

Ni-Ta-BASED ALLOY, TARGET MATERIAL AND MAGNETIC RECORDING MEDIUM

CROSS-REFERENCE TO RELATED APPLICATIONS

5 [0001]

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2016-187722 filed on September 27, 2016, the entire contents of which are incorporated herein by reference.

10

BACKGROUND OF THE INVENTION

Field of the Invention

[0002]

15 The present invention relates to a Ni-Ta-based alloy that can be used as an alloy for an adhesion layer of a perpendicular magnetic recording medium, a sputtering target material containing the Ni-Ta-based alloy, and a magnetic recording medium containing the Ni-Ta-based alloy.

20 Background Art

[0003]

25 Recently, the advance of magnetic recording technology has been remarkable, and increasing the recording density of magnetic recording media is proceeding, and a perpendicular magnetic recording system in which further higher recording density than longitudinal magnetic recording media which was in widespread use can be therefore realized has been in use. A perpendicular magnetic recording system refers to a method, being suitable for achieving high recording density, in which an easy axis is formed so as to orient
30 perpendicularly to media surface in a magnetic film of a perpendicular magnetic recording medium.

[0004]

35 For example, as described in JP-4499044-B2 (Patent Document 1), a perpendicular magnetic recording medium is known in which an adhesion layer, a soft magnetic layer, a seed layer, an intermediate layer, a magnetic recording layer and a protective layer

are laminated in this order, the soft magnetic layer having a Co alloy, the seed layer having a first seed layer at the soft magnetic layer side and a second seed layer at the intermediate layer side, the first seed layer being composed of an amorphous alloy containing Cr and one or more elements selected from Ta, Ti, Nb, Si and Al, the second seed layer being composed of a crystalline alloy containing Ni and one or more elements selected from Cr, Ta, Ti, Nb, V, W, Mo and Cu.

[0005]

Ni-Ta sputtering target material as described in JP-2013-127111-A (Patent Document 2) is used as a target which is used for forming an adhesion layer of a magnetic recording medium. In the sputtering target material described in this Patent Document 2, by containing NiTa compound phase and pure Ta phase in the sputtering target material, the strength of the sputtering target material is improved to reduce generation of cracks and particles during sputtering.

PRIOR ART DOCUMENTS

Patent Documents

[0006]

Patent Document 1: JP-4499044-B2

Patent Document 2: JP-2013-127111-A

SUMMARY OF THE INVENTION

Problems to be solved by the invention

[0007]

In the above-mentioned sputtering target material of Patent Document 2, the strength of the sputtering target material is improved to reduce generation of cracks and particles during sputtering by containing pure Ta phase. However, there has been a drawback in which, a large change of a composition in a microstructure of such sputtering target materials may occur because of the presence of a pure Ta phase in the sputtering target material, which results in an irregular composition of a sputtered film reflecting the composition change. In recent years, further improvement in the strength of the sputtering target for the adhesion

layer is required, and there is a limitation to the strength improvement with the pure Ta phase.

Solution to the problems

5 [0008]

In order to solve the above problems, the inventors found as a result of advanced intensive development, a Ni-Ta-based alloy and a sputtering target material, wherein the strengths of the Ni-Ta-based alloy and the sputtering target material are improved without using
 10 pure Ta, generation of cracks and particles during sputtering can be prevented, and an irregular composition of a sputtered film can be prevented. Thus, the inventors arrived at the completion of the present invention. The present invention makes it possible to improve the mechanical strengths of the Ni-Ta-based alloy and the
 15 sputtering target material, compared to conventional Ni-Ta-based alloys and sputtering target materials, by adding a predetermined amount of Fe and/or Co into a Ni-Ta-based alloy to finely disperse Ta compound phases.

[0009]

20 The present invention encompasses the following inventions.

[1] A Ni-Ta-based alloy, comprising:

15 to 50 at% of Ta;

0 to 10 at% in total of one or two or more M elements

selected from Al, Ga, In, Si, Ge, Sn, Zr, Ti, Hf, B, Cu, P, C, Ru, and Cr;

25 and

the balance comprising Ni, one or two of Fe and Co, and unavoidable impurities,

wherein the ratios of the Ni content, the Fe content, and the Co content to the total content of Ni, Fe, and Co are 20 to 98.5%, 0
 30 to 50%, and 0 to 60%, respectively,

wherein the Ni-Ta based alloy has an FCC phase and a Ta compound phase, and

wherein the Ta compound phase has a maximum inscribed circle diameter of not more than 10 μm .

