

Title of Invention: **Fe-Pt-Ag Based Target And Preparation Method Thereof**

The present invention relates to an Fe-Pt-Ag based target and a preparation method thereof, more particularly to an Fe-Pt-Ag based target and a preparation method thereof for magnetic recording media.

5 As the demand for higher storage capacities of the magnetic recording media increases, how to increase the storage density of the magnetic recording media has become a main focus of researches in the related fields.

 In general, perpendicular magnetic recording (PMR) media comprises, from bottom to top, a substrate, an adhesion layer, a soft underlayer, a seed layer, an
10 intermediate layer, a magnetic recording layer, a cover layer and a lubricating layer, and the magnetic recording layer usually adopts a cobalt-chromium-platinum based (Co-Cr-Pt based) system as the main component. However, as the development of PMR media gradually matures, the PMR media adopting the Co-Cr-Pt based magnetic recording layer is also approaching the limit of storage density.

15 Accordingly, in order to pursue superior storage density of the PMR media, an iron-platinum based (Fe-Pt based) system is adopted to form the magnetic recording layer suitable for heat-assisted magnetic recording (HAMR) media. In briefly, in the HAMR system, during recording, magnetic particles of the recording bit are heated to the temperature over Curie temperature of the magnetic particles, which can reduce the
20 magnetic coercivity of the magnetic particles temporarily, thereby accomplishing the data storage.

 Nevertheless, as the material of the recording layer is formed by Fe-Pt based alloy, high temperature annealing is required to make the Fe-Pt based alloy of the recording layer have an ordered structure. However, after the heat treatment, the Fe-Pt
25 based alloy particles will aggregate into large ones, which cause the magnetic property of the recording layer unable to meet the requirement. Accordingly, silver is additionally

added into the conventional Fe-Pt based system, so as to reduce the ordering temperature of the recording layer.

However, silver is easy to deposit from the Fe-Pt based system. Therefore, when silver is directly added into the Fe-Pt based system, large area of silver-rich aggregation will be found in a metallography of the Fe-Pt-Ag based target, which leads to insufficiency of relative density of the Fe-Pt-Ag based target. Besides, during sputtering of the Fe-Pt-Ag based target, large amounts of falling particles are produced and dropped onto the surface of a magnetic recording layer, which adversely affects the quality and yield of the magnetic recording layer. Moreover, the Fe-Pt-Ag based target has poor oxidation resistance, which makes it prone to tarnishing on its surface when placed under inappropriate conditions, and thus severely restricts the subsequent applications of the produced recording layer.

To overcome the shortcomings of the prior arts, the objective of the present invention is to enhance the relative density of the Fe-Pt-Ag based target, reduce the number of falling particles during sputtering, and enhance oxidation resistance ability of the Fe-Pt-Ag based target at the same time, thereby making the Fe-Pt-Ag based target easy to preserve and improving the quality and yield of the magnetic recording layer formed from the Fe-Pt-Ag based target.

To achieve the aforementioned objectives, the present invention provides an Fe-Pt-Ag based target comprising iron (Fe), platinum (Pt), silver (Ag) and a non-magnetic component. Based on a total atom number of the Fe-Pt-Ag based target, a content of Pt is more than or equal to 5 atomic percent (at%) and less than or equal to 40 at%, a content of Ag is more than or equal to 1 at% and less than or equal to 15 at%, and a content of sulfur (S) of the Fe-Pt-Ag based target is less than 50 parts per million (ppm). A maximum area of silver phase in a metallographic microstructure of the Fe-Pt-Ag based target is less than 10 square micrometers (μm^2).

The Fe-Pt-Ag based target has the following technical features that: (I) the content of Pt is more than or equal to 5 at% and less than or equal to 40 at%, (II) the content of Ag is more than or equal to 1 at% and less than or equal to 15 at%, (III) the content of S is less than 50 ppm, and (IV) the maximum area of silver phase in its metallographic microstructure is less than $10\ \mu\text{m}^2$. With said technical features, silver can distribute uniformly in the Fe-Pt-Ag based target to avoid large area of silver-rich aggregation; moreover, the Fe-Pt-Ag based target can have improved relative density as well as oxidation resistance and only produces less falling particles during sputtering.

In accordance with the present invention, the “maximum area of silver phase” indicates the individual area of the largest one of the multiple silver phases distributed in the metallographic microstructure of the Fe-Pt-Ag based target.

In accordance with the present invention, based on the total atom number of the Fe-Pt-Ag based target, a content of Fe is more than or equal to 5 at% and less than or equal to 85 at%. Preferably, based on the total atom number of the Fe-Pt-Ag based target, the content of Fe is more than or equal to 20 at% and less than or equal to 85 at%. More preferably, based on the total atom number of the Fe-Pt-Ag based target, the content of Fe is more than or equal to 25 at% and less than or equal to 84 at%.

Preferably, the content of S of the Fe-Pt-Ag based target is less than 40 ppm. More preferably, the content of S of the Fe-Pt-Ag based target is less than 36 ppm. Even more preferably, the content of S of the Fe-Pt-Ag based target is less than 20 ppm.

In one embodiment, the content of S of the Fe-Pt-Ag based target is more than or equal to 0.1 ppm and less than 50 ppm; in another embodiment, the content of S of the Fe-Pt-Ag based target is more than or equal to 0.1 ppm and less than 40 ppm; in another embodiment, the content of S of the Fe-Pt-Ag based target is more than or equal to 0.1 ppm and less than 36 ppm; in another embodiment, the content of S of the Fe-Pt-Ag based target is more than or equal to 0.1 ppm and less than 20 ppm.

Preferably, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is less than $9\ \mu\text{m}^2$. More preferably, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is less than $8.7\ \mu\text{m}^2$. Even more preferably, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is less than $4\ \mu\text{m}^2$. Even more preferably, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is less than $3.5\ \mu\text{m}^2$.

In one embodiment, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is more than or equal to $0.1\ \mu\text{m}^2$ and less than $10\ \mu\text{m}^2$; in another embodiment, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is more than or equal to $0.1\ \mu\text{m}^2$ and less than $9\ \mu\text{m}^2$; in another embodiment, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is more than or equal to $0.1\ \mu\text{m}^2$ and less than $8.7\ \mu\text{m}^2$; in another embodiment, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is more than or equal to $0.1\ \mu\text{m}^2$ and less than $4\ \mu\text{m}^2$; in another embodiment, the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is more than or equal to $0.1\ \mu\text{m}^2$ and less than $3.5\ \mu\text{m}^2$.

