented with HDDs (hard disk drives), a material based on Co, Fe or Ni as ferromagnetic metals is being used as the material of a magnetic thin film which is used for the recording. For example, Co-Cr-based or Co-Cr-Pt-based ferromagnetic alloys with Co as its main component are used for the recording layer of hard disks adopting the longitudinal magnetic recording system. Moreover, composite materials of Co-Cr-Pt-based ferromagnetic alloys with Co as its main component and nonmagnetic inorganic substance grains are often used for the recording layer of hard disks adopting the vertical magnetic recording system which was recently put into practical application. In addition, a magnetic thin film of a magnetic recording medium such as a hard disk is often produced by sputtering a ferromagnetic material sputtering target having the foregoing materials as its components in light of its high productivity.

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[0003] Meanwhile, the recording density of magnetic recording mediums is rapidly increasing year by year, and the current surface density of 100 Gbit/in² is expected to reach 1 Tbit/in² in the future. When the recording density reaches 1 Tbit/in², the size of the recording bit will fall below 10 nm and, in such a case, it is anticipated that the superparamagnetism caused by thermal fluctuation will become a problem, and it is further anticipated that the currently used magnetic recording medium; for instance, a material with higher magnetic crystalline anisotropy

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obtained by adding Pt to a Co-Cr-based alloy, or a medium in which B is further added to the foregoing material to attenuate the magnetic coupling between the magnetic grains, will no longer be sufficient. This is because, for grains to stably behave ferromagnetically at a size of 10 nm or less, the grains need to possess even higher magnetic crystalline anisotropy.

[0004] In light of the above, an FePt phase having an $L1_0$ structure is attracting attention as a material for use in an ultrahigh density recording medium. Moreover, since an FePt phase having a $L1_0$ structure yields superior corrosion resistance and oxidation resistance, it is expected to become a material that can be suitably applied as a recording medium. The FePt phase has an order-disorder transformation point at 1573 K, and has a $L1_0$ structure even when an alloy is hardened from a high temperature due to the rapid ordered reaction. Furthermore, in connection with using the FePt phase as a material for use in an ultrahigh density recording medium, demanded is the development of technology for dispersing the ordered FePt phase, in a magnetically separated state, while densely aligning the orientation thereof as much as possible. In light of the foregoing circumstances, a magnetic thin film having a granular structure in which the FePt magnetic phase having an $L1_0$ structure is magnetically separated from nonmagnetic materials is being proposed for use in a magnetic recording medium of next-generation hard disks adopting the thermally assisted magnetic recording system.

[0005] This magnetic thin film having a granular structure has a structure in which the magnetic grains are magnetically insulated through the interposition of nonmagnetic substances. The foregoing magnetic recording layer is configured from a magnetic phase such as a FePt alloy, and a nonmagnetic phase which is separating the magnetic phase, and it is known that C and BN are effective as a nonmagnetic phase material. When forming this kind of magnetic thin film, it is common to use an FePt alloy sputtering target containing C, rather than using multiple targets; that is, using a C target and an FePt alloy target (for example, Patent Documents 1 and 2). Previously, the present inventors invented an FePt-based sputtering target containing C for forming a magnetic recording film (Patent Document 3), and an FePt-based sputtering target containing BN for forming a magnetic recording film (Patent Document 4).

[0006] An FePt-based sputtering target containing C or BN is normally prepared

based on the powder sintering method. However, since the coefficient of thermal expansion of C or BN is too small relative to an FePt alloy, the compressive stress applied to C or BN increases as the sintering temperature becomes higher and, therefore, there were cases where C or BN would be subject to physical defects and cause the generation of particles during sputtering. Meanwhile, if the sintering temperature is too low, the density of the target will deteriorate, and there is a problem in that this would cause the generation of particles.

[Prior Art Documents]

[Patent Documents]

[0007] [Patent Document 1] Japanese Patent Application Publication No. 2012-102387

[Patent Document 2] Japanese Patent Application Publication No. 2012-214874

[Patent Document 3] International Publication No. WO2014/013920

[Patent Document 4] International Publication No. WO2014/065201

[Patent Document 5] Japanese Patent No. 5041261

[Patent Document 6] Japanese Patent No. 5041262

SUMMARY OF THE INVENTION

[Problems to be Solved by the Invention]

[0008] An object of the present invention is to provide an FePt-based sintered sputtering target configured from a magnetic phase such as an FePt-based alloy, and a nonmagnetic phase which is separating the magnetic phase, and which is used for forming a magnetic recording layer, and uses C and/or BN as a nonmagnetic phase material. More specifically, an object of the present invention is to provide a high density FePt-based sputtering target capable of suppressing the particles that are generated during sputtering.

