

SOFT MAGNETIC ALLOY FOR MAGNETIC RECORDING,
SPUTTERING TARGET MATERIAL, AND MAGNETIC RECORDING
MEDIUM

5 [Cross-Reference to Related Application]
[0001]

This application claims priority to Japanese Patent Application No. 2011-30562 filed on February 16, 2011, the entire content of which is incorporated herein by reference.

10 [Technical Field]
[0002]

The present invention relates to a Co-based soft magnetic alloy for magnetic recording, used for a soft magnetic layer in a perpendicular magnetic recording medium, a sputtering target material, and a magnetic recording medium including such a
15 soft magnetic layer.

[Background Art]
[0003]

In recent years, there have been remarkable progresses in
20 perpendicular magnetic recording, heightening of magnetic recording densities has been proceeding due to increasing drive capacities, and perpendicular magnetic recording system, which achieves further high density when compared to longitudinal magnetic recording system conventionally used, has been put
25 into practical use. Perpendicular magnetic recording system is a system in which a magnetization-easy axis is oriented in the direction vertical to the medium surface of a magnetic film of a perpendicular magnetic recording medium and is suitable for heightening a density. For the magnetic recording system, a
30 multilayer recording medium having a magnetic recording layer with an increased recording density, a soft magnetic layer, and an intermediate layer has been developed. Moreover, for the magnetic recording layer, a CoCrPt-SiO₂-based alloy is commonly used.

35 [0004]

As for the soft magnetic film layer, on the other hand, there are

proposed alloys based on soft magnetic elements of Co and Fe, to which Zr, Hf, Ta, Nb and B for improving amorphous properties are added, in Japanese Patent Laid-Open Publication No. 2008-299905 (Patent Literature 1) and Japanese Patent Laid-Open Publication No. 2008-189996 (Patent Literature 2). High saturation magnetic flux density, high amorphous properties and high corrosion resistance are required for the soft magnetic film layer in this perpendicular magnetic recording medium.

10 [0005]

Further, a soft magnetic film of a Fe-Co-B-based compound is proposed as a soft magnetic layer in a double-layer recording medium. For example, as disclosed in Japanese Patent Laid-Open Publication No. 2004-346423 (Patent Literature 3), there is proposed a Fe-Co-B target in which the diameter of a maximum inscribed circle that can be drawn on a region, where no boride layer is present, in a cross-sectional microstructure is 30 μm or less.

[0006]

20 To form the above above-mentioned soft magnetic film, a magnetron sputtering method is generally used. The magnetron sputtering method is a sputtering method that enables high speed film formation by placing a magnet behind the target material, leaking a magnetic flux on the surface of the target material, and converging plasma in its leakage magnetic flux region. Since the magnetron sputtering method is characterized in that the magnetic flux is leaked on the sputtering surface of the target material, it is difficult, when the magnetic permeability of the target material itself is high, to form a leakage magnetic flux necessary and sufficient for the magnetron sputtering method on the sputtering surface of the target material. Patent Literature 3 thus has been proposed for a requirement to minimize the magnetic permeability of the target material itself.

35 [0007]

However, there is such a problem that the limit of the thickness

of the above-mentioned target product is around 5 mm and when the thickness is more increased, a sufficient leakage magnetic flux does not come out and therefore normal magnetron sputtering cannot be performed. The target material is desirably a Fe-based material, since the material is required to have a high magnetic flux density after film formation. In the case of a Fe-based material, however, the target material has the problem of corrosion resistance; film quality may be deteriorated by oxidation of the target material; and poor sputtering may be caused by abnormal discharge in the oxidized region during sputtering.

[0008]

In order to solve this, in Japanese Patent Laid-Open Publication No. 2007-284741 (Patent Literature 4), there has been reported the production of a soft magnetic target improved in corrosion resistance without deteriorating the magnetic properties, but excellent amorphous property is not described.

