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PROCEDURE AND BATH FOR PLATING ON ALUMINUM

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This invention relates to plating 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.

A typical zincate bath is made up with water and about 500 grams per liter of chemicals, and it will be found to be somewhat viscous. Therefore, it has the disadvantages that there are considerable amounts of bath lost by drag-out and there is considerable difficulty in adequately rinsing the work. Attention has previously been given to the possibility of employing less concentrated zincate baths, for example, those which may be made up with less than about 150 grams per liter of principal active chemicals (both zinc salt and caustic alkali). However, it has been found that such baths ordinarily produce undesirably heavy zinc deposits, heavier than are produced in the more concentrated baths first mentioned.

It is, therefore, an object of this invention to improve the zinc immersion procedure, as a part of a process of electroplating aluminum articles, so that dilute zincate baths may be employed, with consequent advantages in regard to drag-out and rinsing characteristics and without the disadvantages of producing heavy zinc deposits. Other objects of the invention are to improve dilute alkaline zincate baths so that they may be used in the zinc immersion procedure, and to improve the characteristics of 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 an aluminum article for electroplating:

1. Buff (if the nature of the surface permits)

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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 double water rinse

After these steps are performed, any of various electroplates may be produced on the aluminum article by known methods.

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

In the conventional zinc immersion step the aluminum article is immersed for about ¼ to 1 minute, at room temperature, in an alkali metal zincate bath which is 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 is, in practice, widely varied as to 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 caustic 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 are employed after the zinc immersion step to produce the type of electroplate desired.

It has been my observation that when the ordinary zincate baths are employed in more diluted form than that described above, the weight of zinc deposited therefrom upon aluminum immersed therein, is greatly increased. This effect is undesirable, as I have found that thin zinc deposits are essential to the production of adherent electroplates and of electroplated articles that are resistant to corrosion. I have found that I can obtain these advantages, while employing dilute zincate baths, by the provision, in such baths, of small amounts of one or more soluble nitrates, nitrites or both. It is convenient to employ sodium nitrate, or sodium nitrite, but other soluble nitrate or nitrite salts may be used. The amount of nitrate or nitrite salt or salts may range between about 0.25 and 2 grams per liter. The effect of the nitrate or nitrite, in a dilute bath, is more or less proportional to the amount used. Sodium nitrate in the amount of 0.5 gram per liter of bath, for example, will reduce the weight of deposited zinc by as much as thirty per cent, while sodium nitrate in the amount of 1

gram per liter will reduce the weight of deposited zinc by as much as fifty per cent. Thus, it is not particularly advantageous to employ smaller amounts of nitrate or nitrite than is indicated by the lower limit of the range first stated. Further, it is not desirable to employ larger amounts of nitrate or nitrite than are indicated by the upper limit of the range first stated, as blistering of the subsequent electroplate may occur.

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

	Preferred	Range
ZnO	5	1 to 25
NaOH	50	15 to 125
$NaNO_3$	1	0.25 to 2

in which sodium nitrite or equivalent amounts of other nitrate or nitrite salts (such as ammonium or potassium nitrate or nitrite) may be substituted for sodium nitrate. It is to be noted that the ratio of caustic soda to zinc oxide, in the dilute baths, should be between about 15:1 and 5:1.

An alternative dilute alkaline zincate bath, according to my invention, may be made up with up to about 100 grams per liter (although usually less) of tartrate, conveniently in the form of Rochelle salts, as an additional ingredient. Such a bath may be made up with water and the following chemicals (grams per liter of bath):

ZnO	5
NaOH	50
$NaNO_3$	1
$NaKC_4H_4O_6$	50

I recommend such a bath for use in the treatment of most aluminum alloys. In fact, I prefer to employ a further addition of iron, of the character described in my prior application, Serial No. 117,514. In such case the bath is made up with water and the following chemicals (grams per liter of bath):

ZnO	5
NaOH	50
$NaNO_3$	1
$NaKC_4H_4O_6 \cdot 4H_2O$	50
$FeCl_3 \cdot 6H_2O$	1

By employing dilute alkaline zincate baths of the type described, which have been improved by the addition thereto of nitrate and/or nitrite salts, in the amounts previously indicated, I am able to produce thin zinc deposits and subsequent electroplates on aluminum articles which are smooth and adherent to the aluminum base, and more resistant to corrosion than those prepared by corresponding zincate baths without such an addition.

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 dilute 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 also 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 the thin smooth zinc deposit.

I claim:

1. A process preparatory to electroplating an aluminum article which comprises immersing the article in a dilute zincate bath made up with about 16 to 150 grams per liter of both zinc salt and caustic alkali, the ratio of caustic alkali to zinc salts being about 5:1 to 15:1, at least one salt selected from the group consisting of soluble nitrates and soluble nitrites, the amount thereof being between about 0.25 and 2 grams per liter of the bath, and stripping the zinc deposit first formed in said alkaline zincate bath and again immersing the aluminum article therein prior to electroplating the same.

2. A process according to claim 1, in which said zincate bath also contains up to about 100 grams per liter of tartrate.

3. A bath for depositing zinc on aluminum by immersion consisting essentially of a dilute aqueous solution of alkali metal zincate, said bath made up with about 16 to 150 grams per liter of both zinc salts and caustic alkali, the ratio of caustic alkali to zinc salts being about 5:1 to 15:1, and at least one salt selected from the group consisting of soluble nitrates and soluble nitrites in an amount between about 0.25 to 2 grams per liter of bath.

4. A bath according to claim 3, which also contains up to about 100 grams per liter of tartrate.

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