[Means for Solving the Problems]

[0009] In order to achieve the foregoing object, as a result of intense study, the present inventors discovered that it is possible to increase the density of the target, even at a sintering temperature that is lower than conventional technologies, by adding a AuCu alloy having a low melting point as the sintering additive to the raw material, and consequently possible to reduce the generation of particles during

sputtering that are caused by defects based on C or BN or deterioration in density.

[0010] Based on the foregoing discovery, the present invention provides:

1) An FePt-based sintered sputtering target containing C and/or BN, wherein an area ratio of AuCu alloy grains on a polished surface of a cross section that is perpendicular to a sputtered surface of the sputtering target is 0.5% or higher and 15% or less.

2) The sputtering target according to 1) above, wherein a total content of Au and Cu relative to an overall composition of the sputtering target is 1 to 20 mol%.

3) The sputtering target according to 2) above, wherein a content ratio of Cu relative to Au in the sputtering target is 20 to 80 mol%.

4) The sputtering target according to any one of 1) to 3) above, wherein a Pt content relative to an overall composition of the sputtering target is 30 to 70 mol%.

5) The sputtering target according to any one of 1) to 4) above, wherein a C content relative to an overall composition of the sputtering target is 5 to 50 mol%.

6) The sputtering target according to any one of 1) to 5) above, wherein a BN content relative to an overall composition of the sputtering target is 5 to 40 mol%.

7) The sputtering target according to any one of 1) to 6) above, wherein one or more types of metal oxides selected from Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Fe, Co, Ni, Al, Ga, and Si are each contained in an amount of 0.1 to 20 mol% relative to an overall composition of the sputtering target.

8) The sputtering target according to any one of 1) to 7) above, wherein the sputtering target has a density of 95% or higher.

[Effect of the Invention]

The FePt-based sintered sputtering target containing C and/or BN of the present invention yields a superior effect of being able to considerably reduce the amount of particles that is generated during sputtering. Accordingly, the present invention yields an effect of being able to efficiently deposit a magnetic thin film of a magnetic recording medium, particularly a granular-type magnetic recording layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[Fig. 1] Fig. 1 is a laser microgram and a binarized image of the sintered body of Example 1.

[Fig. 2] Fig. 2 is an elemental mapping of the sintered body of Example 1 obtained based on FE-EPMA.

DETAILED DESCRIPTION OF THE EMBODIMENT

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[0013] Generally speaking, with a metal material, since the softening temperature will be lower as the melting point of the metal material is lower, the density of the sintered body can be increased, even at a low sintering temperature, by adding a material with a low melting point as the sintering additive. As metals that may be used as the sintering additive to be added to an FePt-based sintered sputtering target, known is the independent addition of Au, Ag or Cu.

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The present inventors took particular note of the fact that, with a AuCu alloy which is made from Au (melting point: 1064.4°C) and Cu (melting point: 1064.6°C), the melting point thereof can be lowered to 910°C based on a eutectic reaction, and discovered that it is possible to obtain a high density sintered body even at a lower sintering temperature by using a AuCu alloy as the sintering additive. Note that, in the present invention, the term "AuCu alloy" refers to an alloy of a compositional range (Au: 20 to 80 at%) in which the liquid phase of the alloy appears at 910°C in a binary phase diagram of Au-Cu.

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[0014] Note that the addition of Ag, Cu or the like to an FePt-based alloy sputtering target has been conventionally known (for instance, Patent Documents 3 to 6). Nevertheless, the objective of adding these elements is to improve the magnetic properties, and these elements are not added as a sintering additive. Moreover, the method of adding these elements is the independent addition of Ag or Cu, or the addition of a AgPt alloy or a CuPt alloy, and a AuCu alloy having a relative low melting point is not added in these conventional technologies. In particular, Patent Documents 5 and 6 describe that a high density target can be obtained by mixing a AuPt alloy powder or a CuPt alloy powder, which has a higher melting point than a pure Au powder or a pure Cu powder, and thereby increasing the sintering temperature, and this technique is clearly different from the present invention which lowers the melting point by alloying Au and Cu.