[Summary of the Invention]

[0009]

The applicants have now found that amorphous property is improved by adding (A) group element(s) selected from Ta, Nb and V; hardness is improved by adding (B) group element(s) selected from Cr, Mo and W; amorphous property is secured by adding (C) group element(s) selected from Ti, Zr and Hf; and the (A) group, (B) group and (C) group elements are also effective at improving corrosion resistance. As a result, a soft magnetic alloy for magnetic recording, superior in amorphous property, corrosion resistance and hardness, has been able to be provided. Further, amorphous properties, hardness and corrosion resistance are effective for noise reduction, shock resistance and thinning of a carbon film, respectively.

[0010]

It is therefore an object of the present invention to provide a soft magnetic alloy for a perpendicular magnetic recording medium superior in amorphous property, hardness and corrosion resistance; and a sputtering target material for

producing a thin film of the alloy.

[0011]

According to one embodiment of the present invention, there is provided a soft magnetic alloy for magnetic recording comprising in at. %:

(A) 0.5% or more of one or two or more of elements selected from the group consisting of Ta, Nb and V;

(B) 0.5% or more of one or two or more of elements selected from the group consisting of Cr, Mo and W;

10 (C) 0 to 5% of one or two or more of elements selected from the group consisting of Ti, Zr and Hf;

(D) 0 to 30% of one or two of elements selected from the group consisting of Ni and Mn;

15 (E) 0 to 5% of one or two of elements selected from the group consisting of Al and Cu; and

(F) 0 to 10% of one or two or more of elements selected from the group consisting of Si, Ge, P, B and C; and

the balance Co and Fe and unavoidable impurities,

20 wherein a ratio of Fe:Co is 10:90 to 70:30; and the total amount of the (A) group element(s), the (B) group element(s) and the (C) group element(s) is 10 to 30% of the alloy.

[0012]

According to another embodiment of the present invention, there is provided a sputtering target material comprising the soft magnetic alloy for magnetic recording of the present invention.

[0013]

According to still another embodiment of the present invention, there is provided a magnetic recording medium comprising a soft magnetic layer comprising the soft magnetic alloy for magnetic recording of the present invention.

[Description of Embodiments]

[0014]

35 The present invention is specifically explained below. Unless otherwise specified, "%" as used herein means at. %.

[0015]

The soft magnetic alloy for magnetic recording according to the present invention comprises in at. %: (A) 0.5% or more of one or two or more of elements selected from the group consisting of Ta, Nb and V; (B) 0.5% or more of one or two or more of elements selected from the group consisting of Cr, Mo and W; (C) 0 to 5% of one or two or more of elements selected from the group consisting of Ti, Zr and Hf; (D) 0 to 30% of one or two of elements selected from the group consisting of Ni and Mn; (E) 0 to 5% of one or two of elements selected from the group consisting of Al and Cu; and (F) 0 to 10% of one or two or more of elements selected from the group consisting of Si, Ge, P, B and C; and the balance Co and Fe and unavoidable impurities, preferably consists essentially of these elements and unavoidable impurities, and more preferably consists of these elements and unavoidable impurities. In the alloy of the present invention, a ratio of Fe:Co is 10:90 to 70:30, and the total amount of the (A) group element(s), the (B) group element(s) and the (C) group element(s) is 10 to 30% of the alloy.

[0016]

Fe and Co compose soft magnetic elements and are contained in the alloy at a ratio of Fe:Co of 10:90 to 70:30. The ratio of Fe and Co is a parameter securing soft magnetism and greatly influencing a saturation magnetic flux density, amorphous property, hardness and corrosion resistance, particularly, the ratio of Fe:Co of less than 10 results in an insufficient saturation magnetic flux density, and the ratio of more than 70 results in deterioration of corrosion resistance.

