METHOD FOR MANUFACTURING METAL-BASED CERAMIC COMPOSITE TARGET CONTAINING NOBLE METAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method for manufacturing a target, in particular, to a method for manufacturing a metal-based ceramic composite target containing noble metal.

2. Description of the Related Art

A hard disk is an important device used for the storage of a large amount of data, and data is mainly stored in a thin-film magnetic recording layer on a hard disk, the main component of which is a Co-based alloy material having the noble metal Pt. It is well known that the thin-film magnetic recording layer is applied onto the hard disk by a sputtering process with a target for sputtering.

In the prior art, CoCrPt-SiO_2 film is a primary material used as magnetic recording film in current high-capacity hard disks. Due to SiO_2 ceramic contained therein, a powder metallurgy process needs to be used to produce CoCrPt-SiO_2 target, that is, selecting Co, Cr, and Pt powders to be thoroughly mixed with SiO_2 powder, or selecting premixed CoCrPt metallic powder to be thoroughly mixed with SiO_2, and then molding and compacting the target by using a hot pressing or hot isostatic pressing process.

There are two well-known powder mixing methods, i.e., dry and wet powder mixing, and the main difference between them is that the powder mixing is either carried out in a solution or not. However, neither of these methods can cause the metal and ceramic powders to be uniformly mixed; normally, this mixing cannot be accomplished due to an overly large

difference between their specific gravities.

Moreover, in the wet powder mixing process, the Co, Cr, Pt, and SiO_2 powders are mixed in a mixing ball, to form a mixed slurry. Therefore, after the wet powder mixing process, when taken out of the mixing ball, part of the mixed slurry will remain in and adhere to the mixing ball. Because the content of noble metal Pt in the CoCrPt-SiO_2 target is above 30 wt%, the wet powder mixing process will lead to the loss of a large amount of noble metal Pt, thus increasing the production cost of the target.

Therefore, there is a need to provide a method for manufacturing a metal-based ceramic composite target containing noble metal to solve the above problems.

SUMMARY OF THE INVENTION

In a first aspect, there is provided a method for manufacturing a metal-based ceramic composite target containing noble metal, comprising the steps of: (a) providing a magnetic metal powder and a ceramic powder with purities higher than 99.9%; (b) wet powder mixing the magnetic metal powder and the ceramic powder in a solvent, to form a slurry, where the ceramic powder is applied onto the surface of the magnetic metal powder; (c) drying the slurry, to form a ceramic-metal composite powder; (d) dry powder mixing the ceramic-metal composite powder with a noble metal powder that has a purity higher than 99.9%; and (e) molding and compacting the mixed ceramic-metal composite powder and noble metal powder, to form the metal-based ceramic composite target containing noble metal.

According to the manufacturing method of the present disclosure, the ceramic powder is firstly uniformly applied onto the surface of the magnetic metal powder by using the wet powder mixing process, and dried to obtain the ceramic-metal composite powder, which is then uniformly mixed with the noble metal powder by using the dry powder mixing

process, and finally the ceramic-metal composite powder is made into the compact target by using a molding and compacting process. The manufacturing method of the present disclosure can uniformly mix the powders of the magnetic metal, the ceramic, and the noble metal, and reduce the loss of the noble metal in the production process of the target, so as to improve the quality of the target and decrease the production cost thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow chart showing the method for manufacturing the metal-based ceramic composite target containing noble metal according to the present invention; and

FIG. 2 is a schematic partial enlargement view showing the metal-based ceramic composite target containing noble metal according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a flow chart showing the method for manufacturing the metal-based ceramic composite target containing noble metal according to the present invention; FIG. 2 is a schematic partial enlargement view showing the metal-based ceramic composite target containing noble metal according to the present invention. The method for manufacturing the metal-based ceramic composite target containing noble metal can be used in the film sputtering process in the magnetic recording, photoelectricity, and semiconductor industries. With reference to FIGs. 1 and 2, firstly referring to step S11, magnetic metal powder 11 and ceramic powder 12 are provided with purities higher than 99.9%. In this embodiment, the purities of the magnetic metal powder 11 and the ceramic powder 12 are preferably higher than 99.95%. The magnetic metal powder 11 can be cobalt, or cobalt-chromium alloy.

In this embodiment, SiO_2 or TiO_2 is used as the ceramic powder 12. The particle size of the ceramic powder 12 is preferably 0.07 to 1.0 μm.

With reference to step S12, the ceramic powder 12 and the magnetic metal powder 11 is wet powder mixed in a solvent (e.g., water or alcohol), to form a slurry, where the ceramic powder 12 is applied onto the surface of the magnetic metal powder 11. In step S12, the surface of the magnetic metal powder 11 and the surface of the ceramic powder 12 are differently charged, enabling the ceramic powder 12 to be applied onto the surface of the magnetic metal powder 11, thereby increasing uniformity of mixing. The time for the wet powder mixing is preferably 6 to 24 hours.