35 [2] The Ni-Ta-based alloy according to [1], wherein the total content of the M elements is 0.9 to 10 at%.

[3] The Ni-Ta-based alloy according to [1] or [2], wherein the Ni-Ta-based alloy is an alloy for an adhesion layer of a magnetic recording medium.

[4] The Ni-Ta-based alloy according to [1] or [2], wherein the
5 Ni-Ta-based alloy has a bending strength of not less than 450 MPa.

[5] A sputtering target material, comprising the Ni-Ta-based alloy according to [1] or [2].

[6] The sputtering target material according to [5], wherein the
10 sputtering target material has a bending strength of not less than 450 MPa.

[7] A magnetic recording medium, comprising an adhesion layer, wherein the adhesion layer comprises the Ni-Ta-based alloy according to [1] or [2].

15 Effects of the invention

[0010]

The present invention provides a Ni-Ta-based alloy, a sputtering target material, and a magnetic recording medium including an adhesion layer formed by using the sputtering target
20 material, wherein an irregular composition of a sputtered film can be prevented, and the mechanical strengths are improved, by adding a predetermined amount of Fe and/or Co into a Ni-Ta-based alloy to disperse finely Ta compound phases.

25 BRIEF DESCRIPTION OF THE DRAWING

[0011]

FIG. 1 is a micrograph, observed by an electron scanning microscope (SEM), of a microstructure of a Ni-Ta-based alloy according to the present invention.

30

DETAILED DESCRIPTION OF THE INVENTION

[0012]

The present invention will be described in detail below.

The Ni-Ta-based alloy according to the present invention
35 contains 15 to 50 at% of Ta. When the Ta content is less than 15 at%, a sputtered film loses an amorphous property required as an

adhesive layer, and thus properties of an adhesive layer are deteriorated. The Ta content is preferably 18 at% or more, more preferably 19 at% or more. On the other hand, when the Ta content exceeds 50 at%, an amount of Ta compounds increase, and thus a diameter of the maximum inscribed circle that can be drawn in the Ta compound phase exceeds 10 μm . As a result, sufficient mechanical strength cannot be obtained. The Ta content is preferably 45 at% or less, more preferably 40 at% or less.

[0013]

The Ni-Ta-based alloy according to the present invention contains 0 to 10 at% in total of one or two or more M elements selected from Al, Ga, In, Si, Ge, Sn, Zr, Ti, Hf, B, Cu, P, C, Ru, and Cr. Each of the M elements is an element which can refine crystal grains when being added in a small amount. Each of the M elements is an optional component, and thus the Ni-Ta-based alloy according to the present invention may not contain any of the M elements. The reason why the total content of the M elements is 10 at% or less consists in the fact that, when the total content of the M elements exceeds 10 at%, the structure is enlarged and the mechanical strength is lowered. The total content of the M elements is preferably 5 at% or less. When one element is selected as an M element, the total content of the M elements is the content of the one element, and when two or more elements are selected as M elements, the total content of the M elements is the total content of the two or more elements.

[0014]

In the Ni-Ta-based alloy according to the present invention, the balance other than Ta and the M elements comprises Ni, one or two of Fe and Co, and unavoidable impurities. The ratios of the Ni content (at%), the Fe content (at%) and the Co content (at%) to the total content (at%) of Ni, Fe and Co are 20 to 98.5%, 0 to 50%, and 0 to 60%, respectively. Since the ratio of the Ni content (at%) to the total content (at%) of Ni, Fe and Co is 20 to 98.5%, the ratio of the total content (at%) of Fe and Co to the total content (at%) of Ni, Fe and Co is 1.5 to 80%. The reason why the ratio of the Ni content is 98.5% or less consists in the fact that, when the ratio of the total

content of Fe and Co is less than 1.5%, sufficient strength of an adhesive layer cannot be obtained. The reason why the ratio of the Ni content is 20% or more consists in the fact that, when the ratio of the Ni content is less than 20%, the ratio of Ni contributing to toughness is too small, and thus the mechanical strength decreases. The ratio of the Ni content (at%) to the total content (at%) of Ni, Fe and Co is preferably 30 to 80%, more preferably 40 to 70%.

