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[54] **DUPLEX METALLIC OVERCOATING**

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[51] **Int. Cl.** **H01f 10/00**

[58] **Field of Search** 117/239, 240; 29/196.1, 196.2, 196.4, 196.6, 197, 195, 194

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[57] **ABSTRACT**

Rhodium plated articles are given superior wear qualities by providing an undercoating of a tin-nickel alloy. The invention is particularly applicable to metallic discs having a magnetic coating on the discs.

1 Claim, No Drawings

DUPLEX METALLIC OVERCOATING

SUMMARY OF THE INVENTION

Rhodium is used as a coating material for many articles because of its hardness and superior wear characteristics. One particular application of such rhodium coatings is in the making of magnetic discs which are used for such purposes as data recording or instant replay television recording. Such discs ordinarily have a substrate of aluminum with a magnetic coating thereon and an outer coating of rhodium which is used because of its hardness and lubricating qualities. Thus, the relatively soft magnetic coating is protected from head wear.

The difficulty of such rhodium overcoatings in the past has been that it is difficult to plate rhodium in sufficient thickness to act as a protective layer since rhodium is a highly stressed metal. When the plating is deposited, defects are frequently found in the rhodium overcoating which consist of small pits or inclusions caused partly by the poor adhesion between rhodium and the plated magnetic layer. Blistering and flaking are frequent defects and all of these defects have resulted in poor wear characteristics of the discs with attendant problems of head and disc scratching. The defects are frequently so severe that the disc is rejected so that only a low yield is achieved of plated rhodium discs. In addition, rhodium is a relatively expensive metal so that much more economical discs could be produced if the quantity of rhodium could be reduced.

In accordance with the present invention it has been found that if a sublayer of a tin-nickel alloy is provided for the rhodium that a very superior rhodium coating can be obtained which is substantially free of defects. Further, the tin-nickel subcoating which is relatively inexpensive can be substituted for a large proportion of the rhodium so that the quantity of expensive metal can be greatly reduced. Further, since the tin-nickel alloy is a relatively low stressed alloy, a much greater yield of usable discs is attained. Low stress rhodium plating baths have been suggested in the past but they have not been fully satisfactory. With the undercoating of the present invention it is not necessary to employ special low stress plating baths.

Thus, the discs of the present invention are superior to discs which only have the rhodium plating thereon, they are less expensive insofar as metal content is concerned and they are more economical since a much greater yield can be obtained in the plating operations and it is not necessary to employ special low-stress baths.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In its broadest sense, the present invention relates to a subcoating of tin-nickel under a rhodium coating wherein the rhodium is used as a protective coating on an article because of its hardness and freedom from corrosion. Thus, the present invention is applicable to any rhodium coating and may be used, for instance, in the manufacture of electrical contacts such as relays and commutators, as well as for bearings. However, the present invention is particularly applicable to the manufacture of magnetic discs and will be so described.

In the manufacture of plated magnetic discs, aluminum is used as the substrate metal because of its favorable strength to weight ratio. However, since aluminum is a reactive metal it is ordinarily necessary to protect it so that before a magnetic coating is put on the aluminum, it is common to give it a thin coating of electroless nickel. Copper or other non-magnetic materials can also be used to protect the aluminum. Over this is placed a magnetic coating and such coatings are well known to those skilled in the art and form no part of the present invention. For instance, the coating could be any of the well known cobalt-nickel-phosphorus or cobalt-nickel magnetic layers. Over this is plated a thin layer of tin and nickel alloy. The ratio of tin to nickel is about 65 to 35 percent by weight or about equal atomic percentages of the two metals. The rhodium outer coating is then plated onto the tin-nickel. The tin-nickel can substitute for a large proportion of the rhodium, drastically reducing the amount of rhodium which is necessary yet the finished duplex coating has a hardness which excells or at least equals rhodium alone.

The following non-limiting examples illustrate preferred embodiments:

EXAMPLE 1

An aluminum disc was polished and cleaned in known manner and electroless nickel was deposited on the disc to a thickness of about 1 mil and polished. A magnetic alloy of cobalt and nickel was then electroplated over this layer. The depositing of such magnetic layers is well known to those skilled in the art and therefore will not be described in detail.

Over the magnetic layer there was plated 11 microinches of a tin-nickel alloy from the following bath:

Stannochlor Compound ($SnCl_2$)	6.5 oz/gal.
Nickel chloride ($NiCl_2{:}6H_2O$)	40.0 oz/gal.
Ammonium bifluoride (NH_4HF_2)	7.5 oz/gal.
Ammonium hydroxide	as needed to adjust pH
Water q.s.	1 gallon

The pH of the bath was adjusted in the range of 2.0 to 2.5 and plating was conducted for a period of 90 seconds at a current density of 5.4 amperes per square foot and at a temperature of 155°F.

