

NON-MAGNETIC AND AMORPHOUS ALLOY, AND SPUTTERING
TARGET MATERIAL AND MAGNETIC RECORDING MEDIUM USING
THE ALLOY

5 CROSS-REFERENCE TO RELATED APPLICATIONS

[0001]

 This application is based upon and claims the benefit of
priority from Japanese Patent Application No. 2015-164493, filed
on August 24, 2015; the entire contents of which are incorporated
10 herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002]

15 The present invention relates to a non-magnetic and
amorphous Co-based alloy, a sputtering target material and
magnetic recording medium using the Co-based alloy.

Background Art

20 [0003]

 In recent years, magnetic recording technology has
remarkably progressed, and the recording density of the magnetic
recording medium has been densified in order to increase the
capacity of a hard disk drive. Further, thermally assisted magnetic
25 recording method has been studied which enables even higher
recording density than conventionally used perpendicular magnetic
recording medium.

[0004]

 The thermally assisted magnetic recording system is a
30 system in which data is recorded while heating a magnetic
recording medium with a laser. As the density of magnetic
recording media increases, the problem of thermal fluctuation in
which magnetically recorded data disappears due to the influence
of surrounding heat becomes pronounced. In order to avoid the
35 problem of such thermal fluctuation, it is necessary to increase the
coercive force of the magnetic material used for the recording

medium. However, if the coercive force becomes too high, recording cannot be performed. It is the thermally assisted magnetic recording method that solves this problem.

[0005]

5 In the thermally assisted magnetic recording method, the coercive force can be greatly reduced by heating the magnetic recording medium. Therefore, it is possible to use a material having a high crystalline magnetic anisotropy constant K_u as a raw material for a magnetic layer of the magnetic recording medium.
10 Ordered alloys such as $L1_0$ type FePt alloy, $L1_0$ type CoPt alloy, and $L1_1$ type CoPt alloy are known as high K_u magnetic materials. These magnetic materials are composed of disordered phases having a face centered cubic (fcc) structure when formed into a film by the sputtering method, for example, and have very small
15 crystalline magnetic anisotropy. Therefore, it is necessary to conduct high-temperature treatment of the disordered alloy thin film after the film formation and to transform it into the $L1_0$ ordered phase in order to increase the crystal magnetic anisotropy. JP-A-2014-220029 (Patent Literature 1) describes that the heating
20 temperature during formation of the magnetic layer can be reduced to about 400 to 500°C by adding Ag, Au, Cu, Ni, or the like.

[0006]

A magnetic recording medium having a non-magnetic and amorphous layer is known as a thermally assisted magnetic
25 recording type magnetic recording medium (thermally assisted magnetic recording medium).

[0007]

For example, JP-A-2013-157071 (Patent Literature 2) describes a thermally assisted magnetic recording medium
30 including a substrate, an underlayer, and a magnetic layer including an alloy having an $L1_0$ structure as a main component in this order. The underlayer of Patent Literature 2 includes, for example, a first underlayer composed of a non-magnetic and amorphous alloy such as NiTa, NiTi, CoTa, CoTi, CrTa, CrTi, CoCrZr,
35 CoCrTa or the like; a second underlayer comprising an alloy having a BCC structure containing Cr as a main component; a third

underlayer composed of an alloy having a BCC structure with a lattice constant of 2.98 Å or more; and a fourth underlayer comprising MgO.

[0008]

5 JP-A-2012-174321 (Patent Literature 3) describes a thermally assisted magnetic recording medium including a non-magnetic substrate, a heat dissipation layer, a buffer layer, a soft magnetic backing layer, and a magnetic recording layer in this order. The buffer layer of Patent Literature 3 is composed of a
10 non-magnetic and amorphous alloy such as CrTi, CrZr, CrTa, CrW, or the like.

[0009]

JP-A-2011-146089 (Patent Literature 4) describes a thermally assisted magnetic recording medium comprising a
15 substrate, a seed layer composed of amorphous ceramics (e.g. SiO₂), an orientation control layer of crystallinity (for example, MgO), and a magnetic layer composed of a material containing a FePt alloy as a main component in this order.