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[0015] Based on the foregoing discovery, the present invention provides an FePt-based sintered sputtering target containing C and/or BN, wherein an area ratio of AuCu alloy grains on a polished surface of a cross section that is perpendicular to

a sputtered surface of the sputtering target is 0.5% or higher and 15% or less. The FePt-based sintered sputtering target containing C and/or BN of the present invention has a texture in which C and/or BN nonmagnetic material grains are dispersed in a ferromagnetic material made from an FePt-based alloy. Here, the reason why the texture of the perpendicular cross section is prescribed is because, since C and BN used as the raw materials are in the form of flakes, when they are hot pressed based on pressure in a uniaxial direction, the appearance of the texture will differ on the perpendicular cross section and on the horizontal cross section. Here, since the perpendicular cross section will appear to be layered like a unique stratum, the texture of the perpendicular cross section has been prescribed.

The AuCu alloy grains are observed by mirror-polishing the surface that is perpendicular to the sputtered surface of the sputtering target until the AuCu alloy grains can no longer be distinguished, observing 10 arbitrary locations of the sputtering target in a visual field of $60\ \mu\text{m} \times 80\ \mu\text{m}$ by using a laser microscope, and then obtaining the average area ratio thereof. Note that an emery paper of SiC abrasive grains is used for the polishing. Polishing is performed by using the emery paper in the following order with the grain size being #240, #400, #600, and #1000 (JISR6010). Subsequently, as the finishing process, wet polishing is performed using alumina abrasive grains having a grain size of $0.3\ \mu\text{m}$. The method of calculating the area ratio is as follows.

[0016] Foremost, a laser microscope (VK-9710 manufactured by Keyence; magnification: objective lens 20X $\times$ digital zoom 1X) is used to take a laser micrograph (visual field: vertical $60\ \mu\text{m} \times$ horizontal $80\ \mu\text{m}$) of the perpendicular cross section of the target. Next, an FE-EPMA is used to perform elemental analysis at the same locations as the laser micrograph to identify the AuCu alloy. Here, the grains in which Au and Cu are detected at the same location in the FE-EPMA image are determined to be the AuCu alloy grains. Since the AuCu alloy grains (alloy phase) appear darker than the FePt-based alloy phase but lighter than the C phase and the BN phase, it is possible to binarize and digitally differentiate only the AuCu alloy phase by utilizing the difference in contrast. Note that, when oxides are added, since the oxide phase will also appear darker than the AuCu alloy grains as with the C phase and the BN phase, the oxide phase can also be easily differentiated by using this difference in contrast. The area ratio of the AuCu alloy grains is calculated based on the thus obtained binarized data. Note that, upon performing binarization,

since those in which the area is 100 pixels or less are likely noise, their values are not included in the binarized data.

[0017] With the sputtering target of the present invention, preferably, the total content of Au and Cu relative to the overall composition of the sputtering target is 1 to 20 mol%. When the total content of Au and Cu is less than 1 mol%, the effect of the AuCu alloy as a sintering additive cannot be exhibited sufficiently, and this is undesirable because the density of the sintered body (sputtering target) cannot be improved, and the generation of particles tends to increase. Meanwhile, when the total content of Au and Cu exceeds 20 mol%, this is undesirable because it becomes difficult to control the characteristics of the magnetic thin film that is formed via sputtering.

With the sputtering target of the present invention, preferably, the content ratio of Cu relative to Au in the sputtering target is 20 to 80 mol%. When the content ratio of Cu relative to Au is less than 20 mol% or exceeds 80 mol%, this is undesirable because the melting point reducing effect of the AuCu alloy cannot be exhibited sufficiently, and, therefore, the density of the sintered body (sputtering target) cannot be improved, and the generation of particles tends to increase.

[0018] With the sputtering target of the present invention, preferably, the Pt content relative to the overall composition of the sputtering target is 30 to 70 mol%. Favorable magnetic properties can be obtained by causing the Pt content to be 30 mol% or higher and 70 mol% or less. Moreover, magnetic insulation can be improved by causing the C content as the nonmagnetic material to be 5 mol% or higher and 50 mol% or less and/or the BN content as the nonmagnetic material to be 5 mol% or higher and 40 mol% or less relative to the overall composition of the sputtering target. The total content of C and BN is preferably 3 vol% or higher and 50 vol% or less. By causing the contents of the foregoing elements to be within the foregoing numerical ranges, it is possible to improve magnetic insulation while suppressing the generation of particles during sputtering.