Preferably, based on the total atom number of the Fe-Pt-Ag based target, a content of the non-magnetic component is more than or equal to 5 at% and less than or equal to 40 at%.

Preferably, the non-magnetic component may be selected from the group consisting of carbon (C), a carbide, a nitride, an oxide, and any combination thereof; wherein based on the total atom number of the Fe-Pt-Ag based target, a content of C is more than or equal to 1 at% and less than or equal to 40 at%, a content of the carbide is more than or equal to 2 at% and less than or equal to 30 at%, a content of the nitride is

more than or equal to 1 at% and less than or equal to 40 at%, and a content of the oxide is more than or equal to 1 at% and less than or equal to 35 at%. More preferably, based on the total atom number of the Fe-Pt-Ag based target, the content of C is more than or equal to 8 at% and less than or equal to 30 at%, the content of the carbide is more than or equal to 3 at% and less than or equal to 20 at%, the content of the nitride is more than or equal to 2 at% and less than or equal to 32 at%, and the content of the oxide is more than or equal to 2 at% and less than or equal to 30 at%.

In one embodiment, the carbide may be, but is not limited to, silicon carbide (SiC), boron carbide (B₄C), titanium carbide (TiC), tungsten carbide (WC), tantalum carbide (TaC), hafnium carbide (HfC), zirconium carbide (ZrC), vanadium carbide (VC), niobium carbide (NbC), chromium carbide (Cr₃C₂), titanium carbon nitride (TiCN) or any combination thereof; in another embodiment, the nitride may be, but is not limited to, boron nitride (BN), aluminum nitride (AlN), titanium nitride (TiN), chromium nitride (CrN), zirconium nitride (ZrN), tantalum nitride (TaN), hafnium nitride (HfN), silicon nitride (Si₃N₄), titanium carbon nitride (TiCN), tungsten nitride (WN), vanadium nitride (VN) or any combination thereof; in another embodiment, the oxide may be, but is not limited to, silicon(IV) oxide (SiO₂), titanium(IV) oxide (TiO₂), chromium(III) oxide (Cr₂O₃), tantalum(V) oxide (Ta₂O₅), cobalt(II) oxide (CoO), manganese(III) oxide (Mn₂O₃), boron(III) oxide (B₂O₃), hafnium(IV) oxide (HfO₂), magnesium(II) oxide (MgO), aluminum(III) oxide (Al₂O₃), zirconium(IV) oxide (ZrO₂), niobium(V) oxide (Nb₂O₅), vanadium(V) oxide (V₂O₅), tungsten(VI) oxide (WO₃), iron(III) oxide (Fe₂O₃), zinc(II) oxide (ZnO) or any combination thereof.

Preferably, the non-magnetic component comprises C, SiC, B₄C, TiC, WC, TaC, HfC, ZrC, VC, NbC, Cr₃C₂, BN, AlN, TiN, CrN, ZrN, TaN, HfN, Si₃N₄, TiCN, WN, VN, SiO₂, TiO₂, Cr₂O₃, Ta₂O₅, CoO, Mn₂O₃, B₂O₃, HfO₂, MgO, Al₂O₃, ZrO₂, Nb₂O₅, V₂O₅, WO₃, Fe₂O₃, ZnO or any combination thereof.

Preferably, a relative density of the Fe-Pt-Ag based target is more than or equal to 98%.

In addition, the present invention further provides a preparation method of a Fe-Pt-Ag based target, comprising the following steps: step (a): preparing a Pt-Ag pre-
5 alloyed raw material with a raw material of Pt and a raw material of Ag, wherein a content of S of the raw material of Pt is less than 50 ppm; step (b): mixing the Pt-Ag pre-alloyed raw material, a raw material of Fe and a raw material of a non-magnetic component to obtain a mixture; step (c): performing a heat treatment to the mixture to obtain a Fe-Pt-Ag mixed raw material; and step (d): sintering the Fe-Pt-Ag mixed raw
10 material to obtain the Fe-Pt-Ag based target. Based on a total atom number of the Fe-Pt-Ag mixed raw material, a content of the raw material of Pt is more than or equal to 5 at% and less than or equal to 40 at%, a content of the raw material of Ag is more than or equal to 1 at% and less than or equal to 15 at%, and a content of S of the Fe-Pt-Ag based target is less than 50 ppm. Besides, a maximum area of silver phase in a metallographic
15 microstructure of the Fe-Pt-Ag based target is less than $10\ \mu\text{m}^2$.

Accordingly, the preparation method of the Fe-Pt-Ag based target adopts the following technical means of: (1) controlling the contents of the raw materials of Pt and Ag, (2) controlling the content of S of the raw material of Pt, (3) preparing the Pt-Ag pre-alloyed raw material, and (4) performing the heat treatment before sintering. Therefore,
20 the Fe-Pt-Ag based target prepared by the method has lower content of S, and silver therein can distribute uniformly to prevent aggregation of large silver phase. Meanwhile, the Fe-Pt-Ag based target not only has improved relative density as well as oxidation resistance, but also produces less falling particles during sputtering.

It is understood that the contents of S of the raw materials of Ag, Fe or the non-
25 magnetic component is generally less than 20 ppm, or even less than 10 ppm, while the content of S of the raw material of Pt is generally higher. Therefore, by controlling the

content of S of Pt at less than 50 ppm as foresaid specific range, the content of S of the Fe-Pt-Ag based target can be effectively controlled to be less than 50 ppm as foresaid specific range.

5 In accordance with the present invention, any ways capable of mixing raw materials uniformly can be adopted in the step (b). For example, the raw materials may be, but are not limited to, placed into a high-speed grinding machine for 1 hour to 4 hours for the purpose of mixing raw materials uniformly.

10 In accordance with the present invention, in the step (c), a prepressing step may be conducted after the Fe-Pt-Ag mixed raw material is obtained. Any ways capable of pressing the Fe-Pt-Ag mixed raw material into a fixed shape can be adopted. For example, the Fe-Pt-Ag mixed raw material may be, but is not limited to, placed into an oil hydraulic press for prepressing under pressure of about 100 bar to 200 bar.

15 Preferably, based on the total atom number of the Fe-Pt-Ag mixed raw material, a content of the raw material of the non-magnetic component is more than or equal to 5 at% and less than or equal to 40 at%.