[0015]

The Ni-Ta-based alloy according to the present invention has an FCC phase and a Ta compound phase, wherein a maximum inscribed circle that can be drawn in the Ta compound phase has a diameter of 10 μm or less. FIG. 1 shows the result of observation of the microstructure of the Ni-Ta-based alloy according to the present invention with a scanning electron microscope (SEM). In FIG. 1, the gray portion denoted by reference numeral 1 is the FCC phase made of NiFe, and the white portion denoted by reference numeral 2 is two types of Ta compound phases, in which one is a Ni_3Ta phase and the other is a Fe_7Ta_3 phase. As can be seen from FIG. 1, the microstructure is constituted by these phases. The diameter of the maximum inscribed circle that can be drawn in the Ta compound phase is 10 μm or less, and the Ta compound phase forms a fine phase. As described above, the Ni-Ta-based alloy according to the present invention has a microstructure in which the Ta compound phase is finely dispersed. Therefore, use of the Ni-Ta-based alloy according to the present invention for producing a sputtering material comprising the Ni-Ta-based alloy, preferably a sputtering material composed of the Ni-Ta-based alloy, makes it possible to prevent an irregular composition of a sputtered film, and to improve the strength of the sputtering target material, thereby preventing generation of cracks and particles during sputtering.

[0016]

The Ni-Ta-based alloy according to the present invention is preferably produced by solidifying and molding a fine gas rapid cooling atomized powder, and more preferably produced by removing coarse particles from the gas rapid cooling atomized powder by classification, followed by heating the classified powder in

a vacuum or an inert atmosphere, followed by solidifying and molding the heated powder. The powder after classification preferably has a particle size distribution in which D50 is 230 μm or less. This makes it possible to form a desired fine structure. On the other hand, when a powder having D50 of more than 230 μm is used, it is not possible to form a desired fine structure sufficiently. Desirably, D50 is 200 μm or less. D50 is a particle diameter at the point of a cumulative volume of 50% in a cumulative frequency distribution curve on a volumetric basis, determined based on a total volume of the alloy powder of 100%. D50 can be measured by a laser diffraction scattering method. Examples of apparatuses suitable for such measurement include a laser diffraction/scattering-type particle size distribution measurement apparatus "MICROTRAC MT3000" from NIKKISO CO., LTD. In the apparatus, the alloy powder is poured with pure water into a cell, and the particle diameter of the alloy powder is detected based on the light scattering information of the alloy powder.

[0017]

A desired fine tissue can be formed by heating the powder after the classification in vacuum or in an inert gas at 300 to 800 $^{\circ}\text{C}$ to release the rapid solidification state of the powder surface, followed by solidifying and molding the heat treated powder. On the other hand, when the gas rapid cooling atomized powder is solidified without heat treatment, a coarse Ta compound may remain, which makes it impossible to sufficiently form a desired fine structure.

[0018]

In the step of solidifying and molding the powder, a microstructure can be formed by setting the molding temperature to 1000 to 1200 $^{\circ}\text{C}$ and the molding pressure to 100 to 150 MPa. However, when the molding temperature is less than 1000 $^{\circ}\text{C}$ or the molding pressure is less than 100 MPa, it is not possible to form a desired fine structure sufficiently. On the contrary, when the molding temperature exceeds 1200 $^{\circ}\text{C}$ or the molding pressure exceeds 150 MPa, it is not possible to sufficiently form a fine structure wherein an inscribed circle diameter of a Ta compound phase is 10 μm or less. Therefore, in the step of solidifying and

molding the powder, it is preferable to set the molding temperature to 1000 to 1200 °C and the molding pressure to 100 to 150 MPa.

