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CHEMICAL DISPLACEMENT PROCESS OF PLATING CADMIUM ON ALUMINUM

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9 Claims. (Cl. 204—38)

This invention relates to a method of coating aluminum and aluminum base alloys with cadmium by immersing the aluminum in aqueous solutions of suitable composition. More specifically the invention has to do with the formation of an adherent coating of cadmium on aluminum by displacement of cadmium ions from a suitable acid solution which also etches and removes aluminum oxide from the aluminum.

One object of the present invention is to provide an improved method of depositing cadmium on aluminum and aluminum base alloys without the use of electric current. Another object of the invention is to provide improved compositions for the immersion plating of aluminum of the type involving displacement of cadmium ions.

Other objects and advantages of the present invention will become more apparent as the description proceeds.

In accordance with the present invention there are provided improved solutions for the immersion cadmium coating of aluminum comprising aqueous solutions containing cadmium and hydrochloric acid, the concentrations of cadmium and hydrochloric acid being controlled whereby adherent cadmium deposits of good quality are formed on the aluminum. We have discovered that aqueous solutions having a cadmium concentration range of about .05 to .25 molar and a hydrochloric acid concentration range of about .35 to .75 normal provide satisfactory baths for forming adherent immersion deposits of cadmium on aluminum. Where the cadmium is present in concentrations below the .05 molar limit there appears to be no appreciable deposition of cadmium and above the .25 molar limit the deposit formed is coarse and granular. Our range of cadmium concentration for most satisfactory deposits is .15 to .17 molar. We have found further that the range of hydrochloric acid concentration for best results is about .5 to .6 normal. However, concentrations both lower and higher than this may be used satisfactorily. In general a range of hydrochloric acid concentration of about .35 to .75 normal may be employed. Below the concentration of about .35 normal the reaction is slow and a great amount of pitting of base metal occurs. Above the concentration of about .75 normal the deposit formed is granular, coarse and relatively non-adherent.

A preferred bath composition consists of an aqueous solution containing 37 grams per liter $CdCl_2 \cdot \frac{1}{2}H_2O$ and 40 milliliters per liter concentrated hydrochloric acid.

Another specific example of a bath in accordance with the invention that has been employed successfully is made up by dissolving in water the following:

4% by weight—cadmium acetate.
12% by volume—concentrated hydrochloric acid.

In carrying out the process of the present invention, bath temperatures of about 80° F. to 140° F. have been found suitable. Below about 80° F. the reaction is slow and at temperatures above about 140° F. the deposits

tend to be non-adherent. Temperatures of about 80° F.–100° F. are preferred.

In preparing the aluminum or aluminum base alloy surface for deposition of cadmium thereon it is first cleaned in any suitable manner. One cleaning procedure that has been employed successfully is to scrub the surface of the aluminum with pumice on a bristle brush, then water rinse and finally etch for fifteen seconds in an aqueous solution containing 20% by volume concentrated hydrofluoric acid at 70° F. to 80° F.

The cleaned aluminum or aluminum base surface then is dipped in the cadmium immersion plating bath preferably at a temperature of 80° F. to 100° F. for thirty seconds causing a coating of cadmium to be deposited thereon. Best results are obtained by water rinsing the plated part and then redipping the part in the cadmium immersion plating bath for an additional thirty seconds, then water rinsing again and finally drying.

The aluminum or aluminum base allow articles having the cadmium deposited thereon may then be electroplated or otherwise coated with various metals as desired. For example, such metals as copper, nickel, indium, lead, tin, etc., may be electroplated or otherwise applied to the immersion plated coating of cadmium.

One specific usage of the method and article of the present invention is as a coating on bearings formed of aluminum alloy. One very satisfactory aluminum alloy bearing has the following composition:

Silicon	3.5%–4.5%.
Cadmium	0.75%–1.4%.
Iron	0.45% Max.
Other Impurities	0.35% Max.

Balance aluminum.

In forming bearings of the foregoing aluminum alloy it is known to employ a sodium zincate process of immersion plating a thin coating of zinc on the aluminum whereby the zinc coated surface forms a base for the electrodeposition of a thin lead-tin alloy or babbitt overlay. The zinc is not a particularly good bearing material and under some conditions there is a tendency for it to diffuse into the lead-tin surface thereby impairing the bearing properties. Cadmium on the other hand is a relatively good bearing material and forms an essential component of the foregoing aluminum bearing alloy.