20 In accordance with the present invention, based on the total atom number of the Fe-Pt-Ag mixed raw material, a content of the raw material of Fe is more than or equal to 5 at% and less than or equal to 85 at%. Preferably, based on the total atom number of the Fe-Pt-Ag mixed raw material, the content of the raw material of Fe is more than or equal to 20 at% and less than or equal to 85 at%. More preferably, based on the total atom number of the Fe-Pt-Ag mixed raw material, the content of the raw material of Fe is more than or equal to 25 at% and less than or equal to 84 at%.

25 Preferably, the raw material of the non-magnetic component may be selected from the group consisting of a raw material of C, a raw material of carbide, a raw material of nitride, a raw material of oxide and any combination thereof. The raw material of carbide may be, but is not limited to, a raw material of SiC, a raw material of

B₄C, a raw material of TiC, a raw material of WC, a raw material of TaC, a raw material of HfC, a raw material of ZrC, a raw material of VC, a raw material of NbC, a raw material of Cr₃C₂, a raw material of TiCN or any combination thereof. The raw material of nitride may be, but is not limited to, a raw material of BN, a raw material of AlN, a raw material of TiN, a raw material of CrN, a raw material of ZrN, a raw material of TaN, a raw material of HfN, a raw material of Si₃N₄, a raw material of TiCN, a raw material of WN, a raw material of VN or any combination thereof. The raw material of oxide may be, but is not limited to, a raw material of SiO₂, a raw material of TiO₂, a raw material of Cr₂O₃, a raw material of Ta₂O₅, a raw material of CoO, a raw material of Mn₂O₃, a raw material of B₂O₃, a raw material of HfO₂, a raw material of MgO, a raw material of Al₂O₃, a raw material of ZrO₂, a raw material of Nb₂O₅, a raw material of V₂O₅, a raw material of WO₃, a raw material of Fe₂O₃, a raw material of ZnO or any combination thereof.

Preferably, the raw material of the non-magnetic component comprises a raw material of C, a raw material of SiC, a raw material of B₄C, a raw material of TiC, a raw material of WC, a raw material of TaC, a raw material of HfC, a raw material of ZrC, a raw material of VC, a raw material of NbC, a raw material of Cr₃C₂, a raw material of BN, a raw material of AlN, a raw material of TiN, a raw material of CrN, a raw material of ZrN, a raw material of TaN, a raw material of HfN, a raw material of Si₃N₄, a raw material of TiCN, a raw material of WN, a raw material of VN, a raw material of SiO₂, a raw material of TiO₂, a raw material of Cr₂O₃, a raw material of Ta₂O₅, a raw material of CoO, a raw material of Mn₂O₃, a raw material of B₂O₃, a raw material of HfO₂, a raw material of MgO, a raw material of Al₂O₃, a raw material of ZrO₂, a raw material of Nb₂O₅, a raw material of V₂O₅, a raw material of WO₃, a raw material of Fe₂O₃, a raw material of ZnO or any combination thereof.

Preferably, in the step (a), the Pt-Ag pre-alloyed raw material is prepared with the

raw material of Pt and the raw material of Ag by grinding or atomizing. Said grinding means that with high-speed grinding to make the particles of different metal materials collide repeatedly, the atoms of the particles of different metal materials will mutually diffuse to form a pre-alloyed material. For example, the raw material of Pt and the raw material of Ag may be, but are not limited to, placed into a high-speed grinding machine for 1 hour to 5 hours to form the Pt-Ag pre-alloyed raw material. Said atomizing means that different metal materials are heated to the atomization temperature and followed by atomizing to obtain the pre-alloyed material. For example, the raw material of Pt and the raw material of Ag may be, but is not limited to, placed under argon atmosphere or vacuum environment with pressure of 10^{-5} bar to 10^{-4} bar, heated to the atomization temperature of 1500°C to 2000°C , and then followed by atomizing to obtain the Pt-Ag pre-alloyed raw material.

Preferably, in the step (c), the heat treatment may be performed under hydrogen atmosphere. For example, in the step (c), the mixture may be, but is not limited to, placed under an environment with hydrogen atmosphere and heated at 600°C to 800°C for 2 hours to 4 hours to obtain the Fe-Pt-Ag mixed raw material.

Preferably, in the step (d), a temperature of sintering is more than or equal to 600°C and less than or equal to 1200°C , and a pressure of sintering is more than or equal to 350 bar and less than or equal to 1800 bar.

In accordance with the present invention, said sintering may be hot pressing (HP), spark plasma sintering (SPS) or hot isostatic pressing (HIP). For example, when said sintering is performed by HP, the temperature of sintering may be, but is not limited to, ranging from 800°C to 1200°C , the pressure of sintering may be, but is not limited to, ranging from 350 bar to 400 bar, and the time of sintering may be, but is not limited to, ranging from 1 hour to 4 hours; when said sintering is performed by SPS, the temperature of sintering may be, but is not limited to, ranging from 700°C to 1200°C , the pressure of

sintering may be, but is not limited to, ranging from 1100 bar to 1200 bar, and the time of sintering may be, but is not limited to, ranging from 5 minutes to 1 hour; when said sintering is performed by HIP, the temperature of sintering may be, but is not limited to, ranging from 700°C to 1200°C, the pressure of sintering may be, but is not limited to, ranging from 1700 bar to 1800 bar, and the time of sintering may be, but is not limited to, ranging from 1 hour to 4 hours.

In this specification, a range represented by “a lower-endpoint value to an upper-endpoint value”, if not particularly specified, indicates that the range is more than or equal to the lower-endpoint value and less than or equal to the upper-endpoint value. For example, grinding for 1 hour to 4 hours indicates that the time of grinding is “more than or equal to 1 hour and less than or equal to 4 hours”.

Other objectives, advantages, and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

IN THE DRAWINGS:

FIG. 1 is a metallographic image of an Fe-Pt-Ag based target of Example 1 obtained by scanning electron microscopy (SEM) at 2000-fold magnification.

FIG. 2 is a metallographic image of an Fe-Pt-Ag based target of Comparative Example 3 obtained by SEM at 2000-fold magnification.

FIG. 3A is an appearance image of an Fe-Pt-Ag based target of Example 1.

FIG. 3B is an image of an Fe-Pt-Ag based target of Example 1 obtained by optical microscope (OM) at 100-fold magnification.

