Description

This invention relates to thin film magnetic recording media or discs and in particular to a magnetic disc structure which is characterized by having excellent magnetic recording, and wear properties and stability-against-oxidation of the magnetic layer. More particularly, the invention relates to a novel combination of materials, each in a thin film form constituting a magnetic recording disc. Further, the invention relates to methods for forming magnetic materials and controlling the magnetic properties thereof so as to provide magnetic recording media having magnetic properties which are selectively variable over a desirable range in order to facilitate optimization of recording system design.

In designing a magnetic recording disc, there are a number of factors, depending upon the properties of available recording heads, that must be considered and provided for. Among the magnetic properties that are desirable, especially where high magnetic recording density is an object, is a high coercivity limited only by the write capability of the recording head. The recording system also requires that the head signal output of the recording head be greater than some minimum value. It is required in turn for thin recording films that the product of the magnetic recording film thickness and its remanent magnetization (hereinafter referred to as the magnetization-thickness product) be greater than some corresponding minimum value. In addition, the high coercivity and desired magnetization-thickness product should be accompanied by a high degree of squareness of the M—H hysteresis loop of the magnetic film. With the given values of coercivity and magnetization-thickness product established, the recording density is desirably the maximum value that is consistent with the minimum value of resolution for the recording process. Because resolution generally decreases both with increasing recording density and with an increasing value of the ratio of the magnetization-thickness product to coercivity, optimization of the recording system requires that the disc coercivity and its magnetization-thickness product be essentially the corresponding maximum and minimum values established above. Any value of magnetization-thickness product greater than its minimum value and any value of coercivity less than its maximum value necessarily results in a recording density less than what would otherwise be achievable with the recording head. Hence, there exists a need to vary the coercivity and magnetization-thickness product independently. Further, the values of these parameters need to change as improved recording heads become available and there is, therefore, an additional need for independent variability of coerivity and magnetization-thickness product over a rather large range of values. Another important constraint is that the necessary independent variability of magnetic properties be achievable on smooth substrates which are suitable for use as the mechanical support for the recording disc. It is also desirable that once a process to achieve targeted or predetermined magnetic properties is in place, minor independent adjustments to the magnetic properties can be readily made by means of relatively easy and straight forward changes in process parameters.

The magnetic recording film properties of cobalt-platinum (Co-Pt) alloys are known and have been reported to some extent. See. for example, the paper by M. Naoe et al., entitled "Preparation of High Coercivity Co-Pt Alloy Films by Targets-Facing Type of High Rate Sputtering," *Intermag 1983, digest AC-5.* These authors showed that a maximum coercivity of about 20,110 A/m was achieved with a Co-Pt alloy in which the platinum content was of about 20 atomic percent. Their films were deposited on glass substrates with a dc magnetic field of about 1,570 A/m in the plane of the film. M. Yanagisawa et al., in a paper entitled "Corrosion-Resisting Co-Pt Thin Film Medium for High Density Recording," *Intermag 1983, digest AC-6,* describe sputtered Co-Pt thin films which showed similar results. A. J. Griest, Jr., in U.S. Patent Specification No. 3,755,796, discloses cobalt-platinum alloys for use in magnetic domain (magnetic bubble) applications but not in thin film form suitable for high density magnetic recording media. EP—A—87559 discloses a magnetic layer of an alloy of cobalt and platinum disposed over substrates of hard glass, aluminium and titanium.

For a magnetic material such as cobalt and its alloys to have a high coercive field, it is known that the crystal structure of a film thereof should be that of the hexagonal (HCP) phase with high magneto-crystalline anisotropy. As noted by Chen et al. in U.S. Patent Specification No. 4,202,932, it is well known that pure cobalt metal in the HCP phase at a low temperature will transform to a face-centered cubic (FCC) phase at higher temperatures. The transformation of the cobalt film to FCC phase causes a decrease in the coercive field to a point where it is no longer useful as a medium for high density recording. Lazzari et al. in their paper entitled "Thin Evaporative Films with High Coercive Force," published in the IEEE Transactions on Magnetics, September, 1967 (Vol. Mag-3, No. 3, Page 205) report that a perturbation of the structure and morphology of the magnetic material (cobalt) by the presence of a nonmagnetic underlayer of chromium, permits the attainment of coercivities of from 2510 to 7540 A/m, which may be adjusted by varying the thickness of the cobalt layer.

These workers achieved their results by the evaporation of successive films of chromium and cobalt, and obtained a maximum value of coercivity with a cobalt film thickness of 20 nm and the minimum with a cobalt film thickness of 140 nm. Similar results were reported by M. T. Maloney for sputter-deposited films of cobalt and chromium in a paper entitled "Sputtered Multilayer Films for Digital Magnetic Recording" IEEE

Transactions on Magnetics, (Vol. 15, No. 3, July 1979 at Page 1135).

The prior art references identified hereinbefore deal principally with the basic magnetic properties of cobalt alloys. Nigh et al., in U.S. Patent Specification No. 4,079,169, do disclose magnetic recording media utilizing a nonmagnetic cobalt-based alloy as a protective cladding or isolation layer for an aluminum substrate. Their magnetic layer is iron or cobalt or an alloy of iron and cobalt which is vacuum deposited on the cobalt-based alloy and then topped by a protective layer of a metal such as rhodium. Nigh et al. also suggest that an undercoat layer of chromium or titanium may be disposited on the isolation layer prior to forming the magnetic layer.