In the several claims herein it will be understood that "aluminum" includes not only pure or substantially pure aluminum but also aluminum base alloys containing about 80% or more of aluminum.

Numerous changes and modifications of the embodiments of our invention described herein may be made by those skilled in the art without departing from the principles and spirit of the invention.

We claim:

1. The method of plating adherent cadmium on aluminum which comprises immersing aluminum in an aqueous solution consisting essentially of cadmium ions in a molar concentration of about .05 to .25 and hydrochloric acid in a concentration of about .35 to .75 normal, whereby adherent cadmium is deposited on the aluminum by chemical displacement.

2. The method of plating adherent cadmium on aluminum which comprises immersing aluminum in an aqueous solution consisting essentially of cadmium salt in a molar concentration of .15 to .17 and hydrochloric acid in a concentration of .5 to .6 normal, whereby cadmium is deposited on the aluminum by chemical displacement.

3. The method of plating cadmium on aluminum which comprises immersing aluminum in an aqueous solution consisting essentially of 37 grams per liter $CdCl_2.2\frac{1}{2}H_2O$

and 40 milliliters per liter concentrated hydrochloric acid at a temperature of about 80° F. to 100° F., whereby cadmium is deposited on the aluminum in adherent form by chemical displacement.

4. The method of plating adherent cadmium on aluminum which comprises immersing aluminum in an aqueous solution consisting essentially of 4% by weight cadium acetate and 12% by volume concentrated hydrochloric acid at a temperature of about 80° F. to 100° F. whereby cadmium is deposited on the aluminum by chemical displacement.

5. A method of plating cadmium on aluminum which comprises immersing aluminum in an aqueous solution consisting essentially of cadmium salt having sufficient cadmium to produce a cadmium ion molar concentration of about .05 to .25 and hydrochloric acid in a concentration of about .35 to .75 normal while solution is at a temperature within the approximate range of 80° F. to 140° F., whereby cadmium is deposited on the aluminum in adherent form by chemical displacement.

6. A method of forming an aluminum bearing having a thin overlay thereon of electrodeposited babbitt which comprises plating a thin adherent coating of cadmium on the aluminum by immersing the aluminum in an aqueous solution consisting essentially of cadmium salt having sufficient cadmium to produce a cadmium ion molar concentration of about .05 to .25 and hydrochloric acid in a concentration of about .35 to .75 normal to deposit adherent cadmium on the aluminum without use of electroplating current and then electrodepositing the babbitt on the cadmium.

7. A method of forming an aluminum bearing having a thin overlay of electrodeposited babbitt thereon which comprises plating a thin adherent coating of cadmium on the aluminum by immersing the aluminum in an aqueous solution consisting essentially of cadmium salt in a molar concentration of .15 to .17 and hydrochloric acid in a concentration of .5 to .6 normal to deposit adherent cadmium without use of electroplating current and then electrodepositing the babbitt overlay on the cadmium.

8. A method of forming an aluminum bearing having a thin overlay of electrodeposited babbitt thereon which comprises plating a thin adherent coating of cadmium on the aluminum by immersing the aluminum in an aqueous solution consisting essentially of 4% by weight cadmium acetate and 12% by volume concentrated hydrochloric acid to deposit adherent cadmium without use of electroplating current and then electrodepositing the babbitt overlay on the cadmium.

9. A method of forming an aluminum bearing having a thin overlay of electrodeposited babbitt thereon which comprises plating a thin adherent coating of cadmium on the aluminum by immersing the aluminum in an aqueous solution consisting essentially of 37 grams per liter $CdCl_2.2\frac{1}{2}H_2O$ and 40 milliliters per liter concentrated hydrochloric acid to deposit adherent cadmium without use of electroplating current and then electrodepositing the babbitt overlay on the cadmium.

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(Addition to No. 523,222)

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,850,441 September 2, 195

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It is hereby certified that error appears in the printed specificatic of the above numbered patent requiring correction and that the said Letter Patent should read as corrected below.

Column 1, line 60, for the formula "$CdCl_2.1/2H_2O$" read -- $CdCl_2.2-1/2$

Signed and sealed this 18th day of November 1958.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patent