[0019]

According to the production method described above, a
5 microstructure wherein an inscribed circle diameter of a Ta
compound phase is 10 μm or less can be formed as a constituent
phase of the Ni-Ta-based alloy according to the present invention.
Therefore, use of the Ni-Ta-based alloy according to the present
invention for producing a sputtering material containing the
10 Ni-Ta-based alloy, preferably a sputtering material composed of the
Ni-Ta-based alloy make it possible to prevent composition
unevenness of the sputtering target material, and to improve the
strength of the sputtering target material, thereby preventing
generation of cracks and particles during sputtering. The
15 Ni-Ta-based alloy according to the present invention is useful as an
alloy for an adhesion layer of a magnetic recording medium. Use of
the Ni-Ta-based alloy according to the present invention makes it
possible to produce a magnetic recording medium including an
adhesion layer containing the Ni-Ta-based alloy. Therefore, the
20 Ni-Ta-based alloy according to the present invention is a very
effective technique for improving the quality of the magnetic
recording medium.

[0020]

Each of the Ni-Ta-based alloy and the sputtering target
25 material according to the present invention preferably has a bending
strength of 450 MPa or more. The bending strength is preferably
550 MPa or more, more preferably 600 MPa or more.

[0021]

The bending strength is measured as follows: A specimen
30 having a longitudinal length of 25 mm, a width of 4 mm, and a
thickness of 3 mm, obtained by division by a wire, is evaluated by a
three-point bending test. In the three-point bending test conducted
under the condition of a supporting-point distance of 20 mm, a
three-point bending strength is calculated from a stress (N)
35 measured when a pressure is applied downward in a thickness

direction to a plane having a longitudinal length of 25 mm and a width of 4 mm, on the basis of the following equation.

$$\text{Three-point bending strength (MPa)} = (3 \times \text{stress (N)} \times \text{supporting-point distance (mm)}) / (2 \times \text{specimen width (mm)} \times \text{specimen thickness (mm)}^2)$$

[0022]

As a rapid solidification treatment method for producing the alloy powder, a gas atomization method is preferable, since this method results in a spherical powder that has a small amount of contamination and a high filling rate, and thus is suitable for sintering. As a pressure sintering method of the powder, methods such as hot pressing, hot isostatic press, electrification pressure sintering, hot extrusion and the like can be applied. The hot isostatic press is particularly preferable, since it has a high pressurizing pressure and can suppress coarsening of the intermetallic compound phase while suppressing the maximum temperature so as to obtain a dense sintered body.

[0023]

As a method of producing the Ni-Ta-based alloy and the sputtering target material according to the present invention, melting casting method and powder sintering method can be applied for the sputtering target material according to the present invention as long as a microstructure thereof can be controlled. In order to control the microstructure so that the maximum inscribed circle diameter of the Ta compound phase in the microstructure is 10 μm or less, it is desirable that when a melting casting method is applied, a solidification rate is adjusted to be faster than that of general castings in which, for example, molten alloy is cast into a mold cooled by water cooling or the like.

30

EXAMPLES

[0024]

Hereinafter, the present invention will be described in detail by examples.

35 Ni-Fe-Co-Ta-(M) alloy powders were prepared by a gas atomizing method according to respective component compositions

shown in Table 1 and Table 2. Each of the obtained powders was classified to 500 µm or less to remove coarse particles, each of the classified powders was subjected to a vacuum heat treatment at 300 °C, and each of the heat treated powders was used as a raw material powder for HIP molding (hot isostatic pressing). A billet for HIP molding was produced by such a way that a raw material powder is filled into a carbon steel can of 50 mm long with 250 mm in diameter, then degassed in vacuum and mounted. This powder billet was HIP-molded in a condition of molding pressure, molding temperature and retention time shown in Table 1. Thereafter, a sputtering target material of 7 mm thick with 180 mm in diameter was produced from the compact.

[0025]

In order to evaluate a microstructure of a sputtering target material, a maximum inscribed circle being able to be drawn in a Ta compound was measured by taking a specimen for an electron scanning microscope (SEM) from the sputtering target material listing, polishing the cross section of the specimen and taking a backscattered electron image.

[0026]

In order to evaluate a strength of a sputtering target material, a specimen having a longitudinal length of 25 mm, a width of 4 mm, and a thickness of 3 mm, obtained by division by a wire, was evaluated by a three-point bending test. In the three-point bending test conducted under the condition of a supporting-point distance of 20 mm, a three-point bending strength was calculated from a stress (N) measured when a pressure was applied downward in a thickness direction to a plane having a longitudinal length of 25 mm and a width of 4 mm, on the basis of the following equation.