FIG. 4A is an appearance image of an Fe-Pt-Ag based target of Example 1 after conducting the oxidation resistance experiment for 96 hours.

FIG. 4B is an image of an Fe-Pt-Ag based target of Example 1 obtained by OM at 100-fold magnification after conducting the oxidation resistance experiment for 96

hours.

FIG. 5A is an appearance image of an Fe-Pt-Ag based target of Comparative Example 2.

5 FIG. 5B is an image of an Fe-Pt-Ag based target of Comparative Example 2 obtained by OM at 100-fold magnification.

FIG. 6A is an appearance image of an Fe-Pt-Ag based target of Comparative Example 2 after conducting the oxidation resistance experiment for 24 hours.

10 FIG. 6B is an image of an Fe-Pt-Ag based target of Comparative Example 2 obtained by OM at 100-fold magnification after conducting the oxidation resistance experiment for 24 hours.

FIG. 7A is an appearance image of an Fe-Pt-Ag based target of Comparative Example 3.

FIG. 7B is an image of an Fe-Pt-Ag based target of Comparative Example 3 obtained by OM at 100-fold magnification.

15 FIG. 8A is an appearance image of an Fe-Pt-Ag based target of Comparative Example 3 after conducting the oxidation resistance experiment for 13 hours.

FIG. 8B is an image of an Fe-Pt-Ag based target of Comparative Example 3 obtained by OM at 100-fold magnification after conducting the oxidation resistance experiment for 13 hours.

20 In order to verify the influences of the composition of the Fe-Pt-Ag based target to the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target, several Fe-Pt-Ag based targets are provided as examples below to illustrate the implementation of the present invention. A person skilled in the art can easily realize the advantages and effects of the present invention in accordance with the contents of the
25 specification. Various modifications and variations could be made in order to practice or apply the present invention without departing from the spirit and scope of the invention.

Examples 1 to 15 (E1 to E15): Fe-Pt-Ag based target

According to the compositions of the Fe-Pt-Ag based targets listed in Table 1, suitable amount of Pt powders with an average particle size less than 15 micrometers (μm) and Ag powders with an average particle size less than 20 μm were adopted to form Pt-Ag pre-alloyed powders. The contents of S contained in the Pt powders adopted in different Examples were listed in Table 1, and the contents of S contained in the Ag powders adopted in different Examples were all less than 10 ppm. E1 to E3, E5, E7 to E9 and E13 adopted grinding to obtain the Pt-Ag pre-alloyed powders. Specifically, the Pt powders and the Ag powders were placed into a high-speed grinding machine, and were ground for 1 hour to 5 hours at a rotation speed of 400 revolutions per minute (rpm) to 900 rpm and at a grinding media to material ratio of 1:3 to obtain the Pt-Ag pre-alloyed powders. E4, E6, E10 to E12, E14 and E15 adopted atomizing to obtain the Pt-Ag pre-alloyed powders. Specifically, the Pt powders and the Ag powders were atomized at the atomization temperature of 1500°C to 2000°C to obtain the Pt-Ag pre-alloyed powders.

Next, according to the compositions of the Fe-Pt-Ag based targets listed in Table 1, suitable amount of Fe powders with an average particle size less than 250 μm and non-magnetic component powders with an average particle size less than 10 μm were adopted. The contents of S contained in the adopted Fe powders were all less than 30 ppm, and the contents of S contained in the adopted non-magnetic component powders were also all less than 30 ppm. Then, the Fe powders, the non-magnetic component powders and the Pt-Ag pre-alloyed powders were placed into the high-speed grinding machine, and then mixed uniformly for 1 hour to 4 hours at a rotation speed of 400 rpm to 900 rpm and at a grinding media to material ratio of 1:3 to obtain a powdered mixture. Afterward, the powdered mixture was heated at 700°C under hydrogen atmosphere for 3 hours to obtain Fe-Pt-Ag mixed powders.

Next, the Fe-Pt-Ag mixed powders were prepressed with a pressure of about 103

bar by an oil hydraulic press, and followed by sintering to obtain the Fe-Pt-Ag based targets of E1 to E15. The sintering method and the temperature of sintering were listed in Table 1, and when said sintering was performed by HP, the pressure of sintering was about 380 bar and the time of sintering was about 1 hour to 4 hours; when said sintering was performed by SPS, the pressure of sintering was about 1188 bar and the time of sintering was about 5 minutes to 60 minutes; when said sintering was performed by HIP, the pressure of sintering was about 1750 bar and the time of sintering was about 1 hour to 4 hours.

In Table 1, the compositions of the Fe-Pt-Ag based targets (hereinafter referred to as “target”) of E1 to E15 can be presented by a general formula “aFe-bPt-cAg-d1C-d2TiCN-e1Cr₃C₂-e2B₄C-e3SiC-e4TaC-e5NbC-e6WC-e7VC-e8TiC-f1BN-f2AlN-f3VN-f4ZrN-f5HfN-f6CrN-f7Si₃N₄-g1TiO₂-g2MgO-g3HfO₂-g4SiO₂-g5Cr₂O₃-g6CoO-g7Ta₂O₅-g8WO₃-g9Al₂O₃-g10B₂O₃-g11ZrO₂-g12Fe₂O₃-g13ZnO”, wherein “a” represents the content of Fe in atomic percent relative to the total atom number of the target; “b” represents the content of Pt in atomic percent relative to the total atom number of the target; “c” represents the content of Ag in atomic percent relative to the total atom number of the target; “d1” represents the content of C in atomic percent relative to the total atom number of the target; “d2” represents the content of TiCN in atomic percent relative to the total atom number of the target; “e1”, “e2”, “e3”, “e4”, “e5”, “e6”, “e7” and “e8” respectively represent the content of Cr₃C₂, of B₄C, of SiC, of TaC, of NbC, of WC, of VC and of TiC in atomic percent relative to the total atom number of the target; “f1”, “f2”, “f3”, “f4”, “f5”, “f6” and “f7” respectively represent the content of BN, of AlN, of VN, of ZrN, of HfN, of CrN, and of Si₃N₄ in atomic percent relative to the total atom number of the target; and “g1”, “g2”, “g3”, “g4”, “g5”, “g6”, “g7”, “g8”, “g9”, “g10”, “g11”, “g12” and “g13” respectively represent the content of TiO₂, of MgO, of HfO₂, of SiO₂, of Cr₂O₃, of CoO, of Ta₂O₅, of WO₃, of Al₂O₃, of B₂O₃, of ZrO₂, of Fe₂O₃

and of ZnO in atomic percent relative to the total atom number of the target.