[0010]

20 A non-magnetic and amorphous layer (particularly an alloy layer) contained in a thermally assisted magnetic recording type magnetic recording medium may possibly crystallize during a high-temperature treatment for forming a magnetic layer.

[0011]

25 An amorphous alloy exhibiting a crystallization temperature of about 800 K is described by Ken Masumoto in "Fundamentals of Amorphous Metals" Ohmsha, Ltd., 1982, P 94 (Non-Patent Literature 1).

30 Citation List

Patent Literature

[0012]

Patent Literature 1: JP-A-2014-220029

Patent Literature 2: JP-A-2013-157071

35 Patent Literature 3: JP-A-2012-174321

Patent Literature 4: JP-A-2011-146089

Non-Patent Literature

[0013]

Non-Patent Literature 1: Ken Masumoto "Fundamentals of Amorphous Metals" Ohmsha, Ltd., 1982, P 94

5

SUMMARY OF THE INVENTION

Problems to be solved by the invention

[0014]

10 The object of the present invention is to provide a non-magnetic and amorphous, Co-based alloy which can prevent occurrence of crystallization during high-temperature treatment (for example, heat treatment at about 400 to 500 °C for formation of a magnetic layer of a thermally assisted magnetic recording medium), and to provide a sputtering target material and magnetic
15 recording medium using the Co-based alloy.

Means for solving the problems

[0015]

20 In order to solve the above problem, the present invention provides the following inventions.

[1] A non-magnetic and amorphous alloy comprising:

0 at% or more and 2 at% or less of Fe;

25 5 at% or more and 20 at% or less of an A-group element consisting of one or two or more elements selected from Ti, Zr and Hf;

16 at% or more and 50 at% or less of a B-group element consisting of two or more elements selected from Cr, Mo, and W;

30 0 at% or more and 25 at% or less of a C-group element consisting of one or two or more elements selected from V, Nb, and Ta;

0 at% or more and 20 at% or less of a D-group element consisting of one or two or more elements selected from Si, Ge, P, B and C; and

35 the balance being Co and inevitable impurities, wherein the total content of the A-group element and the B-group element is more than 35 at% and 70 at% or less.

[2] The alloy according to [1], wherein the content of the C-group element is 1 at% or more and 25 at% or less.

[3] The alloy according to [1] or [2], wherein the content of the D-group element is 5 at% or more and 20 at% or less.

5 [4] The alloy according to any one of [1] to [3], wherein the crystallization temperature is 773 K or higher.

[5] A sputtering target material comprising the alloy according to any one of [1] to [4].

10 [6] A magnetic recording medium comprising an alloy layer, the alloy layer comprising the alloy according to any one of [1] to [4].

Effect of the invention

[0016]

15 According to the present invention, there is provided a non-magnetic and amorphous Co-based alloy which can prevent occurrence of crystallization during high-temperature treatment (for example, heat treatment at about 400 to 500 °C for formation of a magnetic layer of a thermally assisted magnetic recording
20 medium), as well as a sputtering target material and magnetic recording medium using the Co-based alloy.

DETAILED DESCRIPTION OF THE INVENTION

[0017]

25 The present invention will be hereinafter described in detail.

The alloy of the present invention is a Co-based, non-magnetic and amorphous alloy satisfying the following composition:

- (1) The content of Fe is 0 at% or more and 2 at% or less;
- 30 (2) The content of the A-group element is 5 at% or more and 20 at% or less;
- (3) The content of the B-group element is 16 at% or more and 50 at% or less;
- (4) The total content of the A-group element and the B-group
35 element is more than 35 at% and 70 at% or less;
- (5) The content of the C-group element is 0 at% or more and

25 at% or less;

(6) The content of the D-group element is 0 at% or more and 20 at% or less.

[0018]

5 The alloy of the present invention is non-magnetic. The term "non-magnetic" used herein means that the saturation magnetic flux density measured using a vibrating-sample magnetometer (VSM) at an applied magnetic field of 1,200 kA/m is less than 0.3T.

10 [0019]

The alloy of the present invention is amorphous. The alloy of the present invention shows a halo pattern in an X-ray diffraction pattern because of its amorphous nature.