Three-point bending strength (MPa) = $(3 \times \text{stress (N)} \times \text{supporting-point distance (mm)}) / (2 \times \text{specimen width (mm)} \times (\text{specimen thickness (mm)})^2)$

[0027]

[Table 1]

No	Component composition (at%)						Particle size of powder (D50)	Heat treatment of powder	Molding temperature (°C)	Molding pressure (MPa)	Inscribed circle drawn in Ta compound phase (μm)	Bending strength of target (MPa)	Note
	Ni	Ta	Fe	Co	Fe+Co	Other elements							
1	75	15	10		10		I	I	1000	150	4	730	Inventive Examples
2	65	25	10		10		I	I	1100	110	3	700	
3	50	30	20		20		I	I	1200	150	3	720	
4	45	35	20		20		I	I	1200	120	3	500	
5	40	40	20		20		I	I	1200	110	3	600	
6	35	45	20		20		I	I	1200	110	7	650	
7	30	50	20		20		I	I	1200	120	4	630	
8	50	20	30		30		I	I	1100	120	3	720	
9	45	25	30		30		I	I	1100	100	4	730	
10	40	30	30		30		I	I	1200	100	4	680	
11	25	35	40		40		I	I	1200	120	3	690	
12	20	40	40		40		I	I	1200	150	7	600	
13	60	20	10	10	20		I	I	1100	110	6	580	
14	45	25	10	20	30		I	I	1100	120	5	630	
15	40	30	20	10	30		I	I	1200	120	7	680	
16	25	35	20	20	40		I	I	1200	140	8	670	

[Table 1 (continued)]

No	Component composition (at%)						Particle size of powder (D50)	Heat treatment of powder	Molding temperature (°C)	Molding pressure (MPa)	Inscribed circle drawn in Ta compound phase (μm)	Bending strength of target (MPa)	Note
	Ni	Ta	Fe	Co	Fe+Co	Other elements							
17	60	20	5	5	10		I	I	1000	100	4	630	Inventive Examples
18	55	25	5	5	10		I	I	1100	120	3	650	
19	60	20		20	20		I	I	1100	120	3	600	
20	55	25		20	20		I	I	1100	120	5	610	
21	50	30		20	20		I	I	1200	120	4	620	
22	45	35		20	20		I	I	1200	120	7	680	
23	50	40		10	10		I	I	1200	150	6	670	
24	45	45		10	10		I	I	1100	110	5	640	
25	40	50		10	10		I	I	1100	150	6	620	
26	55	15		30	30		I	I	1100	120	5	600	
27	50	20		30	30		I	I	1100	110	5	600	
28	40	30		30	30		I	I	1100	150	2	640	
29	25	35		40	40		I	I	1200	120	6	630	
30	20	40		40	40		I	I	1200	120	6	700	
31	49	48	3		3		I	I	1100	100	7	560	
32	55	40		5	5		I	I	1000	100	8	580	

[0028]

[Table 2]

No	Component composition (at%)						Particle size of powder (D50)	Heat treatment of powder	Molding temperature (°C)	Molding pressure (MPa)	Inscribed circle drawn in Ta compound phase (μm)	Bending strength of target (MPa)	Note
	Ni	Ta	Fe	Co	Fe+Co	Other elements							
33	25	<u>60</u>	10		10		I	I	1200	150	<u>13</u>	320	Comparative Examples
34	25	<u>60</u>		10	10		I	I	1200	140	<u>15</u>	380	
35	<u>10</u>	20	40	30	70		I	I	1100	120	7	400	
36	<u>10</u>	20		<u>70</u>	70		I	I	1100	130	8	390	
37	<u>15</u>	20	<u>65</u>		65		I	I	1100	130	6	380	
38	50	50			<u>0</u>		I	I	1100	140	8	400	
39	60	40			<u>0</u>		I	I	1100	150	8	410	
40	80	20			<u>0</u>		I	I	1100	<u>160</u>	7	400	
41	70	20	10		10		I	I	1100	<u>90</u>	7	420	
42	40	50	10		10		I	I	<u>1350</u>	<u>90</u>	<u>17</u>	410	
43	60	20	10	10	20		I	I	<u>1350</u>	<u>95</u>	<u>17</u>	450	
44	50	30	20		20		I	I	<u>1350</u>	<u>155</u>	<u>15</u>	480	
45	50	40		10	10		I	I	<u>1350</u>	<u>160</u>	<u>18</u>	420	
46	40	50	10		10		I	II	1100	<u>160</u>	<u>11</u>	420	
47	20	40	40		40		I	II	1100	120	<u>18</u>	410	
48	60	20	10	10	20		II	I	1100	130	<u>11</u>	500	