Comparative Examples 1 and 2 (CE1 and CE2): Fe-Pt-Ag based target

The preparation methods of CE1 and CE2 were similar to those of Examples. That is, according to the compositions of the Fe-Pt-Ag based targets listed in Table 1, suitable amounts of different kinds of powders were adopted and then the Pt-Ag pre-alloyed powders were prepared, respectively. The Pt-Ag pre-alloyed powders were obtained by grinding in CE1 and obtained by atomization in CE2. Afterward, preparing processes similar to those of Examples were performed to obtain the Fe-Pt-Ag based targets of CE1 and CE2. The main differences between CE1 and CE2 and Examples were that in CE1 and CE2, the contents of S contained in the Pt powders were not controlled simultaneously and the powdered mixtures were not subjected to the heat treatment. The contents of S contained in the Pt powders, the sintering methods and the temperature of sintering of CE1 and CE2 were listed in Table 1.

Comparative Examples 3 to 12 (CE3 to CE12): Fe-Pt-Ag based target

The preparation methods of CE 3 to CE12 were similar to those of CE1 and CE2. The main differences were that in CE3 to CE12, the Pt-Ag pre-alloyed powders were not prepared, while the Fe powders, the Pt powders, the Ag powders and the non-magnetic component powders were placed in the high-speed grinding machine for mixing uniformly for 1 hour to 4 hours to obtain the powdered mixtures. Afterward, preparing processes similar to those of CE1 and CE2 were performed to obtain the Fe-Pt-Ag based targets of CE3 to CE12. The contents of S contained in the Pt powders, the sintering methods and the temperature of sintering of CE3 to CE12 were listed in Table 1.

The compositions of the Fe-Pt-Ag based targets of CE1 to CE12 and the content in atomic percent of each component of the Fe-Pt-Ag based targets of CE1 to CE12 were listed in Table 1. The Fe-Pt-Ag based targets of CE1 to CE12 can also be represented by the general formula as denoted in Examples, and the expression of the content of each

component in the general formula is same as the definition of Examples.

In this specification, said “a content of the non-magnetic component” indicates a sum of “d1”, “d2”, “e1” to “e8”, “f1” to “f7” and “g1” to “g13”.

Table 1: The compositions, the contents of S contained in the adopted Pt
5 powders, sintering methods and the temperature of sintering of the Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12.

Sample No.	Compositions of the Fe-Pt-Ag based target	Contents of S contained in the Pt powders	Sintering method	Temp. of sintering
E1	30Fe-25Pt-5Ag-8C-32BN	36 ppm	HIP	1000°C
E2	84Fe-5Pt-1Ag-10AlN	48 ppm	HP	1100°C
E3	25Fe-40Pt-15Ag-10TiO ₂ -10MgO	25 ppm	SPS	800°C
E4	55Fe-30Pt-10Ag-2HfO ₂ -3Cr ₃ C ₂	less than 0.6 ppm	SPS	850°C
E5	35Fe-35Pt-6Ag-24SiO ₂	14 ppm	HP	950°C
E6	40Fe-30Pt-13Ag-17B ₄ C	12 ppm	HP	800°C
E7	33Fe-20Pt-7Ag-30Cr ₂ O ₃ -10VN	23 ppm	HIP	900°C
E8	45Fe-30Pt-5Ag-15CoO-2ZrN-3SiC	34 ppm	SPS	950°C
E9	29Fe-35Pt-1Ag-25Ta ₂ O ₅ -10TaC	47 ppm	HP	1100°C
E10	54Fe-25Pt-6Ag-10HfN-5NbC	26 ppm	HP	900°C
E11	37Fe-25Pt-13Ag-5WO ₃ -20BN	24 ppm	HIP	800°C

E12	40Fe-5Pt-15Ag-5Al ₂ O ₃ - 5TiCN-30C	8 ppm	SPS	800°C
E13	46Fe-15Pt-4Ag-15B ₂ O ₃ - 20WC	15 ppm	SPS	950°C
E14	70Fe-10Pt-12Ag-8ZrO ₂	24 ppm	HIP	850°C
E15	60Fe-15Pt-2Ag-20CrN-3VC	9 ppm	HIP	1050°C
CE1	40Fe-5Pt-25Ag-10Ta ₂ O ₅ -20C	180 ppm	HIP	1000°C
CE2	40Fe-30Pt-5Ag-25TiO ₂	161 ppm	HP	950°C
CE3	30Fe-25Pt-5Ag-8C-32BN	244 ppm	HIP	950°C
CE4	49.5Fe-35Pt-0.5Ag-5Al ₂ O ₃ - 10ZrN	432 ppm	HP	1100°C
CE5	43Fe-30Pt-17Ag-5B ₂ O ₃ -5TiC	387 ppm	HP	800°C
CE6	69Fe-3Pt-8Ag-10Fe ₂ O ₃ - 10BN	591 ppm	HIP	900°C
CE7	40Fe-45Pt-10Ag-5ZnO	543 ppm	HIP	900°C
CE8	45Fe-40Pt-12Ag-3C	468 ppm	SPS	850°C
CE9	28Fe-25Pt-2Ag-25Ta ₂ O ₅ - 10Si ₃ N ₄ -10Cr ₃ C ₂	356 ppm	SPS	1000°C
CE10	25Fe-30Pt-15Ag-20BN-10C	35 ppm	HIP	800°C
CE11	44Fe-30Pt-1Ag-25C	103 ppm	HIP	900°C
CE12	30Fe-27Pt-3Ag-40BN	169 ppm	HP	1000°C

Analysis 1: the maximum area of silver phase in the metallographic microstructure

The Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were further

processed by wire cutting and grinding to obtain a disc-shaped Fe-Pt-Ag based target with outer diameter of 209 millimeters (mm) and thickness of 6 mm. Then, a 10 mm×10 mm sample was taken from each of the disc-shaped Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 at half-radius ($r/2$).