[0017]

The (A) group element(s) are one or two or more elements selected from the group consisting of Ta, Nb and V and improving amorphous property and hardness, and are contained in the alloy at 0.5 at. % or more, preferably 2 to 20 at. %, and further preferably 4 to 15 at. %. The (A) group element(s) of less than 0.5 at. % cause the above-described improvement effects to be insufficient.

[0018]

The (B) group element(s) are one or two or more elements selected from the group consisting of Cr, Mo and W and improving amorphous property and corrosion resistance, and
5 are contained in the alloy at 0.5 at.% or more, preferably 1 to 20 at.%, and further preferably 2 to 10 at.%. The (B) group element(s) of less than 0.5 at.% cause the above-described improvement effects to be insufficient.

[0019]

10 The (C) group element(s) are one or two or more elements selected from the group consisting of Ti, Zr and Hf and improving amorphous property, and are contained in the alloy at 0 to 5 at.% and preferably 2 to 4 at.%. The (C) group element(s) of more than 5 at.% result in an insufficient
15 saturation magnetic flux density.

[0020]

The total amount of the (A) group element(s), the (B) group element(s) and the (C) group element(s) is 10 to 30 at.% of the alloy. All of the (A) group elements, the (B) group elements,
20 and the (C) group elements are elements that improve amorphous property and corrosion resistance, but the total amount of these elements of less than 10 at.% causes the effects to be insufficient while the amount of more than 30% results in an insufficient saturation magnetic flux density.

25 [0021]

The (D) group element(s) are one or two optional elements selected from the group consisting of Ni and Mn and adjusting a saturation magnetic flux density, and are contained in the alloy at 0 to 30 at.%, preferably more than 0% and not more than 30
30 at.%, more preferably not more than 10 at.%, and further preferably 1 to 5 at.%. Within these ranges, a sufficient saturation magnetic flux density is easy to be obtained.

[0022]

The (E) group element(s) are one or two optional elements
35 selected from the group consisting of Al and Cu and improving corrosion resistance, and are contained in the alloy at 0 to 5

at.%, preferably more than 0% and not more than 5 at.%, and more preferably 1 to 4 at.%. Within these ranges, deterioration in amorphous property is precluded.

[0023]

- 5 The (F) group element(s) are one or two or more optional elements selected from the group consisting of Si, Ge, P, B and C and improving amorphous property, and are contained at 0 to 10 at.%, preferably more than 0% and not more than 10 at.%, and more preferably 1 to 8 at.%. Within these ranges, a
10 saturation magnetic flux density can be prevented from decreasing without saturating the above-described improvement effect.

[0024]

- The sputtering target material according to the present
15 invention is composed of the above-described soft magnetic alloy for magnetic recording. The thickness of the sputtering target material is not particularly limited but normal sputtering can be performed even when the thickness is more than 5 mm, and the thickness is preferably 7 mm or more. A magnetic
20 recording medium comprising a soft magnetic layer composed of the above-described soft magnetic alloy for magnetic recording can be produced by performing sputtering using such a sputtering target material of the present invention.

[Examples]

- 25 [0025]

The alloy according to the present invention is specifically explained below with reference to Examples.

[0026]

- Normally, a seed layer in a perpendicular magnetic recording
30 medium is formed by sputtering a sputtering target material having the same composition as that of the seed layer to form a film on a glass substrate or the like. At this point, the thin film formed by sputtering has been quenched. Quenched ribbons produced in a single-roll-type quenching device are used as
35 sample materials according to the present invention. This is to evaluate the influence of the thin films, which are actually

formed by sputtering, on various properties by the components in a simple manner using liquid quenched ribbons.

[0027]

Production Conditions of Quenched Ribbon

5 As the production conditions of a quenched ribbon, a raw material of 20 g weighed to have each constituent shown in Table 1 and Table 2 was arc-melted in Ar with a reduced pressure in a water-cooled copper die having a diameter of about 40 mm to provide a molten raw material for the quenched
10 ribbon. The production of the quenched ribbon was conducted by a single roll method under the condition in which the molten raw 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 atmospheric pressure of 61 kPa, at an atomizing
15 pressure difference of 69 kPa, and at a rotational number of 3000 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 temperature at which each raw material melted down was taken as the tapping temperature. Quenched ribbons thus
20 produced were used as sample materials to evaluate the properties described below.