Moreover, with the sputtering target of the present invention, preferably, one or more types of metal oxides selected from Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Fe, Co, Ni, Al, Ga, and Si are each contained in an amount of 0.1 to 20 mol% relative to the overall composition of the sputtering target. These oxides are effective components for improving the magnetic properties of the sputtered film. Note that, in the FePt-based sintered sputtering target of the present invention, excluding Pt, C

and/or BN, AuCu, and the foregoing oxides, the remainder is Fe. The content of each of these components can be measured based on the ICP (inductively coupled plasma)-OES method.

[0019] With the sputtering target of the present invention, preferably, the density is 95% or higher. It is thereby possible to prepare a uniform thin film with minimal generation of abnormal discharge (arcing) during the deposition process. Note that the relative density of the present invention is a value obtained by dividing the measured density of the target by the calculated density (also referred to as the theoretical density). The calculated density is the density when it is assumed that the constituents of the target do not mutually disperse or react and coexist, and is calculated according to the following formula.

Formula: calculated density = Σ (molecular weight of constituents $\times$ molar ratio of constituents) / Σ (molecular weight of constituents $\times$ molar ratio of constituents / literature data density of constituents)

Here, Σ implies taking on the sum of all constituents of the target.

[0020] The FePt-based sintered sputtering target of the present invention can be prepared according to the following method.

Foremost, the respective raw material powders (Fe powder, Pt powder, C powder, BN powder, AuCu alloy powder) are prepared. Moreover, as the raw material powder, an alloy powder (Fe-Pt powder) that is alloyed in advance via heat treatment or with an atomization device may also be used. An alloy powder containing Pt, while this will also depend on the composition thereof, is effective for reducing the oxygen content in the raw material powder. Moreover, a Au powder and a Cu powder may each be used in substitute for the AuCu alloy powder and caused to become alloyed during sintering. Furthermore, the respective raw material powders of the metal oxides listed above are prepared as needed.

[0021] Next, the metal powders (Fe powder, Pt powder, Fe-Pt alloy powder) are pulverized using a ball mill, a medium agitation mill or the like. Normally, the raw material powders of these metals have a spherical shape, a bulk shape or other indefinite shapes, but these can be pulverized using a ball mill or a medium agitation mill to obtain a flaked shape. As a result of using this kind of flaked powder, it is possible to stabilize the crystal orientation of the Fe-Pt alloy phase which forms a layered structure in a cross sectional direction that is perpendicular to the sintered body and this will also contribute to the stabilization of the discharge. Preferably, with

these raw material powders, each of an average grain size of 10 to 100 μm .

[0022] Subsequently, these raw material powders are weighed to attain the intended composition, and the metal powders obtained via pulverization treatment and the AuCu alloy powder, the C powder and/or the BN powder are mixed with a mortar, a medium agitation mill, a sieve or the like. The oxides as additive components may be added together with the metal raw material powders, or added together with the C powder or the BN powder, or otherwise added at the stage of mixing the metal raw material powders and the C powder and/or the BN powder.

[0023] Subsequently, the obtained mixed powder is molded and sintered via hot press. Other than hot press, adopted may be the plasma discharge sintering method, or the hot isostatic sintering method. The holding temperature during sintering is, in many cases, within a temperature range of 850 to 900°C, even though this will also depend on the composition of the sputtering target. Conventionally, while sintering was performed within a temperature range of 800°C to 1400°C in order to increase the density, according to the present invention, it is possible to achieve a high density, which is equivalent to conventional technologies, at a relatively low sintering temperature.

[0024] Next, the sintered body removed from the hot press is subject to hot isostatic pressing (HIP). Hot isostatic pressing is effective for improving the density of the sintered body. The holding temperature during hot isostatic pressing is, in many cases, within a temperature range of 850°C to 900°C, even though this will also depend on the composition of the sintered body. Conventionally, as with the hot press, hot isostatic pressing was also performed within a temperature range of 800°C to 1200°C in order to increase the density. However, according to the present invention, it is possible to achieve a high density, which is equivalent to conventional technologies, at a relatively low sintering temperature.

[0025] The sputtering target of the present invention can be prepared by processing the thus obtained sintered body into an intended shape using a lathe or the like. Based on the process described above, it is possible to prepare an FePt-based sintered sputtering target containing C and/or BN and having a high density, specifically, a density of 95% or higher.