[0020]

15 The crystallization temperature of the alloy of the present invention is preferably 773 K or higher, and more preferably 873 K or higher. The alloy of the present invention is amorphous and crystallizes upon heating. The temperature at which the amorphous alloy of the present invention crystallizes is referred to as "crystallization temperature". An exothermic reaction occurs when the amorphous alloy crystallizes. The crystallization temperature is evaluated by measuring the temperature at which heat generation occurs accompanied with crystallization. For example, the crystallization temperature can be evaluated under
20 as "crystallization temperature". An exothermic reaction occurs when the amorphous alloy crystallizes. The crystallization temperature is evaluated by measuring the temperature at which heat generation occurs accompanied with crystallization. For example, the crystallization temperature can be evaluated under
25 the condition of a heating rate of 0.67 Ks^{-1} by differential scanning calorimetry (DSC).

[0021]

The reasons for limitation of the component composition of the alloy according to the present invention will be described
30 below.

(1) The content of Fe is 0 at% or more and 2 at% or less.

Fe is an element mainly for realizing cost reduction in a Co-based alloy and is an optional component in the alloy of the present invention. The content of Fe is 0 at% or more and 2 at%
35 or less based on the total number of atoms contained in the alloy of the present invention. When the Fe content exceeds 2 at%,

amorphization and non-magnetization of the Co-based alloy cannot be attained. Therefore, the content of Fe is adjusted to 2 at% or less (including 0). When the alloy of the present invention contains Fe, the content of Fe may be appropriately adjusted within a range of more than 0 at% and 2 at% or less.

[0022]

(2) The content of the A-group element is 5 at% or more and 20 at% or less.

The A-group element consists of one or two or more elements selected from Ti, Zr and Hf. The A-group element is an element mainly for attaining amorphization of the Co-based alloy, and is an essential component of the alloy of the present invention. The content of the A-group element is 5 at% or more and 20 at% or less, preferably 6 at% or more and 15 at% or less, and more preferably 9 at% or more and 14 at% or less. When the A-group element is composed of one kind of element, the "content of the A-group element" means the content of the one kind of element. When the A-group element is composed of two or more kinds of elements, "the content of the A-group element" means the total content of the two or more elements. If the content of the A-group element is less than 5 at%, amorphization of the Co-based alloy cannot be attained. Accordingly, the content of the A-group element is adjusted to 5 at% or more, preferably 6 at% or more, and more preferably 9 at% or more. Further, when the content of the A-group element exceeds 20 at%, it is impossible to attain amorphization of the Co-based alloy. Thus, the content of the A-group element is adjusted to 20 at% or less, preferably 15 at% or less, and more preferably 14 at% or less.

[0023]

(3) The content of the B-group element is 16 at% or more and 50 at% or less.

The B-group element consists of two or more elements selected from Cr, Mo, and W. The B-group element is an element mainly for enabling the rise in amorphization temperature of the Co-based alloy, and is an essential component in the alloy of the present invention. When one kind of element selected from Cr, Mo

and W is used alone, amorphization of the Co-based alloy cannot be attained. Therefore, two or more elements selected from Cr, Mo and W are used. The content of the B-group element is 16 at% or more and 50 at% or less, preferably 16 at% or more and 40 at% or less, based on the total number of atoms contained in the alloy of the present invention. The "content of the B-group element" indicates the total content of two or more kinds of elements constituting the B-group element. If the content of the B-group element is less than 16 at%, amorphization of the Co-based alloy cannot be attained. Accordingly, the content of the B-group element is adjusted to 16 at% or more. Further, when the content of the B-group element exceeds 50 at%, it is impossible to attain amorphization of the Co-based alloy. Thus, the content of the B-group element is adjusted to 50 at% or less, and preferably 40 at% or less.

[0024]

(4) The total content of the A-group element and the B-group element is more than 35 at% and 70 at% or less.