Next, the metallographic images of the samples were each obtained by SEM (manufacturer: HITACHI, model: SE-3400) at 2000-fold magnification, and then the images were analyzed by the built-in function of SEM for analyzing the elements distribution called “mapping” to obtain the distribution of silver phases in the metallographic image of each sample. Then, the analyzed metallographic image of each sample was further analyzed by the built-in function of Image J for measuring the area called “Area” to obtain multiple data of the areas of silver phases, and the maximum value among the multiple data was adopted and represented the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target. The results of maximum area of E1 to E15 and CE1 to CE12 were listed in Table 2.

Besides, in order to demonstrate the differences between Examples and Comparative Examples, the metallographic images of the Fe-Pt-Ag based targets of E1 and CE3 were chosen for exemplary explanation and shown in FIG. 1 and FIG. 2, respectively. In comparison with the results in FIG. 1 and FIG. 2, no large area of silver phase result from deposition of silver aggregation was found in the metallographic image of the Fe-Pt-Ag based target of E1. However, in the metallographic image of the Fe-Pt-Ag based target of CE3, large area of silver phase could be found obviously, which indicates that apparent deposition of silver aggregation occurred in the Fe-Pt-Ag based target of CE3.

Analysis 2: the content of S of the Fe-Pt-Ag based target

The Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were processed by wire cutting to a disc-shaped Fe-Pt-Ag based target with outer diameter of 210 mm. After

that, grinding was performed to remove the area of carbonization caused by wire cutting, and samples with weight over 0.2 grams of the Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were obtained by cutting the disc-shaped Fe-Pt-Ag based targets. Then, the samples of E1 to E15 and CE1 to CE12 were placed into an infrared carbon-sulfur analyzer (manufacturer: LECO, model: CS-600) to measure the content of S. The measured contents of S of E1 to E15 and CE1 to CE12 were listed in Table 2.

Analysis 3: the relative density of the Fe-Pt-Ag based target

The Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were further processed by wire cutting and grinding to obtain a disc-shaped Fe-Pt-Ag based target with outer diameter of 209 mm and thickness of 6 mm. Then, the relative density of the Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were obtained according to Archimedes' principle, and the results were listed in Table 2.

Analysis 4: the quality during sputtering of the Fe-Pt-Ag based target

The Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were further processed by wire cutting and grinding to obtain a disc-shaped Fe-Pt-Ag based target with outer diameter of 209 mm and thickness of 6 mm. Then, the target was placed in a magnetic sputtering machine (manufacturer: Kao Duen Technology Corporation), and the magnetic sputtering machine was continuously aerated of argon with amount of 50 sccm (Standard Cubic Centimeter per Minute) and had vacuum environment with pressure of 0.001 torr to 0.01 torr. Afterward, the target was pre-sputtered at power of 200 watts (W) for 600 seconds to remove dirt from the surface of the target, and thus a cleaned target ready for evaluating the quality during sputtering was provided.

Next, the cleaned target was placed in a sputtering environment with pressure of 0.001 torr to 0.01 torr and continuously aerated of argon in an amount of 50 sccm, and then sputtered at power of 1000 W for 300 seconds. During the sputtering, the falling particles having particle size over 0.5 μm were detected with KLA-Tencor Surfsacn

6420, and the number of the falling particles of the size was measured and listed in Table 2.

Analysis 5: oxidation resistance ability of the Fe-Pt-Ag based target

The Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12 were further processed by wire cutting and grinding to obtain a disc-shaped Fe-Pt-Ag based target with outer diameter of 209 mm and thickness of 6 mm. Then, further processed by wire cutting again, a 5 centimeters (cm)×5 cm sample was taken from each of the disc-shaped Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12.

Next, the samples of E1 to E15 and CE1 to CE12 were placed in a high temperature and high humidity environment at a temperature of 60°C and with a relative humidity of 90%. The appearance of the surface of the sample was repeatedly visually observed every hour to assess its oxidation resistance. Once noticeable tarnish appeared and could be visually observed on the surface of the sample, the duration from beginning to the tarnish observed was recorded as “time of tarnish appearance”. The longer the time of tarnish appearance was, the better the oxidation resistance ability of the Fe-Pt-Ag based target was, and when the shorter the time of tarnish appearance was, the worse the oxidation resistance ability of the Fe-Pt-Ag based target was. The time of tarnish appearance of E1 to E15 and CE1 to CE12 under high temperature and high humidity environment was listed in Table 2.

In addition, in order to specifically demonstrate the state of tarnishing on the surface of the Fe-Pt-Ag based target caused by the oxidation, before the oxidation resistance experiment, the appearance images of the samples of the Fe-Pt-Ag based targets of E1, CE2 and CE3 were obtained and shown in FIG. 3A, FIG. 5A and FIG. 7A. The images of those samples were also obtained by OM at 100-fold magnification and shown in FIG. 3B, FIG. 5B and FIG. 7B. In FIG. 3A, FIG. 3B, FIG. 5A, FIG. 5B, FIG. 7A and FIG. 7B, before the oxidation resistance experiment, the surfaces of the samples

of E1, CE2 and CE3 were similar and no tarnish was observed.

Then, according to the foresaid oxidation resistance experiment, after the samples of E1, CE2 and CE3 were subjected to the oxidation resistance experiment for 96 hours, 24 hours and 13 hours, respectively, the surfaces of those samples showed visually observable tarnishes. The appearance images of the samples of E1, CE2 and CE3 were obtained and shown in FIG. 4A, FIG. 6A and FIG. 8A; and the images of those samples obtained by OM at 100-fold magnification were shown in FIG. 4B, FIG. 6B and FIG. 8B. Accordingly, the time of tarnish appearance of E1 was apparently longer than those of CE2 and CE3. In other words, in comparison with the Fe-Pt-Ag based targets of CE2 and CE3, the Fe-Pt-Ag based target of E1 obviously had better oxidation resistance.

Table 2: The compositions, the maximum areas of silver phase, the contents of S, the relative density, the number of falling particles and the time of tarnish appearance of the Fe-Pt-Ag based targets of E1 to E15 and CE1 to CE12.