[Examples]

[0026] The present invention is now explained in detail with reference to the Examples and Comparative Examples. Note that these Examples are merely

illustrative, and the present invention shall in no way be limited thereby. In other words, various modifications and other embodiments are covered by the present invention, and the present invention is limited only by the scope of its claims.

[0027] (Example 1)

5 As the raw material powders, an FePt alloy powder, a C powder, and a AuCu alloy powder were prepared, and these powders were weighed to achieve 60(45Fe-45Pt-5Au -5Cu) -40C (mol%).

10 Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the AuCu alloy powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , and the mixed powder was filled in a carbon mold and then hot pressed.

15 [0028] The hot press conditions were as follows; namely, vacuum atmosphere, rate of temperature increase of 300°C/hour, holding temperature of 850°C, and holding time of 2 hours, and a pressure of 30 MPa was applied from the start of temperature increase to the end of holding. After the end of holding, the resultant product was naturally cooled as is in the chamber.

20 Subsequently, the sintered body removed from the host press mold was subject to hot isostatic pressing. The hot isostatic pressing conditions were as follows; namely, rate of temperature increase of 300°C/hour, holding temperature of 850°C, and holding time of 2 hours, and the gas pressure of Ar gas was gradually increased from the start of temperature increase, and a pressure of 150 MPa was applied during the holding at 750°C. After the end of holding, the resultant product was naturally cooled as is in the furnace.

25 [0029] One end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body was cut out and mirror polished, and the polished surface was observed using a laser microscope. The resulting micrograph is shown in the left diagram of Fig. 1. In this diagram, the dark gray area corresponds to the AuCu alloy grains. Subsequently, this diagram was binarized to obtain the area ratio (average) of the AuCu alloy grains. Consequently, the area ratio was 10.8%. Note that, as a result of using an FE-EPMA image, it was confirmed that these grains are made from a AuCu alloy (refer to Fig. 2). Moreover, as a result of

measuring the density of another end of this sintered body based on the Archimedes method, the density was 95.8%.

[0030]

Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were as follows; namely, after performing 2 kWhr pre-sputtering at an applied power of 1 kW and Ar gas pressure of 1.7 Pa, a film was deposited on a silicon substrate having a diameter of 4 inches for 20 seconds. Subsequently, the number of particles having a grain size of 0.25 μm or more that became adhered on the substrate was measured using a particle counter. The number of particles in this case was 65.

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[0031]

[Table 1]

	Composition	H/P Temperature	HIP Temperature	Archimedes density after HIP	Surface area (average) of AuCu alloy grains	Number of particles in steady state
Example 1	60(45Fe-45Pt-5Au-5Cu)-40C (mol%)	850°C	850°C	95.8%	10.8%	65
Comparative Example 1	60(45Fe-45Pt-10Au)-40C (mol%)	850°C	850°C	93.2%	—	184
Comparative Example 2	60(45Fe-45Pt-10Cu)-40C (mol%)	850°C	850°C	93.5%	—	179
Comparative Example 3	60(50Fe-50Pt)-40C (mol%)	850°C	850°C	92.8%	—	261
Example 2	66(54Fe-40Pt-3Au-3Cu)-34BN (mol%)	850°C	850°C	95.4%	2.4%	94
Comparative Example 4	66(54Fe-40Pt-6Au)-34BN (mol%)	850°C	850°C	93.9%	—	256
Example 3	50(60Fe-30Pt-1.5Au-8.5Cu)-50C (mol%)	850°C	850°C	95.1%	4.8%	82
Comparative Example 5	50(60Fe-30Pt-10Au)-50C (mol%)	850°C	850°C	93.3%	—	439
Example 4	80(20Fe-70Pt-9Au-1Cu)-20BN (mol%)	850°C	850°C	96.0%	9.7%	83
Comparative Example 6	80(20Fe-70Pt-10Cu)-20BN (mol%)	850°C	850°C	93.2%	—	307
Example 5	77(35Fe-45Pt-10Au-10Cu)-8SiO ₂ -15C (mol%)	850°C	850°C	97.1%	14.3%	47
Comparative Example 7	77(35Fe-45Pt-20Au)-8SiO ₂ -15C (mol%)	850°C	850°C	93.6%	—	142
Example 6	73(53Fe-45Pt-1Au-1Cu)-1TiO ₂ -1Cr ₂ O ₃ -25C (mol%)	850°C	850°C	96.2%	0.8%	59
Comparative Example 8	73(53Fe-45Pt-2Au)-1TiO ₂ -1Cr ₂ O ₃ -25C (mol%)	850°C	850°C	92.9%	—	227
Example 7	78.5(45Fe-45Pt-4Au-6Cu)-0.5MnO-1Ta ₂ O ₅ -20BN (mol%)	850°C	850°C	95.2%	6.1%	97
Comparative Example 9	78.5(45Fe-45Pt-10Cu)-0.5MnO-1Ta ₂ O ₅ -20BN (mol%)	850°C	850°C	94.0%	—	398
Example 8	80(45Fe-45Pt-5Au-5Cu)-15SiO ₂ -5C (mol%)	850°C	850°C	97.3%	7.2%	13
Comparative Example 10	80(45Fe-45Pt-10Au)-15SiO ₂ -5C (mol%)	850°C	850°C	92.2%	—	285
Example 9	85(45Fe-45Pt-4Au-6Cu)-10SiO ₂ -5BN (mol%)	850°C	850°C	97.0%	5.9%	31
Comparative Example 11	85(45Fe-45Pt-10Cu)-10SiO ₂ -5BN (mol%)	850°C	850°C	93.8%	—	213
Example 10	60(50Fe-40Pt-5Au-5Cu)-30C-10BN (mol%)	850°C	850°C	95.9%	5.5%	97
Comparative Example 12	60(50Fe-40Pt-10Au)-30C-10BN (mol%)	850°C	850°C	92.7%	—	421