The total content of the A-group element and the B-group element is more than 35 at% and 70 at% or less, preferably 36 at% or more and 65 at% or less, and more preferably 37 at% or more and 64 at% or less. If the total content of the A-group element and the B-group element is 35 at% or less, amorphization of the Co-based alloy cannot be attained. Accordingly, the total content of the A-group element and the B-group element is adjusted to more than 35 at%, preferably 36 at% or more, and more preferably 37 at% or more. Further, when the total content of the A-group element and the B-group element exceeds 70 at%, it is impossible to attain amorphization of the Co-based alloy. Thus, the total content of the A-group element and the B-group element is adjusted to 70 at% or less, preferably 65 at% or less, and more preferably 64 at% or less.

[0025]

(5) The content of the C-group element is 0 at% or more and 25 at% or less.

The C-group element consists of one or two or more

elements selected from V, Nb, and Ta. The C-group element is an element mainly for promoting amorphization of the Co-based alloy and for enabling the rise in the crystallization temperature, and is an optional component in the alloy of the present invention. The content of the C-group element is 0 at% or more and 25 at% or less, preferably 0 at% or more and 20 at% or less, and more preferably 0 at% or more and 10 at% or less, based on the total number of atoms contained in the alloy of the present invention. When the C-group element is composed of one kind of element, the "content of the C-group element" means the content of the one kind of element. When the C-group element is composed of two or more kinds of elements, the "content of the C-group element" means the total content of the two or more elements. If the content of the C-group element exceeds 25 at%, amorphization of the Co-based alloy cannot be attained. Accordingly, the content of the C-group element is adjusted to 25 at% or less, preferably 20 at% or less, and more preferably 10 at% or less. When the alloy of the present invention contains the C-group element, the content of the C-group element may be appropriately adjusted within a range of more than 0 at% and 25 at% or less. The content of the C-group element is, for example, 1 at% or more, 3 at% or more, or 4 at% or more.

[0026]

(6) The content of the D-group element is 0 at% or more and 20 at% or less.

The D-group element consists of one or two or more elements selected from Si, Ge, P, B, and C. The D-group element is an element mainly for improving amorphous nature (amorphous nature) of the Co-based alloy, and is an optional component in the alloy of the present invention. The content of the D-group element is 0 at% or more and 20 at% or less, preferably 0 at% or more and 15 at% or less, and more preferably 0 at% or more and 10 at% or less, based on the total number of atoms contained in the alloy of the present invention. When the D-group element is composed of one kind of element, the "content of the D-group element" means the content of the one kind of element. When the

D-group element is composed of two or more kinds of elements, the "content of the D-group element" means the total content of the two or more elements. If the content of the D-group element exceeds 20 at%, amorphization of the Co-based alloy cannot be attained. Accordingly, the content of the D-group element is adjusted to 20 at% or less, preferably 15 at% or less, and more preferably 10 at% or less. When the alloy of the present invention contains the D-group element, the content of the D-group element may be appropriately adjusted within a range of more than 0 at% and 20 at% or less. The content of the D-group element is, for example, 5 at% or more.

[0027]

In the alloy of the present invention, the balance other than Fe, the A-group element, the B-group element, the C-group element and the D-group element is composed of Co and inevitable impurities. The inevitable impurities include Al, Cu, Mn, and the like. The content of the inevitable impurities is preferably 1,000 ppm or less.

[0028]

The sputtering target material of the present invention contains the alloy of the present invention. The sputtering target material of the present invention may be used for forming an alloy layer (alloy thin film) containing the alloy of the present invention.

[0029]

The magnetic recording medium of the present invention includes an alloy layer (alloy thin film) containing the alloy of the present invention. The magnetic recording medium of the present invention is, for example, a perpendicular magnetic recording medium, a thermally assisted magnetic recording medium, or the like. The alloy layer (alloy thin film) containing the alloy of the present invention can be formed by a sputtering method using a sputtering target material containing the alloy of the present invention.

[0030]

The alloy of the present invention can prevent occurrence of crystallization during high-temperature treatment (for example,

heat treatment at about 400 to 500°C during formation of a magnetic layer of thermally assisted magnetic recording medium). Therefore, the alloy of the present invention is suitable as a raw material for an alloy layer required to be non-magnetic and amorphous alloy layers of a magnetic recording medium (for example, a thermally assisted magnetic recording medium) which requires high temperature treatment at the time of production.