Shine, in U.S. Patent Specification No. 4,221,615, teaches the use of a 50—50 atomic percent platinum-cobalt alloy to provide a soft magnetic material for use as the oscillating ball in flowmeters and the like. U.S. Patent Specification No. 4,154,875 to Yanagisawa et al. discloses a magnetic recording member comprising a magnetic layer of electroless plated cobalt-nickel-phosphorus formed on an electroless plated nickel-phosphorus alloy layer which is disposed on an aluminum base. The magnetic layer is then provided with a protective coating formed of a polysilicate. The aforementioned U.S. Patent Specification No. 4,202,932, to Chen et al. mentions a number of cobalt alloys (cobalt-rhenium, cobalt-ruthenium, cobalt-osmium, or mixtures thereof), for magnetic recording media, but no alloy involves cobalt and platinum.

Besides having acceptable magnetic recording properties, it is highly desirable for magnetic recording discs to possess excellent wear properties and be stable against oxidation of the magnetic layer. It has been customary to provide recording discs with special layers or coatings to protect the underlying layers against wear and contamination. See, for example, U.S. Patent Specifications Nos. 4,152,487 and 4,154,875, to Yanagisawa and Yanagisawa et al., respectively, where the use of protective polysilicate films is disclosed. Likewise, Thomas et al., in U.S. Patent Specification No. 4,079,169, teach the use of a hard protective layer of a precious metal such as rhodium.

Yanagisawa et al, in their U.S. Patent Specification No. 4,069,360, also teach the use of an inorganic oxide layer coated with a lubricant layer to protect and reduce frictional wearing of both the surface of the recording disc and the surface of the magnetic recording head. The inorganic oxide film disclosed in this patent is a polysilicate (such as quartz, glass, silicate glass, borite glass, borosilicate glass, phosphate glass, or amorphous aluminum). The lubricant disclosed may be silicone oil, fluoric oil, fluorosilicone oil and a silane or a silazane group as a surface coupling agent.

When pure cobalt is deposited over chromium, the coercivity of the cobalt film varies markedly with film thickness. See the aforementioned papers of Lazzari et al and Maloney et al. The present invention is based, at least in part, upon the discovery that the addition of platinum increases the film coercivity and that the resulting coercivity is less dependent upon film thickness and further that the remanent magnetization does not change or decrease sharply with the platinum content. Therefore, the magnetization-thickness product is dependent upon and varies principally with the film thickness. These features thus allow one to vary or adjust the coercivity and magnetization-thickness product factors independently. A desired magnetization-thickness product can be obtained by adjusting the cobalt-platinum film thickness without a large effect on the coercivity, and the coercivity can be adjusted to a desired value by varying the platinum content. In addition, small control variations of the coercivity can be obtained by varying the thickness of the chromium layer.

The present invention provides a magnetic recording disc comprising a substrate and a layer of chromium disposed over the substrate and is characterized in that a magnetic layer of an alloy of cobalt and platinum is disposed on said chromium layer, the alloy containing 1 to about 20 atomic percent platinum, said magnetic layer having a thickness of from 12.5 to 100 nm.

Preferably the alloy contains from 1.5 to 7, and preferably 3, atomic percent platinum.

A barrier layer is preferably disposed on the magnetic layer, and may be formed of a material selected from chromium, titanium, tantalum and zirconium, preferably, chromium.

Preferably a wear layer is disposed on the barrier layer, the wear layer being formed of an oxide selected from the oxides of cobalt, titanium, silicon and aluminium, preferably cobalt.

The present invention further provides a magnetic recording disc comprising a substrate and a layer of chromium disposed over the substrate, and is characterized in that the substrate is made of aluminium and has a surface layer thereon of an alloy of nickel and phosphorus, the layer of chromium being disposed on the surface layer; a magnetic layer of an alloy of cobalt and platinum is disposed on the layer of chromium, the alloy containing 1 to 20 atomic percent platinum, and said magnetic layer having a thickness of from 12.5 to 100 nm; a barrier layer is disposed on the magnetic layer, the barrier layer being a material selected from the group comprising chromium, titanium, tantalum and zirconium; and a wear layer of cobalt oxide is disposed on the barrier layer.

In a disc as set forth in the last preceding paragraph, it is preferred that the layer of chromium on the surface layer is at least 100 nm thick, the barrier layer is at least 10 nm thick, and the wear layer is at least 25 nm thick. The present invention further provides a magnetic disc comprising a substrate and a layer of chromium disposed over the substrate and is characterized in that the substrate is made of aluminium and has a surface layer thereon of an alloy of nickel

and phosphorus; a layer of chromium 220 nm thick is disposed on the surface layer, the magnetic layer of the alloy of coblat and platinum being 41 nm thick and being disposed on the chromium layer, the amount of platinum in the magnetic layer being 3 atomic percent; a barrier layer of chromium 50 nm thick is disposed on the magnetic layer; and a protective layer of cobalt oxide 42 nm thick is disposed on the barrier layer.

Preferably, the substrate is 1.905 mm thick and the surface layer thereon is 0.0076 mm thick.