[0032] (Comparative Example 1)

As the raw material powders, an FePt alloy powder, a C powder, and a Au powder were prepared, and these powders were weighed to achieve 60(45Fe-45Pt-10Au)-40C (mol%).

5 Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Au powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh
10 of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0033] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 93.2%.
15 Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of
20 0.25 μm or more that became adhered to the substrate, the number of particles was 184, and increased in comparison to the Examples.

[0034] (Comparative Example 2)

As the raw material powders, an FePt alloy powder, a C powder, and a Au powder were prepared, and these powders were weighed to achieve 60(45Fe-45Pt-10Cu)-40C (mol%).
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Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Cu powder and the C powder were
30 mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0035] As a result of measuring the density of one end of the thus obtained

sintered body based on the Archimedes method, the density was 93.5%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 179, and increased significantly in comparison to Example 1.

[0036] (Comparative Example 3)

As the raw material powders, an FePt alloy powder, and a C powder were prepared, and these powders were weighed to achieve 60(50Fe-50Pt)-40C (mol%).

Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 92.8%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 261, and increased significantly in comparison to Example 1.

[0038] (Example 2)

As the raw material powders, an Fe powder, a Pt powder, a BN powder, and a AuCu alloy powder were prepared, and these powders were weighed to achieve 66(54Fe-40Pt-3Au-3Cu)-34BN (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the

pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the AuCu alloy powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0039] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 2.4%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 95.4%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 94.

[0040] (Comparative Example 4)

As the raw material powders, an Fe powder, a Pt powder, a BN powder, and a Au powder were prepared, and these powders were weighed to achieve 66(54 Fe-40Pt-6Au)-34BN (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Ag powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0041] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 93.9%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon

Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 256, and increased significantly in comparison to Example 2.

5 [0042] (Example 3)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a Au powder, and a Cu powder were prepared, and these powders were weighed to achieve 50(60Fe-30Pt-1.5Au-8.5Cu)-50 C (mol%).

10 Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Au powder, the Cu powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder
15 was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0043] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a
20 laser microscope, the area ratio of the AuCu alloy grains was 4.8%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 95.1%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the
25 number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 82.

[0044] (Comparative Example 5)

As the raw material powders, an Fe powder, a Pt powder, a C powder, and a Au powder were prepared, and these powders were weighed to achieve 50(60 Fe-30Pt-10Au)-50C (mol%).
30

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Au

powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0045] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 93.3%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 439, and increased significantly in comparison to Example 3.

[0046] (Example 4)

As the raw material powders, an Fe powder, a Pt powder, a BN powder, a Au powder, and a Cu powder were prepared, and these powders were weighed to achieve 80(20Fe-70Pt-9Au-1Cu)-20BN (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Ag powder, the Cu powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0047] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 9.7%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 96.0%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the

number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 83.