[Table 2 (continued)]

No	Component composition (at%)					Particle size of powder (D50)	Heat treatment of powder	Molding temperature (°C)	Molding pressure (MPa)	Inscribed circle drawn in Ta compound phase (μm)	Bending strength of target (MPa)	Note
	Ni	Ta	Fe	Co	Fe+Co							
49	45	35	20		20	II	I	1200	120	<u>11</u>	520	Comparative Examples
50	40	30	30		30	III	I	1100	120	<u>14</u>	420	
51	45	45	10		10	III	I	1200	100	<u>18</u>	390	
52	30	50	20		20	III	I	1200	150	<u>20</u>	380	
53	60	20	10		10	I	I	1000	100	3	700	Inventive Examples
54	65	25	10		10	I	I	1200	100	3	720	
55	50	30	20		20	I	I	1000	120	3	580	
56	45	35	20		20	I	I	1200	120	3	600	
57	40	40	20		20	I	I	1200	100	7	650	
58	35	45	20		20	I	I	1200	120	4	630	
59	30	50	20		20	I	I	1100	120	3	720	
60	50	20	30		30	I	I	1100	110	4	630	
61	45	25	30		30	I	I	1200	110	4	680	
62	40	30	30		30	I	I	1200	120	3	630	
63	25	35	40		40	I	I	1200	120	7	600	
64	20	40	40		40	I	I	1100	110	6	580	

[Table 2 (continued)]

No	Component composition (at%)					Particle size of powder (D50)	Heat treatment of powder	Molding temperature (°C)	Molding pressure (MPa)	Inscribed circle drawn in Ta compound phase (μm)	Bending strength of target (MPa)	Note
	Ni	Ta	Fe	Co	Fe+Co	Other elements						
65	60	20	10		10	Ge:1	I	1100	120	8	560	Inventive Examples
66	45	25	10		10	Ge:2, C:1, P:1, Hf:2, Sn:1, In:1	I	1100	120	8	560	
67	70	20	10		10	<u>Al:15</u>	I	1200	100	<u>16</u>	240	Comparative Examples
68	65	25	10		10	<u>Ge:6, Ti:8</u>	I	1000	120	<u>13</u>	290	
69	50	30	20		20	<u>Ru:3, Ti:3, Ge:8</u>	I	1000	120	<u>14</u>	351	
70	40	40	20		20	<u>Hf:1, Cu:2, P:3, Cu:3, Al:3, P:4</u>	I	1100	120	<u>15</u>	340	

Note 1) Underline means not being within the present invention.

[0029]

As shown in Table 1 and Table 2, Nos. 1 to 32 and 53 to 66 correspond to inventive examples, whereas Nos. 33 to 52 and 67 to 70 correspond to comparative examples.

[0030]

Regarding the powders in Tables 1 and 2, the powders having a particle size D50 of 200 μm or less were designated as "I", the powders having a particle size D50 of more than 200 to 230 μm were designated as "II", and the powders having a particle size D50 of more than 230 μm were designated as "III". In addition, the powders subjected to the heat treatment were designated as "I", and the powders not subjected to the heat treatment were designated as "II".

[0031]

As shown in Table 2, Comparative Example No. 33 demonstrates that, although the sputtering target material was composed of FCC phase and Ta compound, the component composition of Ta was high, the maximum inscribed circle diameter of the microstructure of the Ta compound phase was coarsened to 13 μm , and thus the bending strength was low. Likewise, Comparative Example No. 34 demonstrates that the component composition of Ta was high, the maximum inscribed circle diameter of the microstructure of the Ta compound phase was coarsened to 15 μm , and thus the bending strength was low. Each of Comparative Example Nos. 35 to 37 demonstrates that, although the maximum inscribed circle diameter of the microstructure of the Ta compound phase was 10 μm or less, the component composition of Ni having toughness was low, and thus the mechanical strength was low.