[0028]

Structure of Quenched Ribbon

In general, when an X-ray diffraction pattern of the amorphous
25 material is measured, no diffraction peak is observed to show a halo pattern specific to amorphous materials. Although a diffraction peak is observed in a material not completely amorphous, the height of the peak is lower than that of a crystal material and a halo pattern is also observed. Therefore,
30 the amorphous properties were evaluated by the following method.

[0029]

In the evaluation of the amorphous properties, the sample material was adhered on a glass plate with a double-faced tape
35 to obtain a diffraction pattern by an X-ray diffraction device. At this time, the sample material was adhered on the glass plate

so that a surface to be measured could be a copper-roll-contact surface of the quenched ribbon. The X-ray source was Cu-K α ray, and the measurement was conducted at a scan speed of 4°/min. The diffraction patterns in which a halo pattern was able to be confirmed and in which no halo pattern was observed were considered to be "good" and "poor," respectively, for evaluating amorphous properties.

[0030]

Corrosion Resistance of Quenched Ribbon (NaCl)

A sample material was adhered on a glass plate with a double-faced tape to conduct a salt spray test with 5% NaCl at 35°C for 16 h. A sample with rusting on the whole surface was evaluated as "poor" and a sample with rusting in some parts was evaluated as "good."

[0031]

Corrosion Resistance of Quenched Ribbon (HNO₃)

There was weighed 50 mg of a sample material, 10 ml of 3 at.% HNO₃ aqueous solution was added dropwise, and the resultant was then left standing at room temperature for 1 hr, followed by analyzing the amount of Co eluted into the 3% HNO₃ aqueous solution. The amount of eluted Co of less than 500 ppm was evaluated as "good," the amount of 500 or more and less than 1000 ppm as "fair," and 1000 ppm or more as "poor."

[0032]

Hardness of Quenched Ribbon

The quenched ribbon was longitudinally embedded into a resin and polished for measurement by a Vickers hardness tester. The measuring load was 50 g and the evaluation was based on an average of $n=10$. A sample that shows a Vickers hardness of not less than 1000 HV is evaluated as "excellent," 760 to less than 1000 HV as "good," and less than 760 HV as "fair."

[0033]

Saturation Magnetic Flux Density of Quenched Ribbon

Measurement was performed at an applied magnetic field of 1200 kA/m in a VSM device (vibration-sample-type magnetometer). The weight of the sample material was around

15 mg, and a material with a saturation magnetic flux density of 0.3 T or more and less than 1.0 T was evaluated as "good" and a material with that of 1.0 T or more as "excellent." A material with a saturation magnetic flux density of less than 0.3% was
5 evaluated as "poor."

[0034]

Compositions according to the present invention are shown below in Table 1 and Table 2 while a saturation magnetic flux density, amorphous property, corrosion resistance, and hardness
10 as the effects thereof are shown in Tables 3 and 4.

[0035]

[Table 1]