Sample No.	Compositions of the Fe-Pt-Ag based target	Maximum areas of silver phase (μm^2)	Contents of S (ppm)	Relative density (%)	Number of falling particles (piece)	Time of tarnish appearance (hour)
E1	30Fe-25Pt-5Ag-8C-32BN	4.755	18	99.14	96	96
E2	84Fe-5Pt-1Ag-10AlN	2.217	36	98.02	23	48
E3	25Fe-40Pt-15Ag-10TiO ₂ -10MgO	6.139	16	99.56	157	96
E4	55Fe-30Pt-10Ag-2HfO ₂ -3Cr ₃ C ₂	4.967	5	98.81	125	123
E5	35Fe-35Pt-6Ag-24SiO ₂	5.712	12	99.73	151	108
E6	40Fe-30Pt-13Ag-17B ₄ C	8.655	8	99.26	188	117
E7	33Fe-20Pt-7Ag-30Cr ₂ O ₃ -10VN	3.383	13	98.19	54	100
E8	45Fe-30Pt-5Ag-15CoO-2ZrN-3SiC	4.268	23	99.48	102	51
E9	29Fe-35Pt-1Ag-25Ta ₂ O ₅ -10TaC	2.346	31	98.37	21	52
E10	54Fe-25Pt-6Ag-10HfN-5NbC	5.654	17	98.62	148	98
E11	37Fe-25Pt-13Ag-5WO ₃ -20BN	7.941	7	99.95	179	120
E12	40Fe-5Pt-15Ag-5Al ₂ O ₃ -5TiCN-30C	7.732	4	99.66	182	143
E13	46Fe-15Pt-4Ag-15B ₂ O ₃ -20WC	3.921	25	98.61	83	51
E14	70Fe-10Pt-12Ag-8ZrO ₂	7.037	10	99.81	167	115
E15	60Fe-15Pt-2Ag-20CrN-3VC	3.752	7	98.74	73	125

CE1	40Fe-5Pt-25Ag-10Ta ₂ O ₅ -20C	4.826	72	96.37	140	19
CE2	40Fe-30Pt-5Ag-25TiO ₂	3.916	65	97.99	74	24
CE3	30Fe-25Pt-5Ag-8C-32BN	14.918	99	95.92	742	13
CE4	49.5Fe-35Pt-0.5Ag-5Al ₂ O ₃ -10ZrN	11.884	235	95.27	559	1
CE5	43Fe-30Pt-17Ag-5B ₂ O ₃ -5TiC	24.115	209	97.83	931	2
CE6	69Fe-3Pt-8Ag-10Fe ₂ O ₃ -10BN	16.619	462	97.62	813	1
CE7	40Fe-45Pt-10Ag-5ZnO	19.451	357	96.43	925	1
CE8	45Fe-40Pt-12Ag-3C	22.143	258	96.36	957	1
CE9	28Fe-25Pt-2Ag-25Ta ₂ O ₅ -10Si ₃ N ₄ -10Cr ₃ C ₂	13.527	126	95.10	761	5
CE10	25Fe-30Pt-15Ag-20BN-10C	16.215	31	97.31	854	51
CE11	44Fe-30Pt-1Ag-25C	12.013	72	97.43	569	20
CE12	30Fe-27Pt-3Ag-40BN	4.624	106	98.72	112	11

Discussion of the experimental results

According to the preparing methods of Examples and the results listed in Table 2, by adopting the following technical means of: (1) controlling the contents of the raw materials of Pt and Ag, (2) controlling the content of S of the raw material of Pt, (3) preparing the Pt-Ag pre-alloyed raw material, and (4) performing the heat treatment before sintering, the prepared Fe-Pt-Ag based target can simultaneously have the following technical features that: (I) the content of Pt is more than or equal to 5 at% and less than or equal to 40 at%, (II) the content of Ag is more than or equal to 1 at% and less than or equal to 15 at%, (III) the content of S of the Fe-Pt-Ag based target is less than 50 ppm and (IV) the maximum area of silver phase in the metallographic microstructure of the Fe-Pt-Ag based target is less than $10\ \mu\text{m}^2$. In contrast, CE1 to CE12 do not adopt the technical means (1) to (4) at the same time, and thus the prepared Fe-Pt-Ag based targets do not have the technical features (I) to (IV) at the same time, either. Accordingly, in comparison with CE1 to CE12, the Fe-Pt-Ag based targets of E1 to E15 can have relative density more than or equal to 98%, falling particles less than 200 pieces under identical sputtering conditions, and time of tarnish appearance more than or equal to 48 hours. Therefore, the technical means provided by the present invention can simultaneously fulfill the beneficial effects of enhancing the relative density, reducing the number of falling particles and enhancing the oxidation resistance ability.

Further referring to the results of E1 and CE3, although the compositions of the Fe-Pt-Ag based targets of E1 and CE3 are the same, the maximum area of silver phase in the metallographic microstructure and the content of S of the Fe-Pt-Ag based target of CE3 are not controlled within the specific range of less than $10\ \mu\text{m}^2$ and the specific range of less than 50 ppm, respectively. Therefore, the relative density (99.14%), mitigation of falling particles (96 pieces) or tarnishing delaying appearance (96 hours) of E1 are all superior to those of CE3 (the relative density is 95.92%; the number of falling

particles is 742 pieces; the time of tarnish appearance is 13 hours). Accordingly, controlling the maximum area of silver phase in the metallographic microstructure and the content of S of the Fe-Pt-Ag based target within the specific range can actually enhance the relative density of the Fe-Pt-Ag based target, reduce the number of falling particles and enhance the oxidation resistance ability.

Further referring to the results of CE2 and CE12, even though the contents of Pt and Ag and the maximum area of silver phase of CE2 and CE12 are all within the specific range, the contents of S of the Fe-Pt-Ag based targets of CE2 and CE12 are 65 ppm and 106 ppm, respectively, and are not controlled within the specific range of less than 50 ppm. Accordingly, in CE2 and CE12, the relative density of the Fe-Pt-Ag based target are 97.99% and 98.72% respectively, the number of falling particles are 74 pieces and 112 pieces respectively, and the time of tarnish appearance are 24 hours and 11 hours respectively. That is, although only the content of S of the Fe-Pt-Ag based target is not within the specific range, the Fe-Pt-Ag based targets of CE2 and CE12 still cannot simultaneously have the effects of the relative density more than or equal to 98%, the number of falling particles less than 20 pieces, and the time of tarnish appearance more than or equal to 48 hours.

Further referring to the result of CE10, the contents of Pt, Ag and S of the Fe-Pt-Ag based target of CE10 are all within the specific range, while the maximum area of silver phase of CE10 is $16.215 \mu\text{m}^2$ and is apparently more than the upper limit ($10 \mu\text{m}^2$). That is, the relative density of the Fe-Pt-Ag based target of CE10 is only 97.31% and the number of falling particles is up to 854 pieces. Accordingly, even though only the maximum area of silver phase is not in accordance with the limitations of the present invention, the Fe-Pt-Ag based target of CE10 still cannot simultaneously have the effects of high relative density, less falling particles and improved oxidation resistance ability.