It is noted that on the basis of different mixing materials and conditions, in step S12, a further step of pH adjustment can be included, in which an acid or base solution is added to adjust the pH of the slurry, so that the surface of the magnetic metal powder and the surface of the ceramic powder 12 are differently charged.

With reference to step S13, the slurry is dried, to form a ceramic-metal composite powder. In this embodiment, a vacuum drying method is used to dry the slurry, in which the temperature for the vacuum drying is 80°C to 160°C, the time is 2 to 6 hours, and the vacuum level is less than 760 torr.

With reference to step S14, the ceramic-metal composite powder is dry powder mixed with a noble metal powder 13 with a purity higher than 99.9%. In this embodiment, Pt is used as the noble metal powder 13, with a purity of higher than 99.95%, and the time for the dry powder mixing is preferably 4 to 8 hours.

With reference to step S15, the mixed ceramic-metal composite powder and noble metal powder 13 are molded and compacted, to form the metal-based ceramic composite target 1 containing noble metal according to the present invention. In this embodiment, the molding and compacting

step is carried out by a hot pressing or hot isostatic pressing process, where the temperature for the molding and compacting is 800°C to 1200°C, and the time for the molding and compacting is 1 to 4 hours.

The percent by weight (wt%) of the ceramic powder 12 is preferably 5% to 12%, the wt% of the noble metal powder 13 is 20% to 50%, and the rest of the wt% is the content of the magnetic metal powder 11. In this embodiment, the magnetic metal powder 11 is cobalt-chromium alloy, where the wt% of the ceramic powder 12 is 5% to 12%, the wt% of the noble metal powder 13 is 20% to 50%, the wt% of chromium in the cobalt-chromium alloy is 4% to 16%, and the rest is the wt% of cobalt in the cobalt-chromium alloy.

The following embodiments are used to describe the present invention in detail; however, it should be understood that the present invention is not limited to the disclosure of these embodiments.

Embodiment 1:

In this embodiment, the production of the CoCrPt-SiO_2 alloy target for sputtering is taken as an example. Firstly, a magnetic Co powder having a purity above 99.95%, as well as Cr powder, Pt powder, and SiO_2 powder (with a particle size of 0.25 μm) also having a purity above 99.95%, are provided. The contents of Co, Cr, Pt, and SiO_2 are 46 wt%, 5 wt%, 42 wt%, and 7 wt%, respectively. Then, Co powder, Cr powder, and SiO_2 powder are put into deionized water of pH 7 and wet powder mixed for 18 hours. Next, the slurry of CoCr-SiO_2 is placed in a vacuum oven, and dried at a vacuum level of 76 torr, where the drying temperature is 120°C, and the drying time is 4 hours, and thereby, SiO_2 powder could be uniformly applied onto the surface of Co powder and Cr powder. Finally, the dried CoCr-SiO_2 powder and Pt powder are thoroughly mixed for 4 hours by dry powder mixing without a solvent, and then the uniformly mixed powder is put into a graphite mold, and molded and compacted by hot pressing at

1100°C for 1.5 hours, to form a CoCrPt-SiO_2 target having high purity, fine structure, and uniform composition.

Embodiment 2:

In this embodiment, the production of the CoCrPt-TiO_2 alloy target for spluttering is taken as an example. Firstly, magnetic Co powder having a purity above 99.95%, as well as Cr powder, Pt powder, and TiO_2 powder (with a particle size of 0.07 μm) also having a purity above 99.95%, are provided. The contents of Co, Cr, Pt, and TiO_2 are 48 wt%, 13 wt%, 31 wt%, and 8 wt%, respectively. Then, Co powder, Cr powder, and TiO_2 powder are put into deionized water, and wet powder mixed for 12 hours after adjusting the solution to pH 8 with aqueous ammonia. Next, the slurry of CoCr-TiO_2 is placed in a vacuum oven, and dried at a vacuum level of 76 torr, where the drying temperature is 160°C, and the drying time is 2 hours, and thereby TiO_2 powder could be uniformly applied onto the surface of Co powder and Cr powder. Finally, the dried CoCr-TiO_2 powder and Pt powder are thoroughly mixed for 6 hours by dry powder mixing without a solvent, and then the uniformly mixed powder is sealed in stainless steel canning, and molded and compacted by hot pressing at 800°C for 4 hours, to form a CoCrPt-TiO_2 target having high purity, fine structure, and uniform composition.