The disc was then removed from the bath and cleaned and was then plated in a rhodium bath at room temperature having the following composition:

	Grams/liter
Rhodium metal (added as rhodium sulfate)	0.5–20
Sulfamic acid	5–100
Copper ions (added as a soluble salt)	0.10–0.50
Water to 1 liter volume	

The current density was the same as for the tin-nickel bath and a layer of 2 microinches of rhodium was deposited. This produced a hard coating having a low coefficient of friction and the finished disc was tested as follows:

The disc was rotated at 1,800 rpm and a ferrite head was placed in contact with the disc at a radius of 10 inches. After running this head disc combination for 1,000 hours no significant dropouts developed and the test was stopped. The running track was then magnified 1,000 times and only minimal damage was noticed in the rhodium surface. It would be reasonable to expect the ferrite head to run in excess of 10,000 hours on the same track before extensive damage to the disc would occur. By comparison, leaving the tin-nickel layer out and using only rhodium as the overcoating, destruction of the disc occurs under these conditions after several

hundred hours of continuous running on a single track.

EXAMPLE 2

For comparative purposes, two discs which had been plated with a cobalt-nickel-phosphorus magnetic coating were provided with overcoatings 4 microinches in thickness. One of the discs had an overcoating consisting solely of rhodium while the other disc had a coating which was 2 microinches thick of tin-nickel alloy and 2 microinches of rhodium.

The two discs werethen examined for micro defects which in this case is defined as any defect which is greater than one-half mils in diameter. The disc which had been plated with rhodium had more than ten times as many defects as the disc which had been plated a combination of tin-nickel and rhodium.

In the past it has been usual to provide an overcoating of about 10 microinches of rhodium to provide a dequate protection of the underlying magnetic layer. In accordance with the present invention, not only is the amount of rhodium reduced, but it is also possible to use a much thinner total thickness to protect the magnetic coating. For instance, tests have shown that an overcoating of 2 microinches of tin-nickel and 2 microinches of rhodium give protection equivalent to the previously used 10 microinches of rhodium. This is not only saving from the standpoint of rhodium but also is helpful from the standpoint of increasing the electrical output of a given magnetic disc. One common way of measuring this is to determine the ratio of the electrical outputs at two different frequencies, usually 10 and 6 MHz wherein the output falls off at the higher frequency. Utilizing an overcoating of 10 microinches, this ratio is about 0.2 while by reducing the protective coating to 4 microinches, the ratio becomes 0.4. It is obvious that the nearer to unity, the more uniform the frequency response.

The above examples illustrate the use of a low stress rhodium bath but the employment of such baths is not essential. In the following example a conventional rhodium plating solution was employed.

EXAMPLE 3

A disc was prepared as in Example 1 except that the rhodium bath had the following composition:

Rhodium sulfate	5 gm.
H_2SO_4	30 ml.
Water q.s.	1 liter

Plating was conducted at 25°C to produce a rhodium thickness of 2 microinches. The disc was tested as outlined above and found fully satisfactory.

The cost savings on rhodium are very substantial. In one typical example, 24 inch diameter discs were previously protected with 20 microinches of rhodium and the actual metal cost was $28.00 per disc. Utilizing the process of the present invention, equally good protection was obtained with only 2 microinches of rhodium which obviously cost only one-tenth as much. In other words, the direct manufacturing cost was reduced by a factor of 10 insofar as the rhodium content is concerned.

Although certain specific embodiments of the invention have been given, it will be understood that these are for illustration purposes and that many variations can be made without departing from the spirit of this invention. Generally speaking, the thickness of the tin-nickel layer will be at least equal to the rhodium layer and preferably is several times this thickness. The rhodium layer can vary from about 2 microinches up to 20 or more microinches while the thickness of the tin-nickel layer can also vary from about 2 to about 20 microinches or more. The tin-nickel layer can be deposited at current densities of from about 3 to 12 amperes per square foot and plating times of from 15 seconds to 3 minutes are suitable. The same current densities can be used for the rhodium plating and the time will depend upon the thickness of the coating to be deposited.

We claim:

1. As a ntw article of manufacture, a non-magnetic metallic substrate having a magnetic coating thereon, an overcoating on said magnetic layer of from 2 to 20 microinches of a tin-nickel alloy of approximately equal atomic percentages and from 2 to 20 microinches of a rhodium coating over said tin-nickel alloy coating.

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