[0048] (Comparative Example 6)

As the raw material powders, an Fe powder, a Pt powder, a BN powder, and a Cu powder were prepared, and these powders were weighed to achieve 80(20 Fe-70Pt-10Cu)-20C (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Cu powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0049] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 93.2%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 307, and increased significantly in comparison to Example 4.

[0050] (Example 5)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a AuCu powder, and a SiO_2 powder were prepared, and these powders were weighed to achieve 77(35Fe-45Pt-10Au-10Cu)-8 SiO_2 -15C (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the AuCu alloy powder, the SiO_2 powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder

was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0051] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 14.3%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 97.1%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 47.

[0052] (Comparative Example 7)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a Au powder, and a SiO_2 powder were prepared, and these powders were weighed to achieve 77(35Fe-45Pt-20Au)-8 SiO_2 -15C (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Au powder, the SiO_2 powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0053] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 93.6%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 142, and increased significantly in comparison to Example 5.

[0054] (Example 6)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a AuCu powder, a TiO₂ powder, and a Cr₂O₃ powder were prepared, and these powders were weighed to achieve 73(53Fe-45Pt-1Au-1Cu)-1TiO₂-1Cr₂O₃-25C (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the AuCu alloy powder, the TiO₂ powder, the Cr₂O₃ powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm, the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 0.8%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 96.2%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 59.

[0056] (Comparative Example 8)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a Au powder, a TiO₂ powder, and a Cr₂O₃ powder were prepared, and these powders were weighed to achieve 73(53Fe-45Pt-2Au)-1TiO₂-1Cr₂O₃-25C (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Ag powder, the TiO₂ powder, the Cr₂O₃ powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm, the mixed powder was filled in a carbon mold, and hot pressed under the same

conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0057] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 92.9%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 227, and increased significantly in comparison to Example 6.

[0058] (Example 7)

As the raw material powders, an FePt alloy powder, a BN powder, a Au powder, a Cu powder, a MnO powder, and a Ta_2O_5 powder were prepared, and these powders were weighed to achieve 78.5(45Fe-45Pt-4Au-6Cu)-0.5MnO-1 Ta_2O_5 -20BN (mol%).

Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Au powder, the Cu powder, the MnO powder, the Ta_2O_5 powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0059] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 6.1%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 95.2%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 97.

[0060] (Comparative Example 9)

As the raw material powders, an FePt alloy powder, a BN powder, a Cu powder, a MnO powder, and a Ta₂O₅ powder were prepared, and these powders were weighed to achieve 78.5(45Fe-45Pt-10Cu)-0.5MnO-1Ta₂O₅-20BN (mol%).

5 Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Cu powder, the MnO powder, the Ta₂O₅ powder and the BN powder were mixed using a V-shaped mixer, additionally
10 mixed using a sieve having a sieve mesh of 150 μm, the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0061] As a result of measuring the density of one end of the thus obtained
15 sintered body based on the Archimedes method, the density was 94.0%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of
20 Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 398, and increased significantly in comparison to Example 7.

[0062] (Example 8)

As the raw material powders, an FePt alloy powder, a C powder, a AuCu
25 alloy powder, and a SiO₂ powder were prepared, and these powders were weighed to achieve 80(45Fe-45Pt-5Au-5Cu)-15SiO₂-5C (mol%).

Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the AuCu alloy powder, the SiO₂ powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a
30 sieve having a sieve mesh of 150 μm, the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the

same conditions as Example 1.

[0063] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 7.2%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 97.3%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 13.

[0064] (Comparative Example 10)

As the raw material powders, an FePt alloy powder, a C powder, a Au powder, and a SiO_2 powder were prepared, and these powders were weighed to achieve 80(45Fe-45Pt-10Au)-15 SiO_2 -5C (mol%).

Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Au powder, the SiO_2 powder and the C powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0065] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 92.2%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 285, and increased significantly in comparison to Example 8.

[0066] (Example 9)

As the raw material powders, an FePt alloy powder, a BN powder, a Au

powder, a Cu powder, and a SiO₂ powder were prepared, and these powders were weighed to achieve 85(45Fe-45Pt-4Au-6Cu)-10SiO₂-5BN (mol%).

Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Ag powder, the Cu powder, the SiO₂ powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm, the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0067] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 5.9%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 97.0%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 31.