The present invention further provides a method of making a film which is suitable for a magnetic recording disc, the film having a layer of chromium disposed over a substrate, characterized by forming a layer of an alloy of cobalt and platinum on the layer of chromium, the amount of platinum in the alloy being within a range of from 1 to 20 atomic percent and said alloy layer having a thickness of from 12.5 to 100 nm.

Preferably, the alloy contains from 1.5 to 7, and preferably 3 atomic percent platinum.

Preferably, the thickness of said chromium layer is controlled as it is formed so as to provide a secondary adjustment of the predetermined coercivity.

Preferably, the alloy contains from 1.5 to 7, and more preferably 3 atomic percent platinum.

Thus, the combination of a cobalt-platinum alloy film disposed over a chromium layer provides a unique system in which the coercivity and the magnetization-thickness product can be varied independently over a wide range by changing the platinum content and film thickness of the cobalt-platinum layer. The ratio of the magnetization-thickness product to the coercivity determines the transition width between the recorded regions; the lower the ratio value, the higher the achievable recording density. Hence, by the present invention and for a given digital recording system (recording head and disc), the magnetic properties of the cobalt-platinum-layer-over-chromium system can readily be optimized to yield a maximum recording density, consistent with the available write field of the head and the required minimum value of output signal.

The thin film magnetic recording media or disc structure of the present invention is characterized by performance above the minimum read and resolution thresholds, while still permitting maximum recording density. The recording disc of the preferred embodiment of the invention is formed by the sequential deposition by sputtering of four distinct layers onto a highly polished substrate. The first of these layers is a thin chromium isolation layer of from 100 to 300 nm thick to provide a barrier against contamination from the substrate and mask any local inhomogeneities in the substrate surface. In addition to this isolation function, the chromium underlayer also provides a mechanism to further control the coercivity of the magnetic layer.

The second and next layer is a sputtered magnetic cobalt-platinum film of from 12.5 to 100 nm thick with the platinum content ranging from about 1 to about 20 atomic percent. Varying the platinum content and the film thickness permits the magnetic properties to be varied or tailored as desired. With a platinum content above 16 atomic percent, a coercivity of greater than 20,100 A/m can be obtained.

The third or barrier layer disposed on the magnetic film may be of chromium of from 100 to 600 Angstroms thick to provide stability against oxidation of the magnetic layer over the lifetime of the disc and especially during fabrication of the subsequent oxide wear layer.

The final layer is a wear layer which provides excellent protection against wear during the start/stop operations of the disc when it is apt to come into contact with the recording head. For example, a satisfactory and presently preferred wear layer may comprise one or more oxides of cobalt. It is believed that this wear layer is either Co_3O_4 or CoO or other non-stoichiometric combinations of cobalt and oxygen. In any event, the term "cobalt oxide," as used herein, means any of the oxides of cobalt as just defined. Phase diagrams of the cobalt-oxygen system reveal that at room temperature, the stable oxide phase is Co_3O_4, and the oxide changes its phase to CoO at temperatures above 900 degrees Centigrade.

There now follows a detailed description which is to be read with reference to a disc and method according to the present invention; it is to be clearly understood that this disc and method has been selected for description to illustrate the invention by way of example and not by way of limitation.

In the accompanying drawings:-

Figure 1 is a cross-sectional view of a magnetic recording disc according to the invention;

Figure 2 is a diagram illustrating the coercivity of cobalt-platinum films plotted against platinum concentration with curves showing the coercivity of cobalt-platinum films deposited on chromium and on silicon; and

Figure 3 is a diagram illustrating the properties of thin film discs with respect to the constraints imposed by a typical recording/writing head system.

Referring now to Figure 1, a preferred embodiment of the thin film recording disc according to the invention is shown. The disc 1 includes a support substrate 2 of aluminium which may be about 1.905 mm thick. Since it is difficult to obtain a highly polished and sufficiently smooth aluminium surface, (that is, one without any scratches or polishing marks whatever), a smoothing or surface layer 4 of nickel-phosphorus is provided on the surface of the aluminum substrate 2. The nickel-phosphorus layer 4 is preferably about 0.0076 mm and may be up to about 0.025 mm in thickness and is deposited by electroless plating. Plated nickel phosphorus may be polished to a high degree of smoothness and provides a homogeneous, hard and smooth surface for the aluminum disc substrate.

An isolation layer 6 of chromium is sputter

deposited onto the nickel-phosphorus film 4 and may be about 220 nm thick. Atop of the chromium isolation layer 6, a magnetic layer 8 of an alloy of cobalt and platinum is sputter deposited. As mentioned previously, the chromium layer 6 provides isolation of the magnetic layer 8 from the substrate and acts as a barrier against contamination from the substrate. In addition to its isolation properties, the chromium layer 6 improves the magnetic properties of magnetic films of cobalt-platinum alloys. Thus, the grain size and the degree of preferred in-plane orientation of the C axis of the magnetic film can be increased with such a chromium isolation layer. This permits an increase in coercivity and in the squareness of the in-plane M—H hysteresis loop, both of which are essential parameters in achieving high density recording. Furthermore, varying the thickness of this chromium layer permits further adjustments of the coercivity of the overlying cobalt-platinum film. For example, the coercivity of a cobalt-platinum alloy layer of about 41 nm in thickness, containing about 3 atomic percent platinum, can be varied continuously from about 5650 A/m to about 9420 A/m by varying the thickness of the chromium underlayer from about 100 to about 300 nm.