[0031]

Examples of a magnetic recording medium having a non-magnetic and amorphous layer includes: a thermally assisted magnetic recording medium comprising a substrate, a plurality of underlayers including a non-magnetic and amorphous underlayer, and a magnetic layer containing an alloy having an $L1_0$ structure as a main component in this order (for example, JP-A-2013-157071); a thermally assisted magnetic recording medium including a non-magnetic substrate, a heat dissipation layer, a non-magnetic and amorphous buffer layer, a soft magnetic backing layer, and a magnetic recording layer in this order (for example, JP-A-2012-174321); a thermally assisted magnetic recording medium including a substrate, a non-magnetic and amorphous seed layer, an orientation control layer of crystallinity in this order (for example, MgO), and a magnetic layer composed of a material containing an FePt alloy as a main component (for example, JP-A-2011-146089) and the like. The alloys of the present invention can be used as a raw material for these non-magnetic and amorphous layers.

EXAMPLES

[0032]

The present invention will be hereinafter described in detail based on examples.

Normally, a thin film in a perpendicular magnetic recording medium can be obtained by sputtering a sputtering target material having the same composition as that of the thin film to form a film, for example, on a glass substrate. Here, the thin film formed by sputtering is quenched. On the other hand, quenched ribbons

produced by a single roll type liquid quenching apparatus are used as the samples of the examples and comparative examples. This is to evaluate the influence of components on various properties of a thin film which is actually quenched and formed by sputtering and evaluated by a liquid quenched ribbon in a simple manner.

[0033]

[Producing conditions for quenched ribbon]

A raw material 30 g weighed to have the composition shown in Tables 1 and 2 was arc-melted in Ar under reduced pressure in a water-cooled copper mold having a diameter of about 10 x 40 mm to provide a molten base material for a quenched ribbon. The producing conditions for the quenched ribbon are as follows. The production of the quenched ribbon was conducted by a single roll method under the condition in which the molten base material was set in a silica tube having a diameter of 15 mm and was tapped from a tapping nozzle having a diameter of 1 mm, at an atmosphere pressure of 61 kPa, at a spray differential pressure of 69 kPa, at a rotational number of 3,000 rpm of a copper roll (diameter of 300 mm), with a gap between the copper roll and the tapping nozzle being set to 0.3 mm. The tapping temperature was a temperature immediately after burn-through of each sample. Thus, produced quenched ribbon was used as a sample and evaluated for the following items.

[0034]

[Evaluation of saturation magnetic flux density of quenched ribbon]

The saturation magnetic flux density was measured on a VSM apparatus (vibrating-sample magnetometer) at 1,200 kA/m of applied magnetic field. The weight of the sample was about 15 mg. In Tables 1 and 2, the sample having saturation magnetic flux density of less than 0.3T was rated as "A", and that having 0.3T or more was rated as "C".

[0035]

[Structure of quenched ribbon]

Usually, measurement of an X ray diffraction pattern of an amorphous material will find no diffraction peak but find a halo-pattern characteristic of an amorphous material. In addition,

a material which is not completely amorphous shows some diffraction peaks, but the peaks are lower than those of a crystalline material, and also shows a halo-pattern. Therefore, amorphous nature was evaluated according to the following method.

[0036]

[Evaluation of amorphous nature]

Double-sided tape was adhered onto a glass plate and measured on an X-ray diffraction apparatus to obtain a diffraction pattern. In this case, a sample was adhered on the glass plate so that the surface of the quenched ribbon in contact with the copper roll was the surface to be measured. Measurement was carried out using Cu-alpha ray as an X-ray source at scanning speed of 4 °/min. In Tables 1 and 2, a sample wherein a halo-pattern was observed was rated as "A", and a sample wherein no halo-pattern was found was rated as "C".