Besides, further referring to the results of CE1 and CE2, although both CE1 and

CE2 adopt technical means of preparing the Pt-Ag pre-alloyed raw material, CE1 and CE2 do not further control the contents of the raw materials of Pt and Ag and the content of S of the raw material of Pt, and do not perform the heat treatment before sintering, either. Accordingly, the Fe-Pt-Ag based targets of CE1 and CE2 still cannot
5 simultaneously have the effects of high relative density, less falling particles and improved oxidation resistance ability.

Further referring to the results of CE3 to CE12, CE3 to CE12 neither adopt the technical means of preparing the Pt-Ag pre-alloyed raw material and performing the heat treatment before sintering, nor control the contents of the raw materials of Pt and Ag and
10 the content of S of the raw material of Pt. Therefore, the Fe-Pt-Ag based targets of CE3 to CE12 cannot have high relative density, less falling particles and improved oxidation resistance ability at the same time.

In conclusion, by controlling the contents of Pt, Ag and S of the Fe-Pt-Ag based target, and the maximum area of silver phase in the metallographic microstructure of the
15 Fe-Pt-Ag based target within the specific range, the relative density of the Fe-Pt-Ag based target can be enhanced, the number of falling particles during sputtering can be reduced, and the oxidation resistance ability of the Fe-Pt-Ag based target can be enhanced at the same time. Accordingly, the Fe-Pt-Ag based target provided by the present invention not only improves the quality and yield of the magnetic recording layer
20 formed from the Fe-Pt-Ag based target, but also prevents the problem of easily tarnishing caused by the oxidation, thereby enhancing the value in the industry.

Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and features of the present invention, the disclosure is illustrative only. Changes may be made
25 in the details, especially in matters of size within the principles of the present invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

CLAIMS

1. An Fe-Pt-Ag based target, comprising iron, platinum, silver and a non-magnetic component, wherein based on a total atom number of the Fe-Pt-Ag based target, a content of platinum is more than or equal to 5 atomic percent and less than or equal to 40 atomic percent, a content of silver is more than or equal to 1 atomic percent and less than or equal to 15 atomic percent, a content of sulfur of the Fe-Pt-Ag based target is less than 50 ppm, and a maximum area of silver phase in a metallographic microstructure of the Fe-Pt-Ag based target is less than 10 μm^2 .

2. The Fe-Pt-Ag based target as claimed in claim 1, wherein based on the total atom number of the Fe-Pt-Ag based target, a content of the non-magnetic component is more than or equal to 5 atomic percent and less than or equal to 40 atomic percent.

3. The Fe-Pt-Ag based target as claimed in claim 1 or 2, wherein the non-magnetic component is selected from the group consisting of carbon, a carbide, a nitride, an oxide and any combination thereof.

4. The Fe-Pt-Ag based target as claimed in claim 1 or 2, wherein the non-magnetic component comprises carbon, silicon carbide, boron carbide, titanium carbide, tungsten carbide, tantalum carbide, hafnium carbide, zirconium carbide, vanadium carbide, niobium carbide, chromium carbide, boron nitride, aluminum nitride, titanium nitride, chromium nitride, zirconium nitride, tantalum nitride, hafnium nitride, silicon nitride, titanium carbon nitride, tungsten nitride, vanadium nitride, silicon(IV) oxide, titanium(IV) oxide, chromium(III) oxide, tantalum(V) oxide, cobalt(II) oxide, manganese(III) oxide, boron(III) oxide, hafnium(IV) oxide, magnesium(II) oxide,

aluminum(III) oxide, zirconium(IV) oxide, niobium(V) oxide, vanadium(V) oxide, tungsten(VI) oxide, iron(III) oxide, zinc(II) oxide or any combination thereof.

5 5. The Fe-Pt-Ag based target as claimed in any one of claims 1 to 4, wherein a relative density of the Fe-Pt-Ag based target is more than or equal to 98%.

6. A preparation method of an Fe-Pt-Ag based target, comprising the following steps:

10 step (a): preparing a Pt-Ag pre-alloyed raw material with a raw material of platinum and a raw material of silver, wherein a content of sulfur of the raw material of platinum is less than 50 ppm;

step (b): mixing the Pt-Ag pre-alloyed raw material, a raw material of iron and a raw material of a non-magnetic component to obtain a mixture;

15 step (c): performing a heat treatment to the mixture to obtain a Fe-Pt-Ag mixed raw material; and

step (d): sintering the Fe-Pt-Ag mixed raw material to obtain the Fe-Pt-Ag based target;

20 wherein based on a total atom number of the Fe-Pt-Ag mixed raw material, a content of the raw material of platinum is more than or equal to 5 atomic percent and less than or equal to 40 atomic percent, and a content of the raw material of silver is more than or equal to 1 atomic percent and less than or equal to 15 atomic percent;

wherein a content of sulfur of the Fe-Pt-Ag based target is less than 50 ppm, and a maximum area of silver phase in a metallographic microstructure of the Fe-Pt-Ag based target is less than $10\ \mu\text{m}^2$.

7. The preparation method as claimed in claim 6, wherein based on the total atom number of the Fe-Pt-Ag mixed raw material, a content of the raw material of the non-magnetic component is more than or equal to 5 atomic percent and less than or equal to 40 atomic percent.

5

8. The preparation method as claimed in claim 6 or 7, wherein the raw material of the non-magnetic component is selected from the group consisting of a raw material of carbon, a raw material of carbide, a raw material of nitride, a raw material of oxide and any combination thereof.

10

9. The preparation method as claimed in any one of claims 6 to 8, wherein in the step (a), the Pt-Ag pre-alloyed raw material is prepared with the raw material of platinum and the raw material of silver by grinding or atomizing.

15 10. The preparation method as claimed in any one of claims 6 to 9, wherein in the step (c), the heat treatment is performed under hydrogen atmosphere.

11. The preparation method as claimed in any one of claims 6 to 10, wherein in the step (d), a temperature of sintering is more than or equal to 600°C and less than or
20 equal to 1200°C, and a pressure of sintering is more than or equal to 350 bar and less than or equal to 1800 bar.