As stated above, the magnetic film 8 comprises an alloy of cobalt and platinum. In the presently preferred embodiment, the platinum content of the alloy is about 3 atomic percent which provides a coercivity of about 7540 A/m and the film is about 41 nm thick. It is preferably at least 30 nm thick. By varying the platinum content, the magnetic properties of the magnetic film 8 can be tailored as desired. This may be readily understood by reference to Figure 2 wherein Curve A shows the variation of coercivity with respect to the platinum content in cobalt-platinum films deposited on silicon. Curves B and C illustrate the coercivity of films having two different thicknesses (Curve B represents a film being 37 nm thick and Curve C a film being 60 nm thick) each deposited on chromium layers about 2,50 nm thick. It will be noted that the thinner films (Curve B) have a significantly higher coercivity than the thicker films for the same platinum content.

As stated above, the preferred platinum content in the cobalt-platinum alloy films of the invention, is about 3 atomic percent, which provides a coercivity of about 7540 A/M. The coercivity has been found to be less sensitive to the presence of the chromium isolation layer 6 at higher platinum content than at the lower (less than 8 atomic percent) concentrations of platinum. Also the inplane loop squareness does not vary significantly with the platinum content of cobalt-platinum films deposited over chromium.

After deposition of the cobalt-platinum magnetic film 8, a barrier layer 10 of chromium is sputtered over the magnetic film. The preferred thickness is about 50 nm, although thinner films may also be employed. The minimum thickness needed for protection of the underlying magnetic film is at least 10 nm, the primary criterion being the thickness at which the film is continuous, which is usually above 10 nm. While chromium is a preferred material for this barrier layer, other materials such as titanium, tantalum and zirconium may be employed. The requirements for the barrier layer 10 are: (1) that it adhere well to the magnetic layer therebeneath and the wear layer thereabove; and (2) that it be chemically inert or nonreactive with either of the layers with which it is in contact. Since virtually all of the films formed and deposited to fabricate the preferred embodiment of the magnetic recording disc of the invention are achieved by sputtering (as will be described more fully hereinafter), and since the isolation layer 6 is of necessity chromium, chromium is preferred as the material for the barrier layer 10.

The final layer 12, the wear layer, is sputtered over the barrier film 10. This wear layer 12 is a cobalt oxide layer preferably about 42 nm in thickness. As previously noted, this cobalt oxide may be either Co_3O_4 or CoO or other non-stoichiometric combinations of cobalt and oxygen or a complex mixture of two or more phases of the cobalt-oxygen system. The stable oxide phase is Co_3O_4 at room temperature, but since the sputtering process by which the film is formed according to the present invention is a non-equilibrium deposition process, the cobalt oxide wear layer is believed to be a non-stoichiometric mixture of cobalt and oxygen, either of the Co_3O_4 phase or the CoO phase, or a mixture of both. The thickness can be as low as desired depending upon the expected or desired number of start/stop operations for the disc. (It will be understood that the magnetic recording head is in contact with the disc as it begins to spin up and agains as the disc slows down and stops). A cobalt oxide film of 50 nm for example, was found in tests to survive over 20,000 stop/start operations. A wear layer thickness of 25 nm was likewise found to suffer little degradation after 10,000 continuous stop/starts. The wear layer 12 thus described provides a low coefficient of friction and wear properties that are relatively independent of relative humidity below 50%. While a cobalt oxide wear layer is presently preferred, the oxides of the other materials may be employed, including but not limited to, titanium, silicon and aluminum.

Except for the initial layer 4 of nickel-phosphorus, the various layers of the recording disc of the invention are prepared by sputtering processes which are well known in the art. The nickel-phosphorus layer 4 is formed on the surface of the aluminum substrate 2 by electroless plating. The surface of the aluminium substrate is prepared by a zincate pre-treat cycle well known in the art. A detailed description of this pre-treat cycle may be found in a paper presented by C. P. Nargi on March 17, 1981 at the Electroless Nickel Conference II, entitled "Surface Treatments for Electroless Nickel Plating" published by Gardner Publications, Inc., 600 Main St., Cincinnati, Ohio. Electroless nickel plating is well known and a

detailed description thereof is found in electroplating engineering handbook (Third Edition, Edited by A. Kenneth Graham and published 1971 by Van Nostrand Rhinehold Company, New York, New York, with special reference to pages 488—501. After cleaning and polishing the nickel-phosphorus plated disc, it is placed in a sputtering chamber, and the remaining layers may be formed in succession without removing the disc from the chamber or system of chambers.

The chromium isolation layer 6 is sputter-deposited using a chromium target in an argon atmosphere at a pressure of about 0.93 Pa, for example. Using a DC magnetron sputtering technique to minimize substrate heating, a chromium film of about 220 nm can be formed in about 7.5 minutes. It will be appreciated that the rate of sputter deposition is primarily dependent upon the magnitude of the power suppplied to the magnetron.

The disc is then moved to an adjacent sputter chamber and the magnetic layer 8 is formed on the chromium isolation layer 6 by RF diode sputtering using a composite target comprised of platinum and cobalt. The process is practiced in an argon atmosphere at a pressure of about 1.33 Pa for example. The percentage of platinum desired to be alloyed with the sputtered cobalt determines the ratio of the exposed area of platinum to the exposed area of cobalt on the target surface. By this process, a cobalt-platinum layer 8, of preferably about 3 atomic percent platinum and of about 41 nm thickness is formed in about 2 minutes using about 0.6 watts/cm^2.