[0037]

[Evaluation of crystallization temperature of quenched ribbon]

Usually, an amorphous material crystallizes upon heating, and the temperature at which the material crystallizes is referred to as a crystallization temperature. In addition, an exothermic reaction occurs during crystallization. A crystallization temperature was evaluated by measuring a temperature at which exothermic reaction occurs accompanied with crystallization. Therefore, a crystallization temperature was evaluated according to the following method. A crystallization temperature was studied under conditions involving a heating rate of 0.67 Ks^{-1} according to a differential scanning calorimetry (DSC). In Tables 1 and 2, a sample having a crystallization temperature of 873 K or higher was rated as "A", and a sample having a crystallization temperature of 773 K or more and less than 873 K was rated as "B", and a sample having a crystallization temperature of less than 773 K was rated as "C".

[0038]

Table 1

No	Fe	A-group Element (at%)					B-group Element (at%)					A+B	C-group Element (at%)					D-group Element (at%)					Co
		Ti	Zr	Hf	Total A	Cr	Mo	W	Total B	V	Nb		Ta	Si	Ge	P	B	C					
1	0	5	5	5	15	25	25		50			65									Balance		
2	0		10	5	15		20	20	40			55									Balance		
3	2	3	3		6	20		20	40			46									Balance		
4	0	6		8	14	20	20	10	50			64									Balance		
5	2	5			5	10	10	20	40			45									Balance		
6	0		10		10		13	13	26			36									Balance		
7	0			5	5	14	14	14	42			47									Balance		
8	0	20			20	4	6	6	16			36									Balance		
9	0		5		5	16	16		32			37									Balance		
10	0			20	20		25	25	50			70									Balance		
11	0		10	10	20	10	6		16			36									Balance		
12	0	5	5	10	20	4	4	8	16			36									Balance		
13	0	5	5	5	15	25	25		50			65		5	5						Balance		
14	0		10	5	15		15	25	40			55		5							Balance		
15	0	3	3		6	22		18	40			46		10	5						Balance		
16	0	6		8	14	15	17	18	50			64		10	10						Balance		
17	0	5			5	10	10	20	40			45			1						Balance		
18	0		10		10		15	15	30			40		3							Balance		
19	0			5	5	12	12	12	36			41				8					Balance		
20	0	20			20	4	6	6	16			36			20						Balance		
21	0		20		20	20	30		50			70		25							Balance		
22	0			20	20		20	30	50			70									Balance		
23	0		10	10	20	8	8		16			36			20						Balance		
24	0	8	2	10	20	4	4	8	16			36		5	5	10					Balance		
25	0	5	3	7	15	25	25		50			65			10	3	3	3	3	3	Balance		
26	0		14	1	15		15	25	40			55			4		5	5	5	5	Balance		

Table 1 (continued)

No	Saturation Magnetic Flux Density	Amorphous Nature	Crystallization Temperature	Remarks
1	A	A	B	Inventive Examples.
2	A	A	A	
3	A	A	A	
4	A	A	B	
5	A	A	A	
6	A	A	B	
7	A	A	A	
8	A	A	A	
9	A	A	B	
10	A	A	B	
11	A	A	A	
12	A	A	A	
13	A	A	B	
14	A	A	B	
15	A	A	B	
16	A	A	B	
17	A	A	A	
18	A	A	A	
19	A	A	A	
20	A	A	A	
21	A	A	B	
22	A	A	B	
23	A	A	A	
24	A	A	A	
25	A	A	B	
26	A	A	B	

[0039]

Table 2

No	Fe	A-group Element (at%)				B-group Element (at%)				A+B	C-group Element (at%)				D-group Element (at%)				Co
		Ti	Zr	Hf	Total A	Cr	Mo	W	Total B		V	Nb	Ta	Si	Ge	P	B	C	
27	0	1	4		5	22		18	40	45						8	8	4	Balance
28	0	13		1	14	15	17	18	50	64							5	5	Balance
29	0	5			5	10	10	20	40	45								10	Balance
30	0		10		10		15	15	30	40						5		10	Balance
31	0			5	5	12	12	12	36	41			20		6			4	Balance
32	0	20			20	4	6	6	16	36				5					Balance
33	0		15		15	20	30		50	65		25			5				Balance
34	0			15	15		20	30	50	65	5	5				10			Balance
35	0	10		10	20	8	8		16	36							20		Balance
36	0	8	2	10	20	4	4	8	16	36	20							10	Balance
37	0		5		5		3	2	5	10									Balance
38	0		10		10		35		35	45									Balance
39	0		25		25		15	15	30	55									Balance
40	0	3			3	15		20	35	38									Balance
41	0			5	5	25	25	5	55	60									Balance
42	0	10			10	10	10	10	30	40			30						Balance
43	0			10	10	10	8	12	30	40		28							Balance
44	0		10		10	10	10	10	30	40	5			10	10		5		Balance
45	0		5	5	10	10	10	10	30	40						25			Balance
46	<u>50</u>	5	5		10		15	15	30	40									Balance

