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ELECTRODEPOSITION OF IRON-TUNGSTEN ALLOYS

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2 Claims. (Cl. 204—43)

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This invention relates to the electrodeposition of iron-tungsten alloys.

An object of the invention is to improve the electrodeposition of iron-tungsten alloys, and the methods and compositions used therefor.

Other objects of the invention will be apparent from the description and claims.

An electrodeposit of iron containing small percentages of tungsten can provide a highly desirable facing for many commercial applications, such as where a hard or abrasion resistant surface is desired. It also has some advantages where corrosion resistance is required.

Tungstates have a marked effect on an iron plating bath. A rapid drop in current efficiency occurs as the tungstate concentration is increased. There is also a tendency for non-metallic deposits to be produced. This is perhaps due to the formation of a film on the cathode allowing passage of hydrogen ions but not the heavier metallic ions, which may be deposited in the film as insoluble basic compounds.

We have found, however, that under certain conditions an iron plating bath containing tungstates, such as sodium tungstate, can be electrolyzed to obtain smooth, adherent metallic deposits of iron-tungsten alloys on the cathode.

We have also found that the percentage of tungsten in the deposit can be increased by agitation or by rotating the cathode.

One suitable iron-tungsten plating bath contained:

	Grams per liter
Ferrous ammonium sulfate	350
Sodium tungstate	1
3.5 N sulfuric acid to bring pH to	2

The bath was prepared from stock solutions of ferrous sulfate and ammonium sulfate. The ferrous sulfate solution was treated with iron powder and then acidified with sulfuric acid to a pH of about 2; it was kept in the ferrous state by the presence of metallic iron until used for preparing a bath.

A standard sodium tungstate solution, acidified to about pH 3 with sulfuric acid, was used for addition of tungsten to the iron bath. The acidification of the tungstate solution was necessary to prevent the precipitation of an insoluble iron tungstate upon the addition of sodium tungstate to the ferrous sulfate solution. The bath as made up had a pH of about 3, and it was adjusted to lower pH values by the addition of 3.5 N sulfuric acid.

Plating was carried out at a temperature of about 75° C. using an iron anode.

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The cathode basis metal was copper although brass, iron, steel, nickel, or any of the other common basis metals either plain or with a preliminary flash or plated coating of copper may be used.

The composition of the resulting electrodeposit and its character was dependent upon the current density and the rate of motion of the cathode or agitation of the solution.

The current efficiency of alloy deposition is very poor at the lower current densities and it increases rapidly with increased current density. The alloy plates obtained at the higher current densities were metallic in appearance, whereas those obtained at lower current densities were much less metallic and perhaps contained oxides. A current density between 8 and 12 amperes per square decimeter is preferred for still baths and results in a deposit containing about 8 to 12% by weight of tungsten. By rotating the cathode the percentage of tungsten in the alloy deposit can be increased, however with a decrease in cathode efficiency.

In general, current densities between 2 and 20 amp./dm. are useful, depending on the temperature, composition and rate of agitation.

The conditions of electrolysis and composition of the bath may be varied to obtain different proportions of tungsten in the alloy deposit. Deposits containing from a trace up to 25% or more of tungsten can be obtained.

The amount of tungsten in the bath may be between 0.2 and 10 grams per liter and is added as sodium tungstate or other soluble compounds of tungsten, such as potassium tungstate, ammonium tungstate, or phospho tungstic acid. Usually 1 to 2 grams of tungsten per liter is preferred. The ferrous ammonium sulfate can also be varied widely in concentration.

The pH of the bath should be maintained between 1.5 and 3, the preferred acidity being a pH of 2 although higher pH values, such as a pH of 2.5, increase the current efficiency somewhat.

Good deposits are best obtained at elevated temperatures, the range between 40° C. and 95° C. being most suitable. The current efficiency reaches a maximum at about 50° C. and then falls off somewhat for higher temperatures. Deposits obtained from the bath at 75° C. had the best appearance. The amount of tungsten in the alloy deposit increases somewhat regularly with increase of bath temperature.

The iron-tungsten alloy plate can be used to improve the appearance of the basis metal, to improve its corrosion resistance properties and to

produce a hard durable surface for building up worn parts. It could also be used to produce an alloy surface which is suitable for special treatment such as nitriding, carbonizing, and the like.

While specific embodiments of the invention have been described, it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of electrodepositing an iron-tungsten alloy which comprises passing an electric current through a bath consisting of an aqueous solution of 350 g. of ferrous ammonium sulfate, 1 g. of sodium tungstate and 3.5 N sulfuric acid in one liter of the solution, said solution having a pH of about 2.0, and the electrodeposition being performed at about 75° C.

2. A plating bath for iron-tungsten alloy plating, said bath consisting of an aqueous solution of 350 g./l. of ferrous ammonium sulfate and 1 g./l. of sodium tungstate and sulfuric acid in an amount to bring the pH of the solution to about 2.0.

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