The disc is next moved to a sputter chamber where the chromium barrier layer 10 may be formed. The atmosphere is again argon at a pressure of about 0.93 Pa. The target, of course, is chromium, and since the barrier layer 10 is about 50 nm in thickness the sputter time is only about 1.5 to 2 minutes, again using a DC magnetron.

The wear layer 12 is formed on the chromium barrier layer 10 by sputter-depositing a layer of cobalt oxide thereon. To achieve the formation of this layer, a cobalt target is employed in an atmosphere of argon (80%) and oxygen (20%) at a pressure of about 15 millitorr. A layer of about 42.5 nm in thickness is formed in about 9 minutes using the RF diode sputtering technique at about 0.6 watts/cm^2.

Figure 3 illustrates how the design of a magnetic recording disc may be tailored to meet some typical desired system constraints. The system constraints are a write field below an acceptable maximum, a minimum read capability, and a minimum resolution. These constraints are shown to define a small area rather than a point to allow for inevitable small variation in system parameters. The maximum write field determines the desired coercivity of the magnetic film. As depicted in Figure 3 this may be achieved by selecting a cobalt-platinum film having an appropriate platinum content. It will be seen that any one of the three curves shown will permit operation at the coerivity determined by the available maximum write current, for example. However, while this particular objective may be met by cobalt films having a platinum content of from 0 to 4 atomic percent, only a magnetic film having a platinum content of about 2.5 atomic percent will satisfy both of the other constraints: namely, acceptable minimum resolution and minimum read cabability. With the level of the maximum write current depicted, only one of the films depicted will satisfy the constraints imposed by the head properties and system design, and this is a film having a platinum content of about 2.5 atomic percent and a thickness of between 30 nm and 42 nm. These three parameters (maximum write current, a minimum read capability, and a minimum resolution) define the Triangle A shown on the plot in Figure 3; only the 2.5 percent cobalt-platinum film traverses this Triangle. It is equally clear that should the system design require operation with the same maximum write field and a larger output read signal, the triangle moves to the right to the position designated by Triange B. Increasing the film thickness with a slight change in platinum concentration permits a new match to the disc design requirements. It should be noted that resolution may be decreased unless there is a compensating reduction in recording density.

Triangle C illustrates an example where the same resolution as for Triangle A is achieved with a head requiring a greater magnetization-thickness product for signal output but capable of writing at higher fields. Triangle D is representative of a system in which a higher resolution is achieved with a head cabable of writing at higher fields and requiring no increase in signal output. It is readily seen that a suitable independent choice of platinum concentration and film thickness allows the match of disc magnetic properties to the desired values.

Thus, by varying the thickness of the cobalt-platinum films and/or the platinum content thereof according to the invention, magnetic recording discs may be fabricated to meet a wide range of recording system design parameters. Furthermore, discs made according to the invention exhibit not only highly desirable and controllable magnetic properties but excellent stability against oxidation and wear. The present invention provides these advantages with a relatively straight-forward manufacturing process readily adaptable to continuous or batch processing with little or no complex procedures and operations.

Claims

1. A magnetic recording disc comprising a substrate (2) and a layer (6) of chromium disposed over said substrate (2), characterized in that a magnetic layer (8) of an alloy of cobalt and platinum is disposed on said chromium layer (6), said alloy containing 1 to 20 atomic percent platinum, and said magnetic layer (8) having a thickness, of from 12.5 to 100 nm.

2. A disc according to claim 1 wherein, said

detailed description thereof is found in electroplating engineering handbook (Third Edition, Edited by A. Kenneth Graham and published 1971 by Van Nostrand Rhinehold Company, New York, New York, with special reference to pages 488—501. After cleaning and polishing the nickel-phosphorus plated disc, it is placed in a sputtering chamber, and the remaining layers may be formed in succession without removing the disc from the chamber or system of chambers.

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The disc is then moved to an adjacent sputter chamber and the magnetic layer 8 is formed on the chromium isolation layer 6 by RF diode sputtering using a composite target comprised of platinum and cobalt. The process is practiced in an argon atmosphere at a pressure of about 1.33 Pa for example. The percentage of platinum desired to be alloyed with the sputtered cobalt determines the ratio of the exposed area of platinum to the exposed area of cobalt on the target surface. By this process, a cobalt-platinum layer 8, of preferably about 3 atomic percent platinum and of about 41 nm thickness is formed in about 2 minutes using about 0.6 watts/cm^2.

The disc is next moved to a sputter chamber where the chromium barrier layer 10 may be formed. The atmosphere is again argon at a pressure of about 0.93 Pa. The target, of course, is chromium, and since the barrier layer 10 is about 50 nm in thickness the sputter time is only about 1.5 to 2 minutes, again using a DC magnetron.

The wear layer 12 is formed on the chromium barrier layer 10 by sputter-depositing a layer of cobalt oxide thereon. To achieve the formation of this layer, a cobalt target is employed in an atmosphere of argon (80%) and oxygen (20%) at a pressure of about 15 millitorr. A layer of about 42.5 nm in thickness is formed in about 9 minutes using the RF diode sputtering technique at about 0.6 watts/cm^2.