Table 1

No.	Co:Fe	Composition (at.%)																				Co				
		(A) Group		(B) Group		(C) Group			(A)+(B)+(C)			(D) Group			(E) Group			(F) Group								
		Ta	Nb	V	Cr	Mo	W	Ti	Zr	Hf	Ni	Mn	Al	Cu	Si	Ge	P	B	C							
1	90:10			20		5					25														Bal.	
2	90:10	10					20				30															Bal.
3	90:10	8			2				4		14					1								6		Bal.
4	90:10	8				2			4		14					1		2	2							Bal.
5	90:10		10						4		16					2	2			2						Bal.
6	90:10	3		5	1			1	3		13					1	2			2			2			Bal.
7	80:20	8				2			1		11					1							8			Bal.
8	80:20		8			2					10					1	2									Bal.
9	80:20	5		3		2		2			12					2										Bal.
10	80:20			7		5					12															Bal.
11	70:30	0.6			10				2		12.6					1	1									Bal.
12	70:30	10			1				3		14					6		1								Bal.
13	70:30	11			3				3		17					12	1									Bal.
14	70:30	8			3				3		14						1									Bal.
15	70:30	8				2		2		2	14					1		1						5		Bal.
16	70:30	6	2			2					10					2			2							Bal.
17	70:30	13					2		3		18												2			Bal.
18	50:50	10			1						11												8			Bal.
19	50:50		8			2	3		3		16															Bal.
20	50:50			8	5				3		16															Bal.
21	50:50	6		4	2				3		15															Bal.
22	50:50	6	4			2			3		15					1	1								1	Bal.
23	40:60	8				2			2		12					1							4			Bal.
24	40:60		8		3					3	14															Bal.
25	40:60			8		10			2		20															Bal.
26	40:60	6		4	3			3			16												4			Bal.
27	40:60	6	4		3				3		16					1		1					4			Bal.
28	30:70	10			3				2		15							1					4			Bal.
29	30:70		8		5				4		17					1									8	Bal.
30	30:70			8	5				4		17														8	Bal.
31	30:70	6		4	5				4		19							1								Bal.
32	30:70	6	4		5			2	2		19					1		1								Bal.

Present Invention Examples

Present Invention Examples

Table 2

Composition (at.%)																							
No.	Co:Fe	(A) Group		(B) Group			(C) Group				(A)+(B)+(C)	(D) Group			(E) Group			(F) Group					Co
		Ta	Nb	V	Cr	Mo	W	Ti	Zr	Hf		Ni	Mn	Al	Cu	Si	Ge	P	B	C			
33	90:10	30			10				4		44			1					6	Bal.			
34	70:30	10				30		1			41			2					8	Bal.			
35	50:50	<u>0.4</u>			3	3	3		2		11.4			1			1	4		Bal.			
36	80:20	8			<u>0.35</u>						8.35			1	2				2	Bal.			
37	80:20		6				2	3	<u>20</u>		31		2	2						Bal.			
38	70:30		8								8			<u>30</u>	2				2	Bal.			
39	50:50		5			5					10		2	1		<u>2</u>	<u>2</u>	<u>20</u>		Bal.			
40	<u>92:8</u>		8		8				4		20			1	1					Bal.			
41	<u>20:80</u>		8		8					4	20			1	1			8		Bal.			
42	70:30		8			5			2		15		<u>20</u>	<u>12</u>						Bal.			
Comparative Examples																							

NOTE: The underlined figures fall outside the scope of the present invention.

[0037]

[Table 3]

Table 3

No.	Amorphous Properties	Corrosion Resistance (NaCl)	Corrosion Resistance (HNO ₃)	Hardness	Saturation Magnetic Flux Density	
1	Good	Good	Good	Good	Good	Present Invention Examples
2	Good	Good	Good	Excellent	Good	
3	Good	Good	Fair	Excellent	Good	
4	Good	Good	Good	Excellent	Good	
5	Good	Good	Good	Excellent	Good	
6	Good	Good	Fair	Excellent	Good	
7	Good	Good	Good	Excellent	Good	
8	Good	Good	Good	Excellent	Excellent	
9	Good	Good	Good	Excellent	Excellent	
10	Good	Good	Good	Fair	Good	
11	Good	Good	Good	Fair	Excellent	
12	Good	Good	Fair	Excellent	Excellent	
13	Good	Good	Fair	Excellent	Good	
14	Good	Good	Fair	Excellent	Excellent	
15	Good	Good	Good	Excellent	Good	
16	Good	Good	Good	Excellent	Excellent	
17	Good	Good	Good	Excellent	Excellent	
18	Good	Good	Fair	Excellent	Excellent	
19	Good	Good	Good	Excellent	Good	
20	Good	Good	Good	Good	Good	
21	Good	Good	Fair	Excellent	Excellent	
22	Good	Good	Good	Excellent	Good	
23	Good	Good	Good	Excellent	Excellent	
24	Good	Good	Fair	Excellent	Excellent	
25	Good	Good	Good	Excellent	Good	
26	Good	Good	Good	Excellent	Good	
27	Good	Good	Good	Excellent	Good	
28	Good	Good	Good	Excellent	Excellent	
29	Good	Good	Good	Excellent	Good	
30	Good	Good	Good	Excellent	Good	
31	Good	Good	Good	Excellent	Good	
32	Good	Good	Good	Excellent	Good	