[0032]

Each of Comparative Example Nos. 38 to 40 demonstrates that, although the maximum inscribed circle diameter of the microstructure of the Ta compound phase was 10 μm or less, Fe or Co was not added, and thus the mechanical strength was low. Comparative Example No. 41 demonstrates that the molding pressure was as low as 90 MPa, and thus the mechanical strength was low. Each of Comparative Example Nos. 42 to 45 demonstrates that the molding temperature for HIP molding was 1350 $^{\circ}\text{C}$, which was higher than that of the present

invention, the maximum inscribed circle diameter of the microstructure of the Ta compound phase was coarsened than 10 μm , and thus the mechanical strength was low.

[0033]

Each of Comparative Example Nos. 46 and 47 demonstrates that the powder was not heat-treated, and thus coarse Ta compound was remaining, and thus the mechanical strength was low. Each of Comparative Example Nos. 48 and 49 demonstrates that the powder having a particle size D50 of more than 200 to 230 μm was used, the maximum inscribed circle diameter of the microstructure of the Ta compound phase was slightly coarsened to 11 μm , and thus the bending strength was low. Each of Comparative Example Nos. 50 to 52 demonstrates that the powder having a particle size D50 of more than 230 μm was used, the maximum inscribed circle diameter of the microstructure of the Ta compound phase was coarsened, and thus the bending strength was low.

[0034]

Nos. 53 to 66 correspond to inventive examples, Nos. 67 to 70 correspond to comparative examples. Each of these examples demonstrates that the sputtering target material was composed of FCC phase and Ta compound phase. However, Each of Comparative Example Nos. 67 to 70 demonstrates that the content of the M element was more than 10%, the maximum inscribed circle diameter of the microstructure of the Ta compound phase was coarser than 10 μm , and thus the bending strength was low. On the other hand, each of Inventive Examples Nos. 1 to 32 and 53 to 66 demonstrates that the conditions of the present invention were satisfied, and thus the bending strength of the sputtering target material was high.

[0035]

As described above, the present invention provides a Ni-Ta-based alloy and a sputtering target material, wherein the strength of the sputtering target material is improved by adding a predetermined amount of Fe and/or Co into a Ni-Ta-based alloy to finely disperse the Ni-Fe-(Co)-Ta compound phase, and thus generation of cracks and particles and composition unevenness of a

sputtered film can be prevented at the time of sputtering. Thus, the present invention can exhibit extremely excellent effects.

Reference Sign

[0036]

- 1 FCC phase
- 2 Ta compound phase

CLAIMS

1. A Ni-Ta-based alloy, comprising:
15 to 50 at% of Ta;
0 to 10 at% in total of one or two or more M elements selected from Al, Ga, In, Si, Ge, Sn, Zr, Ti, Hf, B, Cu, P, C, Ru, and Cr; and
the balance comprising Ni, one or two of Fe and Co, and unavoidable impurities,
wherein the ratios of the Ni content, the Fe content, and the Co content to the total content of Ni, Fe, and Co are 20 to 98.5%, 0 to 50%, and 0 to 60%, respectively,
wherein the Ni-Ta based alloy has an FCC phase and a Ta compound phase, and
wherein the Ta compound phase has a maximum inscribed circle diameter of not more than 10 μm .
2. The Ni-Ta-based alloy according to claim 1, wherein the total content of the M elements is 0.9 to 10 at%.
3. The Ni-Ta-based alloy according to claim 1 or 2, wherein the Ni-Ta-based alloy is an alloy for an adhesion layer of a magnetic recording medium.
4. The Ni-Ta-based alloy according to claim 1 or 2, wherein the Ni-Ta-based alloy has a bending strength of not less than 450 MPa.
5. A sputtering target material, comprising the Ni-Ta-based alloy according to claim 1 or 2.
6. The sputtering target material according to claim 5, wherein the sputtering target material has a bending strength of not less than 450 MPa.
7. A magnetic recording medium, comprising an adhesion layer, wherein the adhesion layer comprises the Ni-Ta-based alloy according to claim 1 or 2.