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Thus, by varying the thickness of the cobalt-platinum films and/or the platinum content thereof according to the invention, magnetic recording discs may be fabricated to meet a wide range of recording system design parameters. Furthermore, discs made according to the invention exhibit not only highly desirable and controllable magnetic properties but excellent stability against oxidation and wear. The present invention provides these advantages with a relatively straight-forward manufacturing process readily adaptable to continuous or batch processing with little or no complex procedures and operations.

Claims

1. A magnetic recording disc comprising a substrate (2) and a layer (6) of chromium disposed over said substrate (2), characterized in that a magnetic layer (8) of an alloy of cobalt and platinum is disposed on said chromium layer (6), said alloy containing 1 to 20 atomic percent platinum, and said magnetic layer (8) having a thickness, of from 12.5 to 100 nm.

2. A disc according to claim 1 wherein, said

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magnetic layer (8) contains from 1.5 to 7, and preferably 3 atomic percent platinum.

3. A disc according to claim 1 or 2 wherein a barrier layer (10) is disposed on said magnetic layer (8).

4. A disc according to claim 3 wherein said barrier layer (10) is formed of a material selected from the group comprising chromium, titanium, tantalum and zirconium, preferably, chromium.

5. A disc according to any one of the preceding claims where a wear layer (12) is disposed on said barrier layer (10).

6. A disc according to claim 5 wherein said wear layer (12) is formed of an oxide selected from the oxides of cobalt, titanium, silicon and aluminium, preferably, cobalt.

7. A magnetic recording disc comprising a substrate (2) and a layer (6) of chromium disposed over said substrate (2), characterized in that said substrate (2) is made of aluminium and has a surface layer (4) thereon of an alloy of nickel and phosphorus, said layer (6) of chromium being disposed on said surface layer (4); a magnetic layer (8) of an alloy of cobalt and platinum is disposed on said layer (6) of chromium, said alloy containing 1 to 20 atomic percent platinum, and said magnetic layer (8) having a thickness of from 12.5 to 100 nm, a barrier layer (10) is disposed on said magnetic layer (8), said barrier layer (10) being a material selected from the group comprising chromium, titanium, tantalum and zirconium; and a wear layer (12) of cobalt oxide is disposed on said barrier layer (10).

8. A disc according to claim 7 wherein said layer (6) of chromium on said surface layer (4) is at least 100 nm thick, said barrier layer (10) is at least 10 nm thick, and said wear layer (12) is at least 25 nm thick.

9. A magnetic recording disc comprising a substrate (2) and a layer (6) of chromium disposed over said substrate (2), characterized in that said substrate (2) is made of aluminium and has a surface layer (4) thereon of an alloy of nickel and phosphorus; a layer (6) of chromium 220 nm thick is disposed on said surface layer, a magnetic layer (8) of said alloy of cobalt and platinum being 41 nm thick and being disposed on said chromium layer (6), the amount of platinum in said magnetic layer (8) being 3 atomic percent; a barrier layer (10) of chromium 50 nm thick is disposed on said magnetic layer; and a protective layer of cobalt oxide 42 nm thick is disposed on said barrier layer.

10. A disc according to claim 9 wherein said substrate (2) is 1.905 mm thick and said surface layer (4) is 0.0076 mm thick.

11. A method of making a film which is suitable for a magnetic recording disc, said film having a layer (6) of chromium disposed over a substrate (2), characterized by forming a magnetic layer (8) of an alloy of cobalt and platinum on said layer (6) of chromium, the amount of platinum in said alloy being within a range of from 1 to 20 atomic percent and said alloy layer (8) having a thickness of from 12.5 to 100 nm.

12. A method according to claim 11 wherein said magnetic layer (8) contains from 1.5 to 7, and preferably 3 atomic percent platinum.

13. A method according to any one of claims 11—12 wherein said substrate is made of aluminium and a surface layer (4) of alloy of nickel and phosphorus is formed on said substrate, said chromium layer (6) being formed on said surface layer.

14. A method according to any one of claims 11—13 wherein the thickness of said chromium layer (6) is within the range of 100-300 nm and is preferably 220 nm and wherein the thickness of said alloy layer (8) is within the range of 12.5—100 nm and is preferably 41 nm.

15. A method according of any one of claims 11—14 wherein a barrier layer (10) is disposed on said magnetic layer (8), said barrier layer (10) being formed of a material selected from the group comprising chromium, titanium, tantalum and zirconium, preferably, chromium, and wherein a wear layer (12) is formed of an oxide selected from the oxides of cobalt, titanium, silicon and aluminium, preferably, cobalt.

Patentansprüche

1. Magnetische Aufzeichnungsscheibe, die ein Substrat (2) und eine auf dem Substrat (2) aufgebrachte Chromschicht (6) umfaßt, dadurch gekennzeichnet, daß eine magnetische Schicht (8) einer Legierung aus Kobalt und Platin auf der Chromschicht (6) aufgebracht ist, wobei die Legierung 1 bis 20 Atom-% Platin umfaßt und die magnetische Schicht (8) eine Dicke von 12,5 bis 100 nm hat.

2. Aufzeichnungsscheibe nach Asrpruch 1, dadurch gekennzeichnet, daß die magnetische Schicht (8) 1,5 bis 7 Atom-%, vorzugsweise 3 Atom-% Platin enthält.