Note 1) The underlined value is not included in the present invention.

Note 2) The blank means zero.

Table 2 (continued)

No	Saturation Magnetic Flux Density	Amorphous Nature	Crystallization Temperature	Remarks
27	A	A	B	Inventive Examples
28	A	A	B	
29	A	A	A	
30	A	A	A	
31	A	A	B	
32	A	A	A	
33	A	A	B	
34	A	A	B	
35	A	A	B	
36	A	A	B	
37	C	A	B	Comparative Examples
38	A	C	C	
39	A	C	C	
40	A	C	C	
41	A	C	C	
42	A	C	C	
43	A	C	C	
44	A	C	C	
45	A	C	C	
46	C	C	C	

[0040]

In Tables 1 and 2, Nos. 1 to 36 are Inventive Examples, and Nos. 37 to 46 are Comparative Examples.

[0041]

5 As can be seen in Tables 1 and 2, the Inventive Example Nos. 1 to 36 are Co-based alloys satisfying the following compositions and rated as "A" or "B" for the saturation magnetic flux density and crystallization temperature.

(1) The content of Fe is 0 at% or more and 2 at% or less.

10 (2) The content of the A-group element is 5 at% or more and 20 at% or less.

(3) The content of the B-group element is 16 at % or more and 50 at% or less.

(4) The total content of the A-group element and the B-group
15 element is more than 35 at% and 70 at% or less.

(5) The content of the C-group element is 0 at% or more and 25 at% or less.

(6) The content of the D-group element is 0 at% or more and 20 at% or less.

20 [0042]

Since Comparative Example No. 37 has the content of the B-group element of less than 16 at% and the total content of the A-group element and the B-group element of 35 at% or less, it has magnetic property. In Comparative Example No. 38, since the
25 B-group element included only one constituting element, it is not amorphous and has low crystallization temperature. Since Comparative Example No. 39 has the content of the A-group element of more than 20 at%, it is not amorphous and has low crystallization temperature. Since Comparative Example No. 40
30 has the content of the A-group element of less than 5 at%, it is not amorphous and has low crystallization temperature. Since Comparative Example No. 41 has the B-group element of more than 50 at%, it is not amorphous and has low crystallization temperature. Since Comparative Examples Nos. 42 and 43 have
35 the C-group element of more than 25 at%, they are not amorphous and have low crystallization temperature. Since Comparative

Examples Nos. 44 and 45 have the C-group element of more than 20 at%, they are not amorphous and have low crystallization temperature. Since Comparative Example No. 46 has Fe content of more than 50 at%, it is not non-magnetic and amorphous and
5 has low crystallization temperature.

[0043]

Next, the method for producing a sputtering target material will be described. For seven constitutional components of the Inventive Example Nos. 1, 10, 15, 25, and 30 in Table 1, as well as
10 Comparative Example Nos. 37, and 45 in Table 2 were melted by induction heating in a refractory crucible in an Ar gas atmosphere under reduced pressure, then tapped through a nozzle having a diameter of 8 mm located at the lower part of the crucible, and atomized with Ar gas. This gas-atomized powder was degassed
15 and charged as a raw material in a can made of SC having outer diameter of 220 mm, inner diameter of 210 mm, and length of 200 mm. The reachable vacuum degree during degassing was set to about 1.3×10^{-2} Pa.

