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PREPARATION OF HARD MAGNETIC COATINGS OF NICKEL-PHOSPHORUS ALLOYS

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This invention relates to electrodeposition of hard magnetic coatings and more particularly to a method of producing nickel-phosphorus alloys having square hysteresis loop properties and coercive forces of about 240 oersteds.

An object of the present invention is to provide hard magnetic coatings of nickel-phosphorus alloys having coercive forces in the range of about 240 oersteds, a squareness ratio in the range of about 0.8 and a remanence value, B_r, of about 1.2 kilogausses.

A more specific object of the present invention is to provide nickel-phosphorus suitable for use as magnetic storage media on drums, discs, and the like, which process includes electrodeposition from an acid bath containing hypophosphite ion at a pH of about 4 and subsequently heat treating the deposit at about 400° C.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention.

What is described herein is a process which produces hard magnetic coatings of nickel-phosphorus alloys which are eminently suitable for use as storage media on discs and drums as used in present day computer circuitry. The process of the present invention includes electrodeposition of nickel-phosphorus alloys from an electrolyte consisting essentially of a nickel salt and a hypophosphite ion containing addition agent at a pH of about 4 and subsequently heat-treating the nickel-phosphorus alloy thus formed at elevated temperatures.

In order to aid those skilled in the art to practice the invention the following specific example will now be presented, although other conditions in accordance with the principles of the invention as herein set forth may be used as well.

A thin metallic film of nickel-phosphorus alloy was electrodeposited at room temperature from an electrolyte of nickel chloride ($NiCl_2 \cdot 6H_2O$), 200 g./l., and sodium hypophosphite ($NaH_2PO_2 \cdot H_2O$), 15.5 g./l., at a pH of 4.0 and a current density of 25 amps./ft.^{2}. The films then were subjected to a heat treatment at 400° C. in nitrogen for one hour. Examination of the magnetic properties of the film gave the following set of properties: coercive force, H_c, 240 oersteds, remanence, B_r, 1.2 kilogausses and squareness ratio, sq. r., 0.84 at a drive field of 1000 oersteds.

Further experimentation has shown that electrodeposition of the nickel-phosphorus alloy at a pH of 2.0 produced resultant films after heat-treatment which had markedly inferior magnetic properties. At a pH of 6.0 nickel precipitated from the bath which is undesirable.

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The process of the present invention has been shown to be applicable only to nickel-phosphorus alloys. When cobalt is substituted in whole for nickel, the heat treatment substantially deteriorates the crystal structure of the film such that the coercive forces are reduced rather than increased by the heating step.

While one suitable source and concentration of nickel and hypophosphite ions have been described, other nickel salts and hypophosphite containing compounds may be used as well in widely varying concentrations without substantially changing the results described in detail herein. The preferred current density range is 25–125 amps./sq. ft.

While an inert atmosphere of nitrogen is described in the preferred embodiment, other suitable atmospheres may be used as will be understood to those skilled in the art, such as air, argon, helium, and the like.

The mechanism by which the heat treating steps improve the magnetic properties of nickel-phosphorus films is not completely understood at present. Microscopic examination, however, has indicated that heating changes the crystalline structure in the nickel-phosphorus alloy produced by electrodeposition from hypophosphite solutions. Films produced from baths not containing hypophosphite are not as susceptible to this change in structure when heated in a similar manner.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method of preparing a magnetic coating of a nickel-phosphorus alloy which comprises subjecting a substrate to an electrolytic action in an electroplating bath having a pH of about 4 containing 49.38 grams per liter of solution of nickel ions, 9.50 grams per liter of solution of hypophosphite ions, at a current density of 25 to 125 amperes per square foot, thereafter heating the coating thus deposited at elevated temperatures, to produce thereby a magnetic coating having a coercive force of about 240 oersteds and a squareness ratio, B_r/B_s, of 0.84 when driven at 1000 oersteds.

2. A method according to claim 1 wherein said heating is carried out in a nitrogen atmosphere.

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