3. Aufzeichnungsscheibe nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß eine Sperrschicht (10) auf der magnetischen Schicht (8) ausgebildet ist.

4. Aufzeichnungsscheibe nach Anspruch 3, dadurch gekennzeichnet, daß die Sperrschicht (10) Chrom, Titan, Tantal oder Zirkonium, vorzugsweise Chrom umfäßt.

5. Aufzeichnungsscheibe nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß eine Verschleißschicht (12) auf der Sperrschicht (10) ausgebildet ist.

6. Aufzeichnungsscheibe nach Anspruch 5, dadurch gekennzeichnet, daß die Verschleißschicht (12) aus Kobalt-, Titan-, Silizium- oder Aluminiumoxid, vorzugsweise aus Kobaltoxid hergestellt ist.

7. Magnetische Aufzeichnungsscheibe, die ein Substrat (2) und eine auf dem Substrat (2) aufgebrachte Chromschicht (6) umfaßt, dadurch gekennzeichnet, daß das Substrat (2) aus Aluminium hergestellt ist und eine Oberflächenschicht (4) eine Legierung aus Nickel und Phosphor trägt, wobei die Chromschicht (6) auf der Oberflächenschicht (4) aufgebracht ist; eine magnetische

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Schicht (8) aus einer Legierung aus Kobalt und Platin auf der Chromschicht (6) aufgebracht ist, wobei die Legierung 1 bis 20 Atom-% Platin enthält und die Dicke der Magnetschicht (8) 12,5 bis 100 nm beträgt; eine Sperrschicht (10) auf der magnetischen Schicht (8) aufgebracht ist, die Chrom, Titan, Tantal und/oder Zirkonium enthält; und eine Kobaltoxid umfassende Verschleißschicht (12) auf der Sperrschicht (10) aufgebracht ist.

8. Aufzeichnungsscheibe nach Anspruch 7, dadurch gekennzeichnet, daß die Chromschicht (6) auf der Oberflächenschicht (4) mindestens 100 nm, die Sperrschicht (10) mindestens 10 nm und die Verschleißschicht (12) mindestens 25 nm dick sind.

9. Magnetische Aufzeichnungsscheibe, die ein Substrat (2) und eine auf dem Substrat (2) aufgebrachte Chromschicht (6) umfaßt, dadurch gekennzeichnet, daß das Substrat (2) aus Aluminium besteht und auf dem Substrat (2) eine Oberflächenschicht (4) einer Legierung aus Nickel und Phosphor ausgebildet ist; eine Chromschicht (6) mit einer Dicke von 220 nm auf der Oberflächenschicht aufgebracht ist, wobei eine magnetische Schicht (8) aus einer Legierung aus Kobalt und Platin mit einer Dicke von 41 nm auf der Chromschicht (6) aufgebracht ist und wobei ferner der Platinanteil der magnetischen Schicht (8) 3 Atom-% beträgt; eine Sperrschicht (10) aus Chrom mit einer Dicke von 50 nm auf der magnetischen Schicht ausgebildet ist; und eine Schutzschicht aus Kobaltoxid mit einer Dicke von 42 nm auf der Sperrschicht aufgebracht ist.

10. Aufzeichnungsscheibe nach Anspruch 9, dadurch gekennzeichnet, daß das Substrat (2) eine Dicke von 1,905 mm und die Oberflächenschicht (4) eine Dicke von 0,0076 mm haben.

11. Verfahren zum Herstellen einer für eine magnetische Aufzeichnungsscheibe geeigneten Folie, die eine Chromschicht (6) auf einen Substrat (2) umfaßt gekennzeichnet durch Ausbilden einer magnetischen Schicht (8) einer Legierung aus Kobalt und Platin auf der Chromschicht (6), wobei der Platinanteil der Legierung in einem Bereich von 1 bis 20 Atom-% liegt und die Legierungsschicht (8) eine Dicke von 12,5 bis 100 nm hat.

12. Verfahren nach Anspruch 11, dadurch gekennzeichnet, daß die magnetische Schicht (8) 1,5 bis 7 Atom-%, vorzugsweise 3 Atom-% Platin enthält.

13. Verfahren nach Anspruch 11 oder 12, dadurch gekennzeichnet, daß das Substrat aus Aluminium hergestellt wird und eine Oberflächenschicht (4) einer Legierung aus Nickel und Phosphor auf dem Substrat ausgebildet wird, wobei die Chromschicht (6) auf der Oberflächenschicht ausgebildet wird.

14. Verfahren nach einem der Ansprüche 11 bis 13, dadurch gekennzeichnet, daß die Dicke der Chromschicht (6) in dem Bereich von 100 bis 300 nm, vorzugsweise bei 220 nm und diejenige der Legierungsschicht (8) in dem Bereich von 12,5 bis 100 nm, vorzugsweise bei 41 nm liegen.

15. Verfahren nach einem der Ansprüche 11 bis 14, dadurch gekennzeichnet, daß eine Sperrschicht (10) auf die magnetische Schicht (8) aufgebracht wird, die Chrom, Titan, Tantal und/oder Zirkonium, vorzugsweise Chrom umfaßt, und daß eine Verschleißschicht (12) Kobalt-, Titan, Silizium- oder Aluminiumoxid, vorzugsweise-Kobaltoxid umfaßt.

