

Patent Application

W. C. Heraeus GmbH

Material mixture, sputter target, method for its production and use of the material mixture

This invention relates to a material mixture comprising a cobalt-based alloy as the predominant component, a sputter target, as well as a method of production for it.

Material mixtures comprising a cobalt-based alloy as the predominant component are known, for example, from US 6,759,005 or from DE 195 08 535 A1. These material mixtures are used, *inter alia*, to create thin layers as magnetic function layers, especially in magnetic data storage technology; or the material mixtures form these layers, respectively. Due to the requirements on a high capacity of these layers, the requirements on the layer materials are increasing and thus on the sputter targets which are used for the production of the layers since these layers are preferably produced by sputtering.

The invention is based on the objective of improving the known material mixtures with regard to their magnetic properties.

The objective is solved by the independent claims. Advantageous embodiments result from the dependent claims. A cobalt-based alloy as the predominant component – i. e. with a percentage of more than 50 weight % – which additionally comprises at least TiO_x as the smaller component, has significantly improved magnetic properties and is thus, as a thin layer, better suitable for magnetic data storage. Such materials are preferably deposited as thin layers by means of the sputter technique. Particularly good homogeneity in depositing sputter material from the sputter target on a substrate will be achieved by the oxygen-reduced (sub-stoichiometric), electrically conductive titanium oxide being present as a powder with a particle size ranging from 0.1 to 50 μm . With TiO_x , x is preferably between 1.5 and 1.998.

The material mixture or, respectively, a sputter target produced therefrom is preferably formed from the oxide powder and a metallic powder from the cobalt-based alloy. The sputter target preferably has a density of at least 95 % of the theoretic density of its material. It is produced such that a powder of a cobalt-based alloy is mixed with a TiO_x powder and the powder mixture will be hot pressed. It is here advantageous that the powder mixture is pressed hot axially or hot isostatically. The material mixtures according to the invention will result in storage mediums of a very high capacity. They have a TiO_x percentage of preferably 15 mol% maximum. A metallurgical melt production of these material mixtures or, respectively, the corresponding sputter targets is difficult to impossible since the ceramic TiO_x does not alloy with the cobalt-based alloy. As a rule, mechanical stirring of TiO_x particles into the cobalt-based alloy melt does not result in a homogeneous material. Powder metallurgical production methods are also problematic since there is, on the one hand, a mixing problem between metallic particles and ceramic particles and, on the other hand, a technical sputter problem because failures in the sputter process will result if electrically insulating ceramic particles are present in sputter targets. Surprisingly, these problems were also solved by the invention.

The invention is explained below by an exemplary embodiment.

In a tumble mixer, 880 g of an inert gas atomized powder of a cobalt chromium alloy with a chromium part of 12 weight % is mixed for 24 hours with 120 g of a powder from pre-treated TiO_x . The mixture can also be prepared with another standard mixing method, thus, for example, with a ball mill or a drum mixer. The TiO_x powder is pretreated by vacuum annealing in a reducing atmosphere at a temperature of approx. 1,400° C. The oxygen content in TiO_x powder will be reduced by the oxygen-reducing annealing by approx. 2 weight % (versus the stoichiometric oxygen content). Thereafter, the reduced TiO_x powder is screened with a screen of 50 μm mesh size. In a tumble mixer, the TiO_x powder with a particle size of less than 50 μm will be homogeneously mixed, for 24 hours, with the powder from the cobalt chromium alloy. Thereafter, the resulting mixture of the cobalt chromium alloy and 9 mol% TiO_x is filled into a hot pressing form and compressed in a vacuum press at 1,100° C with a compacting pressure of 30 MPa. The accordingly hot-pressed sputter target from the described material mixture (CoCr12TiO_x) has a relative density of 98.0 % of the theoretical density. A metallographic section preparation shows a very homogeneous distribution of the electrically conductive TiO_x particles in the cobalt alloy matrix.

Another example is the analogously produced $\text{Co/Pt18 at\% / Cr10 at\% / TiO}_x\text{8 mol\%}$.

Patent Claims

1. Material mixture comprising a cobalt-based alloy as the predominant component, characterized in that it additionally contains at least TiO_x .
2. Material mixture according to claim 1, characterized in that TiO_x is contained with $x < 2$.
3. Material mixture according to claim 2, characterized in that TiO_x is contained with $1.5 < x < 1.998$.
4. Material mixture according to any one of the claims 1 to 3, characterized in that TiO_x is contained in particle form with a particle size ranging from 0.1 to 50 μm .
5. Material mixture according to any one of the claims 1 to 4, characterized in that it is formed of a mixture of a metallic powder and an oxide powder.
6. Sputter target from a material mixture according to any one of the claims 1 to 5.
7. Sputter target according to claim 6, characterized in that it comprises a density of at least 95 % of the theoretical density.
8. Method for the production of a sputter target according to claim 6 or 7, characterized in that a powder from a cobalt-based alloy is mixed with a TiO_x powder, and the powder mixture is hot-pressed.
9. Method according to claim 8, characterized in that the powder mixture is pressed hot axially or hot isostatically.
10. Use of a material mixture according to any one of the claims 1 to 5 as a sputter target.