problems in that the quality of the deposited thin film will decrease which reduce SNR as well as epitaxial growth of the magnetic layer, and the generation of arcing and particles will become notable during sputtering. As a result, it was not possible to obtain a target material having the characteristics required for the PMR device. Arcing and generation of particles are problematic phenomena that may occur during a sputtering process and should be suppressed as much as possible. Furthermore, it would be desirable if a uniform and consistent sputtering is possible with the sputtering target, and the sputtered thin layer obtained from the sputtering process has a uniform composition.

US 2009/0114535 A1 describes a Ru-containing alloy sputtering target having an oxygen content of 100 to 500 wt-ppm. To achieve a low oxygen content, the sputtering target is prepared by a powder metallurgical method wherein a Ru powder and a powder of a second metal which is tantalum are sintered. However, if the additive amount of tantalum is more than 20% in this patent example may form an intermetallic phase which will cause arcing and particle problems.

US 2007/0116592 A1 describes the preparation of a Ru-containing alloy sputtering target by a powder metallurgical process wherein metal powders are mixed to a preform which is then heated in a hydrogen atmosphere and subjected to hot isostatic pressing. Due to the treatment in a reducing atmosphere (i.e. hydrogen), the sputtering target can have an oxygen content of 200 ppm or less. However, this patent mentioned only hydrogen reduction effect to decrease the oxygen content. This patent did not evaluate multi-phase formation which will cause arcing and particle problems.

An object of the present invention is to provide a Ru-containing sputtering target which can be used for providing an intermediate layer to provide a uniform microstructure, and which shows low arcing and particle generation during the sputtering process.

The object is solved by a Ru-Co-Cr alloy sputtering target, wherein Co and Cr are present in the sputtering target in a combined amount of 80 at% or less, the balance being Ru and unavoidable impurities; and wherein the sputtering target has an oxygen content of less than 200 wt-ppm, wherein the sputtering target has a fluctuation in composition for each of the elements Ru, Co and Cr of less than +/- 5 at%.

particle is based on the projected area diameter which is the diameter of a sphere having the same projected area as the particle. The projected area diameter d of a particle can be related to the particle projected area A by

$d = ((4 \times A) / \pi)^{1/2}$

or $r = (A / \pi)^{1/2}$, wherein r is the circle radius (i.e. 0.5 x d)

The sputtering target can be in the form of a plate. However, other commonly known forms of sputtering targets, e.g. tubes, are possible as well.

Optionally, the sputtering target can be fixed on a supporting member, e.g. a backing plate or a backing tube.

The present invention further relates to a process for preparing the Ru-Co-Cr alloy sputtering target as described herein, wherein a metal starting material comprising Ru, Co and Cr is subjected to two or more vacuum melting steps, each vacuum melting step followed by a solidification step, wherein the vacuum melting step is a vacuum induction melting step, a vacuum arc remelting step, or a vacuum electron beam melting step, or a combination of at least two of these vacuum melting steps, wherein the process further comprises a final vacuum melting step followed by a final solidification step, wherein the final solidification step has an average cooling rate of less than 15°C/min.

As already mentioned above, it has been realized in the present invention that a Ru-Co-Cr alloy sputtering target having a very uniform microstructure can be obtained by using one or more vacuum melting steps. Each vacuum melting step is followed by a solidification step which is typically carried out under vacuum or inert gas atmosphere, for example, argon. If needed, the solid alloy composition obtained after the final vacuum melting and solidification step can be subjected to a thermo-mechanical treatment (such as hot isostatic pressing or hot rolling) and/or a machining so as to obtain the final sputtering target.

The metal starting material can be in the form of two or more separate components, such as Ru or a Ru-based alloy, Co or a Co-based alloy, and Cr or a Cr-based alloy. These separate components can be separately introduced into the furnace where the vacuum melting is carried out. Alternatively, the two or more separate components can be mixed before they are introduced into the furnace where the vacuum melting is carried out.

Alternatively, it is also possible that the metal starting composition comprises just one component.

Patent Claims

1. A Ru-Co-Cr alloy sputtering target, wherein Co and Cr are present in the sputtering target in a combined amount of 80 at% or less, the balance being Ru and unavoidable impurities; and wherein the sputtering target has an oxygen content of less than 200 wt-ppm, wherein the sputtering target has a fluctuation in composition for each of the elements Ru, Co and Cr of less than +/- 5 at%.

2. The sputtering target according to claim 1, having an oxygen content of less than 160 ppm.

3. The sputtering target according to claim 1 or 2, wherein Cr is present in the sputtering target in an amount of from 5 at% to less than 80 at%.

4. The sputtering target according to one of the preceding claims, wherein the amount of Cr, based on the total amount of Co and Cr in the sputtering target, is from 10 at% to 90 at%.

5. The sputtering target according to one of the preceding claims, wherein no intermetallic phase is present in the sputtering target.

6. The sputtering target according to one of the preceding claims, wherein the sputtering target is made of a single Ru-Co-Cr alloy phase.

7. A process for preparing the Ru-Co-Cr alloy sputtering target of one of the claims 1 to 6, wherein a metal starting material comprising Ru, Co and Cr is subjected to two or more vacuum melting steps, each vacuum melting step followed by a solidification step, wherein the vacuum melting step is a vacuum induction melting step, a vacuum arc remelting step, or a vacuum electron beam melting step, or a combination of at least two of these vacuum melting steps, wherein the

process further comprises a final vacuum melting step followed by a final solidification step, wherein the final solidification step has an average cooling rate of less than 15°C/min.

8. The process according to claim 7, comprising at least one vacuum induction melting step, and subsequently at least one vacuum arc remelting step or at least one vacuum electron beam remelting step.