[0068] (Comparative Example 11)

As the raw material powders, an FePt alloy powder, a BN powder, a Cu powder, and a SiO₂ powder were prepared, and these powders were weighed to achieve 85(45Fe-45Pt-10Cu)-10SiO₂-5BN (mol%).

Next, the FePt alloy powder was placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Cu powder, the SiO₂ powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm, the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0069] As a result of measuring the density of one end of the thus obtained

sintered body based on the Archimedes method, the density was 93.8%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 213, and increased significantly in comparison to Example 9.

[0070] (Example 10)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a BN powder, and a AuCu alloy powder were prepared, and these powders were weighed to achieve 60(50Fe-40Pt-5Au-5Cu)-30C-10BN (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the AuCu alloy powder, the C powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0071] As a result of cutting out one end (corresponds to the cross section that is perpendicular to the sputtered surface) of the thus obtained sintered body, performing mirror polishing thereto and then observing the polished surface with a laser microscope, the area ratio of the AuCu alloy grains was 5.5%. Moreover, as a result of measuring the density of another end of the thus obtained sintered body based on the Archimedes method, the density was 95.9%. Next, this sintered body was sputtered under the same conditions as Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 97.

[0072] (Comparative Example 12)

As the raw material powders, an Fe powder, a Pt powder, a C powder, a BN powder, and a Au powder were prepared, and these powders were weighed to achieve 60(50Fe-40Pt-10Au)-30C-10BN (mol%).

Next, the Fe powder and the Pt powder were placed in a medium agitation mill having a capacity of 5 liters together with zirconium balls as the pulverizing medium, and pulverized for 2 hours at a rotation speed of 300 rpm. Subsequently, the powder removed from the medium agitation mill and the Ag powder, the C powder and the BN powder were mixed using a V-shaped mixer, additionally mixed using a sieve having a sieve mesh of 150 μm , the mixed powder was filled in a carbon mold, and hot pressed under the same conditions as Example 1. Next, the sintered body removed from the hot press mold was subject to hot isostatic pressing under the same conditions as Example 1.

[0073] As a result of measuring the density of one end of the thus obtained sintered body based on the Archimedes method, the density was 92.7%. Subsequently, the sintered body was machined with a lathe into a shape having a diameter of 180.0 mm and a thickness of 5.0 mm, thereafter mounted on a magnetron sputtering device (C-3010 sputtering system manufactured by Canon Anelva), and then sputtered. The sputtering conditions were the same as those of Example 1. As a result of measuring the number of particles having a grain size of 0.25 μm or more that became adhered to the substrate, the number of particles was 421, and increased significantly in comparison to Example 10.

[Industrial Applicability]

[0074] The FePt-based sintered sputtering target containing C and/or BN of the present invention yields a superior effect of being able to reduce the amount of particles that is generated during sputtering. Accordingly, the present invention is effective as a ferromagnetic material sputtering target for depositing a magnetic thin film of a magnetic recording medium, particularly a granular-type magnetic recording layer.

CLAIMS

5 [Claim 1] An FePt-based sintered sputtering target containing C and/or BN, wherein an area ratio of AuCu alloy grains on a polished surface of a cross section that is perpendicular to a sputtered surface of the sputtering target is 0.5% or higher and 15% or less.

[Claim 2] The sputtering target according to claim 1, wherein a total content of Au and Cu relative to an overall composition of the sputtering target is 1 to 20 mol%.

10 [Claim 3] The sputtering target according to claim 2, wherein a content ratio of Cu relative to Au in the sputtering target is 20 to 80 mol%.

[Claim 4] The sputtering target according to any one of claims 1 to 3, wherein a Pt content relative to an overall composition of the sputtering target is 30 to 70 mol%.

[Claim 5] The sputtering target according to any one of claims 1 to 4, wherein a C content relative to an overall composition of the sputtering target is 5 to 50 mol%.

15 [Claim 6] The sputtering target according to any one of claims 1 to 5, wherein a BN content relative to an overall composition of the sputtering target is 5 to 40 mol%.

[Claim 7] The sputtering target according to any one of claims 1 to 6, wherein one or more types of metal oxides selected from Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Fe, Co, Ni, Al, Ga, and Si are each contained in an amount of 0.1 to 20 mol% relative to an overall composition of the sputtering target.

20 [Claim 8] The sputtering target according to any one of claims 1 to 7, wherein the sputtering target has a density of 95% or higher.