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ELECTROPLATING ON ALUMINUM

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This invention relates to electroplating on aluminum, with special reference to the zinc immersion procedure for preparing aluminum articles for electroplating. As used herein, the term "aluminum" includes pure aluminum, commercial aluminum containing the usual impurities, and aluminum base alloys.

Electroplated aluminum articles have wide utility for various applications where a pleasing, decorative appearance is desired or where other surface characteristics of electroplated articles are desired. One of the most satisfactory processes for plating aluminum articles starts with the zinc immersion procedure, in which procedure the aluminum articles are immersed in an alkaline zincate bath prior to electroplating and thus acquire a zinc coating over which electroplates may be deposited. The zinc coated aluminum articles may then be electroplated with various metals and by various methods. However, even when the zinc immersion procedure is used with very careful control of all preparatory and plating steps, it is not always possible to produce articles having strongly adherent electroplates and high resistance to corrosion.

It is, therefore, an object of this invention to improve the zinc immersion procedure as part of a process of electroplating aluminum articles, so that the electroplates show better adherence to the aluminum and the electroplated articles exhibit improved resistance to corrosion. Other objects of the invention are to improve the alkaline zincate bath used in the zinc immersion step and to improve the zinc coating produced thereby. These and other objects and advantages of the invention will be apparent in the following description of the invention.

A typical zinc immersion procedure requires performance of the following steps in the preparation of the aluminum articles for electroplating:

1. Buff (if the nature of the surface permits)
2. Solvent clean
3. Alkaline clean and water rinse
4. Hot sulfuric acid dip (for some alloys) and water rinse
5. Cold nitric acid dip and water rinse
6. Zinc immersion dip (zincate bath) and water rinse

After these steps are performed, various electroplates are produced on the aluminum articles by known methods.

During the zinc immersion step above described, a thin zinc deposit is formed on the surface of the aluminum article by immersing the aluminum article in an aqueous alkaline solution of alkali metal zincate.

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The zinc immersion step per se comprises immersing the aluminum article for about ¼ to 3 minutes, at room temperature, in an aqueous solution of alkali metal zincate, which may be made up with about 100 grams of zinc oxide and about 400 grams of caustic soda per liter of bath, the balance being substantially all water. Of course, the zincate bath may vary widely in the proportions and concentrations of its components. The amount of zinc oxide may be much lower than 100 grams per liter of bath, but the ratio of causitc soda to zinc oxide should be between about 3:1 to 8:1. Further the bath may be made up with equivalent amounts of other zinc salts and other caustic alkalis. Various electroplating practices may be employed after the zinc immersion step to produce the type of electroplate desired.

However, I have found that the provision, in any of the above-described alkaline zincate baths, of small amounts of at least one of the hydrous oxides of iron, cobalt and nickel (which form negative inorganic colloid sols in the alkaline bath) is of material advantage. Such an addition leads to the production of a zinc deposit on the aluminum surface which is uniform, dense and adherent. This deposit permits the subsequently formed electroplate layers to build up smoothly and uniformly. In fact, electroplates applied over this zinc deposit are firmly adherent; and the electroplated articles are, in general, more resistant to corrosion.

The hydrous oxides of the iron group are conveniently provided in the zincate bath by additions of salts of the iron group metals, such as ferric chloride, cobalt chloride or sulfate, and nickel sulfate, preferably with additions of at least one protective colloid-agent, such as tartrate, tannate, sugars (e. g. sucrose or glucose) glycerin, mannite or the like. The amount of iron group metal in the bath should be about 0.1 to 1.5 grams (preferably about 0.2 gram) per liter of the bath. These indicated amounts of iron may be supplied by about 0.5 to 7.5 grams (preferably 1 gram) of ferric chloride per liter of the bath. Smaller amounts of iron or other iron group metals do not seem to be effective, and larger amounts tend to cause blistering of electroplates applied over the zinc deposit. The protective agents may be employed in various amounts, usually at least about 5, and up to about 50, grams per gram of metal from the iron group, although

larger amounts are not usually harmful and may sometimes be desired. When ferric chloride and tartrate are added, for example, the amount of tartrate may be about 1 to 50 grams per gram of ferric chloride.

By way of example, my improved alkaline zincate bath may be made up with water and the following chemicals (grams per liter of bath):

ZnO	100
NaOH	400
$FeCl_3.6H_2O$	1
$C_4H_4O_6=$	5

By employing an alkaline zincate bath of the type described which has been improved by the provision therein of a metal from the iron group, in the amounts indicated above, I am able to produce zinc deposits and subsequent electroplates on aluminum articles which are smooth and adherent to the aluminum base, and more resistant to corrosion than aluminum articles prepared by the zinc immersion procedure without an addition of the iron group metal to the zincate bath.

In addition to the improvements above described, I have also found that further improvements can be obtained when a double zinc immersion procedure is employed. That is, after the zinc deposit is formed in accordance with the procedure just described, the zinc deposit is stripped. This may conveniently be done by an immersion in nitric acid. Then the article is again immersed in the improved alkaline zincate bath. This procedure has the advantage of reducing the number of, or eliminating, the cleaning and preparatory steps ordinarily required prior to immersion in the zincate bath, while providing a uniformly active aluminum surface for reception of the last zinc deposit. The last zinc deposit will be a very thin zinc deposit, which is continuous and smooth, a type of zinc deposit that which I have found to be highly desirable. Further, I have been consistently able to produce, over such a zinc deposit electroplated aluminum articles having good electroplate-adherence characteristics and greatly improved resistance to corrosion. These results I believe to be dependent upon the production of a uniformly clean and chemically active aluminum surface condition by the first treatment in the improved zincate bath, upon the production upon that surface of a uniformly thin, protective deposit of zinc by the last treatment in the improved zincate bath, and finally upon the production of smooth electroplates over a thin smooth zinc deposit.

I claim:

1. In a process for electroplating an aluminum article wherein the article is provided with a zinc deposit by immersion in an aqueous alkaline zincate bath and thereafter electroplated over said deposit, the improvement therein which comprises employing in said zincate bath at least one of the hydrous oxides of metals from the iron group, the amount of iron group metal provided being about 0.1 to 1.5 grams per liter of bath.

2. In a process according to claim 1, additionally employing in said zincate bath at least about 5 grams of tartrate per gram of metal from the iron group.

3. In a process according to claim 1, the additional improvement therein which comprises providing a preliminary zinc deposit by immersion in said alkaline zincate bath and stripping the zinc deposit first formed in said alkaline zincate bath prior to providing the zinc deposit over which the electroplate is produced.

4. In a process for electroplating an aluminum article wherein the article is provided with a zinc deposit by immersion in an aqueous alkaline zincate bath and thereafter electroplated over said deposit, the improvement therein which comprises employing in said zincate bath about 0.5 to 7.5 grams of ferric chloride per liter of bath and about 1 to 50 grams of tartrate per gram of ferric chloride so employed.

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