[0044]

The charged powdery billet was heated to 1,150°C, then
20 charged into a constrained container having a diameter of 230 mm, and molded under applied pressure of 500 MPa. The solidified molding manufactured by the aforementioned method was processed into a disc having a diameter of 180 mm and thickness
25 of 7 mm by wire-cutting, turning process, and surface grinding to provide a sputtering target material.

[0045]

The seven types of component compositions were formed into sputtered film onto a glass substrate using a sputtering target
30 material. All compositions provided the sputtered film of the same magnetic flux density, amorphous nature and crystallization temperature of as those given in Tables 1 and 2.

[0046]

As described above, the present invention provides a
35 non-magnetic and amorphous (amorphous) Co-based alloy having a sufficiently high crystallization temperature and a sputtering

target material and a magnetic recording medium using the Co-based alloy.

CLAIMS

1. A non-magnetic and amorphous alloy for magnetic recording, the alloy comprising in at. %:
 - 2 % or less (including 0) of Fe;
 - 5 5 % or more and 20 % or less of an A-group element consisting of one or two or more elements selected from an A-group;
 - 16 % or more and 50 % or less of a B-group element consisting of two or more elements selected from a B-group;
 - 10 and
 - the balance being Co and inevitable impurities, wherein the total content of the A-group element and the B-group element is more than 35 % and 70 % or less, wherein the A-group consists of Ti, Zr, and Hf, and
 - 15 wherein the B-group consists of Cr, Mo, and W.
2. A non-magnetic and amorphous alloy for magnetic recording, the alloy comprising in at. %:
 - 2 % or less (including 0) of Fe;
 - 20 5 % or more and 20 % or less of an A-group element consisting of one or two or more elements selected from an A-group;
 - 16 % or more and 50 % or less of a B-group element consisting of two or more elements selected from a B-group;
 - 25 1 % or more and 25 % or less of a C-group element consisting of one or two or more elements selected from a C-group; and
 - the balance being Co and inevitable impurities, wherein the total content of the A-group element and the
 - 30 B-group element is more than 35 % and 70 % or less, wherein the A-group consists of Ti, Zr, and Hf, wherein the B-group consists of Cr, Mo, and W, and wherein the C-group consists of V, Nb, and Ta.
- 35 3. A non-magnetic and amorphous alloy for magnetic

recording, the alloy comprising in at. %:

- 2 % or less (including 0) of Fe;
- 5 % or more and 20 % or less of an A-group element consisting of one or two or more elements selected from an A-group;
- 16 % or more and 50 % or less of a B-group element consisting of two or more elements selected from a B-group;
- 5 % or more and 20 % or less of a D-group element consisting of one or two or more elements selected from a D-group; and
- the balance being Co and inevitable impurities, wherein the total content of the A-group element and the B-group element is more than 35 % and 70 % or less, wherein the A-group consists of Ti, Zr, and Hf, wherein the B-group consists of Cr, Mo, and W, and wherein the D-group consists of Si, Ge, P, B, and C.

4. A non-magnetic and amorphous alloy for magnetic recording, the alloy comprising in at. %:

- 2 % or less (including 0) of Fe;
- 5 % or more and 20 % or less of an A-group element consisting of one or two or more elements selected from an A-group;
- 16 % or more and 50 % or less of a B-group element consisting of two or more elements selected from a B-group;
- 1 % or more and 25 % or less of a C-group element consisting of one or two or more elements selected from a C-group;
- 5 % or more and 20 % or less of a D-group element consisting of one or two or more elements selected from a D-group; and
- the balance being Co and inevitable impurities, wherein the total content of the A-group element and the B-group element is more than 35 % and 70 % or less, wherein the A-group consists of Ti, Zr, and Hf, wherein the B-group consists of Cr, Mo, and W,

wherein the C-group consists of V, Nb, and Ta, and
wherein the D-group consists of Si, Ge, P, B, and C.

5. A sputtering target material, comprising the
5 non-magnetic and amorphous alloy for magnetic recording
according to any one of claims 1 to 4.
6. A magnetic recording medium, comprising the
non-magnetic and amorphous alloy for magnetic recording
10 according to any one of claims 1 to 4.