[0038]

[Table 4]

Table 4

No.	Amorphous Properties	Corrosion Resistance (NaCl)	Corrosion Resistance (HNO ₃)	Hardness	Saturation Magnetic Flux Density	
33	Good	Good	Good	Excellent	Poor	Comparative Examples
34	Good	Good	Good	Good	Poor	
35	Poor	Good	Good	Fair	Good	
36	Poor	Poor	Poor	Good	Good	
37	Good	Good	Fair	Good	Poor	
38	Poor	Good	Good	Fair	Poor	
39	Good	Poor	Poor	Excellent	Poor	
40	Good	Good	Good	Fair	Poor	
41	Good	Poor	Fair	Good	Good	
42	Good	Good	Good	Fair	Poor	

- 5 First, the compositions shown in Table 1 and Table 2 will be explained. Nos. 1 to 32 shown in Table 1 are present invention examples, while Nos. 33 to 41 shown in Table 2 are comparative examples.

[0039]

- 10 In addition, in the description of the compositions, in the case of taking No. 3 described in each column in Table 1 as an example, the contents of Ta in the (A) group, Cr in the (B) group, Zr in the (C) group, Al in the (E) group and B in the (F) group as (A)-(F)-group elements are 8 at.%, 2 at.%, 4 at.%, 1 at.% and
- 15 6 at.%, respectively. The total amount thereof is 21 at.%. The amount of the balance Co and Fe in the (A) group to the (F) group is 79 at.% obtained by subtracting 21 at.% from 100. Then, Co:Fe=90:10 as the ratio of Co and Fe means, in at.%, a content of Co of $0.79 \times 90 = 71.1$ at.% and a content of Fe of
- 20 $0.79 \times 10 = 7.9$ at.%.

[0040]

Comparative Examples No. 33 and No. 34 result in a low

saturation magnetic flux density due to the high sum of the contents of an (A) group element and a (B) group element. No. 35 results in a poor amorphous property and also in a low hardness due to the low content of an (A) group element. No. 36 results in a poor amorphous property and also in an insufficient corrosion resistance due to the low content of a (B) group element. No. 37 results in a low saturation magnetic flux density due to the high content of (C) group elements. No. 38 results in a low saturation magnetic flux density due to the high content of (E) group elements. No. 39 results in a low saturation magnetic flux density and also in an insufficient corrosion resistance due to the high content of an (F) group element. No. 40 results in an insufficient saturation magnetic flux density due to a low Fe ratio.

[0041]

No. 41 results in a poor corrosion resistance, particularly a poor corrosion resistance to NaCl, due to a high Fe ratio. No. 42 results in a low saturation magnetic flux density due to the high content of (D) group elements. In contrast, Present Invention Examples No. 1 to No. 32 all satisfy the requirements of the present invention and are thus found to be superior in amorphous properties, hardness, corrosion resistance and a saturation flux density.

[0042]

As described above, in accordance with the present invention, there are provided: a soft magnetic alloy for perpendicular magnetic recording superior in amorphous properties, hardness, corrosion resistance and a saturation magnetic flux density; a sputtering target material; and a magnetic recording medium employing the alloy.