Revendications

1. Un disque d'enregistrement magnétique, comprenant un substrat (2) et une couche (6) de chrome placée sur ce substrat (2), caractérisé en ce qu'une couche magnétique (8) d'un alliage de cobalt et de platine est disposée sur cette couche de chrome (6), cet alliage contenant entre 1 et 20% d'atomes de platine, et la couche magnétique (8) ayant une épaisseur comprise entre 12,5 et 100 nm.

2. Le disque de la revendication 1, dans lequel la couche magnétique (8) contient entre 1,5% et 7%, de préférence 3%, d'atomes de platine.

3. Le disque de l'une des revendications 1 et 2, dans lequel une couche d'arrêt (10) est disposée sur la couche magnétique (8).

4. Le disque de la revendication 3, dans lequel la couche d'arrêt (10) est formée d'une matière choisie dans le groupe comprenant le chrome, le titane, le tantale et le zirconium, de préférence le chrome.

5. Le disque de l'une des revendications précédentes, dans lequel une couche d'usure (12) est disposée sur la couche d'arrêt (10).

6. Le disque de la revendication 5, dans lequel la couche d'usure (12) est formée d'un oxyde choisi parmi les oxydes de cobalt, de titane, de silicium et d'aluminium, de préférence les oxydes de cobalt.

7. Un disque d'enregistrement magnétique, comprenant un substrat (2) et une couche (6) de chrome placée sur ce substrat (2), caractérisé en ce que ce substrat (2) est en aluminium et porte une couche de surface (4) d'un alliage de nickel et de phosphore, la couche (6) de chrome étant disposée sur cette couche de surface (4), en ce qu'une couche magnétique (8) d'un alliage de cobalt et de platine est disposée sur cette couche de chrome (6), cet alliage contenant entre 1 et 20% d'atomes de platine, et la couche magnétique (8) ayant une épaisseur comprise entre 12,5 et 100 nm, en ce qu'une couche d'arrêt (10) est disposée sur la couche magnétique (8), cette couche d'arrêt (10) étant formée d'une matière choisie dans le groupe comprenant le chrome, le titane, le tantale et le zirconium, et en ce qu'une couche d'usure (12) d'oxyde de cobalt est disposée sur cette couche d'arrêt (10).

8. Le disque de la revendication 7, dans lequel la couche (6) de chrome sur la couche de surface (4) a une épaisseur d'au moins 100 nm, la couche d'arrêt (10) a une épaisseur d'au moins 10 nm et la couche d'usure (12) a une épaisseur d'au moins 25 nm.

9. Un disque d'enregistrement magnétique,

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comprenant un substrat (2) et une couche (6) de chrome placée sur ce substrat (2), caractérisé en ce que ce substrat (2) est en aluminium et porte une couche de surface (4) d'un alliage de nickel et de phosphore, en ce qu'une couche de chrome (6) de 220 nm est disposée sur cette couche de surface, une couche magnétique (8) d'un alliage de cobalt et de platine ayant 41 nm d'épaisseur et étant disposée sur cette couche de chrome (6), la proportion de platine dans la couche magnétique (8) étant de 3% d'atomes, en ce qu'une couche d'arrêt (10) de chrome de 50 nm d'épaisseur est disposée sur la couche magnétique, et en ce qu'une couche protectrice (12) d'oxyde de cobalt de 42 nm d'épaisseur est disposée sur cette couche d'arrêt.

10. Le disque de la revendication 9, dans lequel le substrat (2) a une épaisseur de 1,905 mm et la couche de surface (4) a une épaisseur de 0,0076 mm.

11. Un procédé de réalisation d'un film convenant à un disque d'enregistrement magnétique, ce film ayant une couche (6) de chrome disposée sur un substrat (2) caractérisé en ce qu'on forme une couche magnétique (8) d'un alliage de cobalt et de platine sur cette couche (6) de chrome, la proportion de platine dans cet alliage étant comprise dans une gamme allant de 1 à 20% d'atomes, et la couche d'alliage (8) ayant une épaisseur comprise entre 12,5 et 100 nm.

12. Le procédé de la revendication 11, dans lequel la couche magnétique (8) contient entre 1,5% et 7%, de préférence 3%, d'atomes de platine.

13. Le procédé de l'une des revendications 11 et 12, dans lequel le substrat est en aluminium et dans lequel on forme une couche de surface (4) d'un alliage de nickel et de phosphore, la couche (6) de chrome étant formée sur cette couche de surface (4),

14. Le procédé de l'une des revendications 11 à 13, dans lequel l'épaisseur de la couche de chrome (6) est comprise entre 100 et 300 nm et vaut de préférence 220 nm, et dans lequel l'épaisseur de la couche d'alliage (8) est comprise entre 12,5 et 100 nm et vaut de préférence 41 nm.

15. Le procédé de l'une des revendications 11 à 14, dans lequel une couche d'arrêt (10) est disposée sur la couche magnétique (8), cette couche d'arrêt (10) étant formée d'une matière choisie dans le groupe comprenant le chrome, le titane, le tantale et le zirconium, de préférence le chrome, et dans lequel une couche d'usure (12) est formée d'un oxyde choisi parmi les oxydes de cobalt, de titane, de silicium et d'aluminium, de préférence les oxydes de cobalt.

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