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PROCESS OF PLATING ZINC ON ALUMINUM

Jesse E. Stareck, Birmingham, and Frank Passal, Detroit, Mich., assignors to United Chromium, Incorporated, New York, N. Y., a corporation of Delaware

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1 Claim. (Cl. 204—38)

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This invention relates to the plating of zinc on aluminum.

We are unaware that zinc has heretofore been satisfactorily electroplated on aluminum. With methods heretofore proposed consistent adhesion is not obtained and such adhesion as is obtained is poor. The present invention provides a process by which zinc can be successfully and satisfactorily plated on aluminum, with good and consistent adhesion. The process is reliable and consistent in commercial performance.

According to the present invention, aluminum is immersed in a suitable bath, which results in the formation of an extremely thin immersion coating of the zinc on the aluminum, and the aluminum with the immersion coating of zinc, is then suspended, as a cathode, in an aqueous pyrophosphate zinc plating bath having the properties of initiating the electrodeposition of zinc on the immersion coating before the solution can act on the zinc immersion coating sufficiently to expose the aluminum. By contrast, cyanide zinc baths actively attack the zinc immersion coating. The zinc pyrophosphate plating solution, having the properties set out above, is one which contains a complex alkaline metal zinc pyrophosphate ($K_2Zn(P_2O_7)_2$, for example) having a pH between 8.5 and 9.5, and containing a small amount of an organic polyamine.

An example of a suitable bath is one made up with

Grams per liter

$Zn_2P_2O_7 \cdot 3H_2O$ ----- 82
 $K_4P_2O_7$ ----- 400

Corresponding to

Grams per liter

Zn ----- 30
 P_2O_7 ----- 240

with approximately $\frac{1}{100}$ of 1% to $\frac{1}{10}$ of 1%, by volume, of an organic polyamine, as for example, diethylene triamine. The bath may also contain about 15 g./l. of citric acid, to aid anode corrosion.

The pH of the solution is adjusted and maintained within the range pH 8.5 to 9.5.

Air agitation is desirable.

A wetting agent and an anti-foamant may be used to advantage. Any of the wetting agents and anti-foamants known to the art may be used. Zinc anodes such as ordinarily used in zinc plating may be used.

The baths which we have used for forming the immersion coating of zinc on the aluminum have been essentially zincate aqueous baths known to

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the art made by adding zinc oxide or zinc salts to an excess of sodium hydroxide. Any bath known to the art for forming an adherent zinc coating on aluminum, by immersion, may be used.

In addition to the diethylene triamine, other organic polyamines generally can be used. Diethylene triamine, tetraethylene pentamine, and ethylene diamine are examples of organic polyamines readily available on the market. The function of the organic polyamine in the bath is to produce a smooth, continuous zinc deposit. Without the presence of the organic polyamine, the zinc deposit would be rough, that is, nodular or pimply, and the bath would be very sensitive to metallic impurities such as lead, copper and iron.

Current densities of 5 to 35 amperes per square foot have been obtained with a pyrophosphate zinc bath according to the example previously given. In practice, the bath is used at a temperature range from 100° to 120° F.

A mode of procedure in practicing the process is as follows:

As a preliminary procedure, the aluminum is suitably cleaned and etched, following methods known to the prior art. These methods usually are to immerse the aluminum (which has been previously degreased) in an alkaline cleaner at an elevated temperature. The cleaners may be either of the etching or non-etching type. If the cleaning solution is of the non-etching type, an etching treatment should follow, such as an immersion for a few seconds in a 50 grams per liter sodium hydroxide solution at 150° F. This latter solution can be used for both cleaning and etching.

The clean aluminum is dipped in a solution of nitric acid to dissolve any film or smut developed in the etching treatment. If the silicon content of the aluminum is high, the dipping is done in a solution of nitric and hydrofluoric acids.

The cleaned and etched aluminum is then immersed for about 1 minute in a zincate bath made up by dissolving in water 525 grams of sodium hydroxide and 100 grams of zinc oxide, for each liter of solution. The aluminum with the zinc immersion coating is removed and then rinsed.

The aluminum with the zinc immersion coating thereon is then hung as a cathode in a pyrophosphate zinc plating bath having the composition hereinbefore stated, and having its pH in the range 8.5 to 9.5, and current passed until an electrodeposit of zinc of desired thickness is obtained.

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Any of the pyrophosphate zinc plating baths, minus the brightener, disclosed in our application Ser. No. 551,258, filed August 25, 1944, now Patent No. 2,488,246, granted November 15, 1949, with pH within the range 8.5 to 9.5 may be used. The pyrophosphate zinc plating baths of said application consist basically of a complex zinc-alkali metal pyrophosphate dissolved in water. The pyrophosphate radicals and zinc content are in the molecular ratio of 2 to 1, plus an excess of pyrophosphate radicals; with said excess the molecular weight ratio range is from 2.3 to 1 to 4.6 to 1.

The word "aluminum" is used herein as it is used in the trade. Virtually all commercially designated aluminum products are aluminum alloyed with various metals, such as copper, nickel, silicon, manganese, magnesium, etc. The invention, however, is applicable to high purity aluminum, and to the generality of high aluminum alloys. There is one known exception in the case of alloys, and that is aluminum alloys containing more than 2.5% of magnesium.

An advantage of the present process is that by the deposition of an adherent coating of zinc on the aluminum, a greater corrosion resistance is imparted to the aluminum base metal. Zinc has been found to be slightly anodic to some of the common aluminum alloys so that the zinc deposit protects the aluminum base cathodically, i. e. the zinc dissolves preferentially to the aluminum. The protective action of the zinc may be further enhanced by the formation of surface conversion coatings on the zinc.

What is claimed is:

A process of electroplating zinc on aluminum, in which a thin coating of zinc is first formed by

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immersing the aluminum in a zincate solution and zinc afterward electroplated on the immersion coating, characterized by the novel step of electrodepositing zinc cathodically on the zinc-coated aluminum from an aqueous plating solution having a pH between 8.5 and 9.5, consisting essentially of a zinc-alkali-metal pyrophosphate complex and one-hundredth to one-tenth per cent, by volume, of diethylene triamine, said pyrophosphate bath having the property of starting the electrodeposition of the zinc under the action of electric current before the solution acts chemically on the thin zinc immersion coating to expose the aluminum.

JESSE E. STARECK.
FRANK PASSAL.

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