According to the manufacturing method of the present invention, the ceramic powder is firstly uniformly applied onto the surface of the magnetic metal powder by using the wet powder mixing process, and dried to obtain the ceramic-metal composite powder, which is then uniformly mixed with the noble metal powder by using the dry powder mixing process, and finally the ceramic-metal composite powder is made into the compact target by using a molding and compacting process. The manufacturing method of the present invention can uniformly mix the powders of the magnetic metal, the ceramic, and the noble metal, and reduce the loss of the noble metal powder in the production process of the

target, so as to improve the quality of the target and decrease the production cost thereof.

While the embodiments of the present invention have been illustrated and described, various modifications and improvements can be made by those skilled in the art. The embodiments of the present invention are therefore described in an illustrative but not restrictive sense. It is intended that the present invention may not be limited to the particular forms as illustrated, and that all modifications that maintain the spirit and scope of the present invention are within the scope as defined in the appended claims.

WHAT IS CLAIMED IS:

1. A method for manufacturing a metal-based ceramic composite target containing noble metal, comprising the steps of:

(a) providing a magnetic metal powder and a ceramic powder with purities higher than 99.9%;

(b) wet powder mixing the ceramic powder and the magnetic metal powder in a solvent, to form a slurry, wherein the ceramic powder is applied onto the surface of the magnetic metal powder;

(c) drying the slurry, to form a ceramic-metal composite powder;

(d) dry powder mixing the ceramic-metal composite powder with a noble metal powder with a purity higher than 99.9%; and

(e) molding and compacting the mixed ceramic-metal composite powder and noble metal powder, to form the metal-based ceramic composite target containing noble metal.

2. The method as claimed in Claim 1, wherein in steps (a) and (d), the purities of the magnetic metal powder, the ceramic powder, and the noble metal powder are higher than 99.95%.

3. The method as claimed in Claim 1, wherein in step (a), the percent by weight (wt%) of the ceramic powder is 5% to 12%, the wt% of the noble metal powder is 20% to 50%, and the rest of the wt% is the content of the magnetic metal powder.

4. The method as claimed in Claim 3, wherein in step (a), the magnetic metal powder is cobalt, or an alloy thereof.

5. The method as claimed in Claim 4, wherein in step (a), the cobalt alloy is cobalt-chromium alloy.

6. The method as claimed in Claim 5, wherein in step (a), the wt% of chromium in the cobalt-chromium alloy is 4% to 16%.

7. The method as claimed in Claim 1, wherein in step (a), the ceramic powder is SiO_2 or TiO_2.

8. The method as claimed in Claim 1, wherein in step (a), the particle size of the ceramic powder is 0.07 to 1.0 μm.

9. The method as claimed in Claim 1, wherein in step (a), the noble metal powder is Pt.

10. The method as claimed in Claim 1, wherein in step (b), water or alcohol is used as the solvent.

11. The method as claimed in Claim 1, wherein in step (b), the surface of the magnetic metal powder and the surface of the ceramic powder are differently charged, enabling the ceramic powder to be applied onto the surface of the magnetic metal powder.

12. The method as claimed in Claim 1, wherein step (b) further comprises a step of pH adjustment, wherein an acid or base solution is added to adjust the pH of the slurry.

13. The method as claimed in Claim 1, wherein in step (b), the time for the wet powder mixing is 6 to 24 hours.

14. The method as claimed in Claim 1, wherein in step (c), the slurry is dried through a vacuum drying method.

15. The method as claimed in Claim 14, wherein in step (c), the temperature for the vacuum drying is 80°C to 160°C, and the time for the vacuum drying is 2 to 6 hours.

16. The method as claimed in Claim 15, wherein in step (c), the vacuum level for the vacuum drying is less than 760 torr.

17. The method as claimed in Claim 1, wherein in step (d), the time for the dry powder mixing is 4 to 8 hours.

18. The method as claimed in Claim 1, wherein in step (e), the molding and compacting step is carried out by a hot pressing or hot isostatic pressing process.

19. The method as claimed in Claim 18, wherein in step (e), the temperature for the molding and compacting is 800°C to 1200°C, and the time for the molding and compacting is 1 to 4 hours.

20. The method as claimed in Claim 1, wherein the method for manufacturing the metal-based ceramic composite target comprising noble metal is used in the film sputtering process, in the magnetic recording, photoelectricity, and semi-conductor industries.

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ABSTRACT

A method for manufacturing a metal-based ceramic composite target containing noble metal is provided, which includes firstly applying a ceramic powder uniformly onto a surface of a magnetic metal powder by using a wet powder mixing process, and drying it to obtain a ceramic-metal composite powder, and then uniformly mixing a noble metal powder with the ceramic-metal powder by using a dry powder mixing process, and finally making the ceramic-metal composite powder into a compact target by using a molding and compacting process. The manufacturing method of the present invention can uniformly mix the powders of the magnetic metal, the ceramic, and the noble metal, and reduce the loss of the noble metal powder in the production process of the target, so as to improve the quality of the target and decrease the production cost thereof.

Fig. 1