[0043]

Production of Sputtering Target Material

Next, there is shown a method for producing a sputtering target material. As for the 7 compositions shown in No. 3, No. 11, No. 12, No. 13 and No. 24 in Table 1 and No. 35 and No. 38 in Table 2, molten raw materials were weighed, melted by induction

heating in a refractory crucible with an Ar gas atmosphere under a reduced pressure, then tapped from a nozzle having a diameter of 8 mm in the lower portion of the crucible, and atomized with an Ar gas. The gas-atomized powders as raw materials were degassed and charged into a can having an outside diameter of 220 mm, an inside diameter of 210 mm, and a length of 200 mm and made of SC. The vacuum arrival degree during the degassing was set to about 1.3×10^{-2} Pa. The above-described powder-filled billets were heated to 1150°C, then charged into a restraint container with a diameter of 230 mm, and molded by pressurization at 500 MPa. The solidified molded products produced by the above-described method were processed into a disk shape with a diameter of 180 mm and a thickness of 7 mm by wire cut, turning processing, and surface grinding to make sputtering target materials.

[0044]

Production of Sputtered Film

As for these 7 compositions, sputtered films were formed on glass substrates using the sputtering target materials. In the X-ray diffraction patterns, halo patterns were seen in all No. 3, No. 11, No. 12, No. 13 and No. 24, while crystalline peaks were seen in No. 35 and No. 38. Further, when a corrosion resistance test (salt spray test) was conducted in the same manner as in the case of the quenched ribbons, no rust was generated in all No. 3, No. 11, No. 12, No. 13 and No. 24, while rust was seen in some parts in No. 35 and No. 38. The above was summarized as follows: it was confirmed that the results evaluated in the quench ribbons tended to be equivalent to the evaluations of the sputtered films formed using the sputtering target materials.

Claims

1. A soft magnetic alloy for magnetic recording, consisting of:
 - (A) 0.5% or more of one or two or more of elements selected from the group consisting of Ta, Nb and V;
 - (B) 0.5% or more of one or two or more of elements selected from the group consisting of Mo and W;
 - (C) 0 to 5% of one or two or more of elements selected from the group consisting of Ti, Zr and Hf;
 - (D) 0 to 30% of Mn;
 - (E) 0 to 5% of one or two of elements selected from the group consisting of Al and Cu; and
 - (F) 0 to 10% of one or two or more of elements selected from the group consisting of Si, Ge, P, B and C; andthe balance Co and Fe and unavoidable impurities, wherein a ratio of Fe:Co is 10:90 to 70:30; and the total amount of the (A) group element, the (B) group element and the (C) group element is 10 to 30% of the alloy.
2. The alloy according to claim 1, comprising:
 - more than 0% and not more than 30% of the (D) group element;
 - more than 0% and not more than 5% of one or two of the (E) group elements;
 - more than 0% and not more than 10% of one or two or more of the (F) group elements.
3. The alloy according to any one of claim 1 or 2, comprising 2 to 20% of one or two or more of the (A) group elements.
4. The alloy according to any one of claims 1 to 3, comprising

1 to 20% of one or two or more of the (B) group elements.

5. The alloy according to any one of claims 1 to 4, comprising 2 to 4% of one or two or more of the (C) group elements.

6. The alloy according to any one of claims 1 to 5, comprising more than 0% and not more than 10% of the (D) group element.

7. The alloy according to any one of claims 1 to 6, comprising 1 to 4% of one or two of the (E) group elements.

8. The alloy according to any one of claims 1 to 7, comprising 1 to 8% of one or two or more of the (F) group elements.

9. A sputtering target material comprising the alloy according to any one of claims 1 to 8.

10. A magnetic recording medium comprising a soft magnetic layer comprising the alloy according to any one of claims 1 to 8.