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PROCESS OF ELECTRODEPOSITING
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4 Claims. (Cl. 204—1)

This invention relates to processes of electrodepositing chromium, and aims to provide improvements therein.

The invention provides a novel process of depositing chromium, by which a good quality of plate, both as to structure, brightness, and color may be obtained, and with good efficiencies for chromium plating.

The invention further provides a process of electroplating chromium which may be used without etching polished surfaces of articles to be plated.

According to the present invention, chromic acid is used as the electrolyte. The catalyst is a compound of fluorine, usually a fluorid, such as chromic or sodium fluorid. We have obtained satisfactory bright plates using as catalysts the following: chromic fluorid, sodium fluorid, fluosilicic acid, fluoboric acid (HBF_4) and hydrofluoric acid, the substances being arranged substantially in their order of efficiencies.

Temperatures from 15°C . to 35°C . are quite suitable, and current densities from $\frac{1}{4}$ to 1 ampere per square inch are suitable, the lower current densities being preferred for bright deposits.

The efficiency of the current in depositing chromium varies with the amount of fluorid used in the bath. With a solution containing 250 grams per liter of chromic acid the best current efficiency has been found to be around 3 grams per liter of the fluorine compound, calculated as chromium fluorid, the efficiencies decreasing above and below this amount, the fluorine radical being considered the constituent of importance. In amounts up to about 10 grams per liter of the fluorid the solution does not etch polished surfaces of articles (steel, iron, brass, for example) placed therein for electroplating.

A mode of procedure is as follows:—A bath is made up containing 250 grams per liter of chromic acid (CrO_3) and about 2 grams per liter of hydrofluoboric acid (made by adding hydrofluoric acid to boric acid— $4\text{HF} + \text{H}_3\text{BO}_3 \rightarrow \text{HBF}_4 + 3\text{H}_2\text{O}$) or an equivalent amount of a soluble fluoboric compound. The article to be plated, a polished piece of flatware (a spoon) for example, is connected to the cathode busbar and a current of about $\frac{1}{2}$ ampere per square inch passed through the solution to the cathode at room temperature.

Good bright chromium plate generally is obtained at bath temperatures 15° to 35°C . The temperature may be kept approximately constant at a desired temperature by suitable heating and cooling means.

The process may be carried out by other modes

of procedure than that herein specifically described. As a guide to such other modes of procedure it may be stated that chromic acid baths containing the fluoboric compound follow the general rule of the catalyst compound being proportional to the concentration of chromic acid in the bath; and of the current-density increasing with temperature for maintaining a given current efficiency.

In the present process, involving the use of fluoboric compounds we have found that chromium plate is best obtained at a bath concentration of 150 grams per liter chromic acid. In such a solution the fluoboric acid content may be 0.39 to 2 grams per liter, the optimum varying somewhat with temperature, being approximately as follows:—

20°C .—0.86 grams per liter fluoboric acid
 30°C .—0.86 grams per liter fluoboric acid
 40°C .—1.15 grams per liter fluoboric acid
 50°C .—1.43 grams per liter fluoboric acid

Mirror plate is best obtained by the use of baths of lower chromic acid concentration, as for example the 150 gram per liter baths described above, with which mirror plate may be obtained through a considerable range of temperature and current density, as for example—

20°C .— $\frac{1}{4}$ amp./sq. inch
 30°C .— $\frac{1}{2}$ amp./sq. inch
 40°C .— $\frac{3}{4}$ amp./sq. inch
 50°C .—1 amp./sq. inch

At 450 grams per liter of chromic acid, chromium plates show a milkiness at 20°C . to 50°C . over a wide range of current densities and fluoboric acid content.

The range of fluoboric content is not quite as wide as in the case of the chromium fluoride.

Subject-matter claimed in this case has been divided from our application, Serial No. 49,820, filed August 12, 1925, now Patent 1,844,751, this application being a continuation in part thereof.

What is claimed is:—

1. A process of electroplating chromium comprising passing an electric current through a solution containing chromic acid and a soluble fluoboric compound, the amount of fluoboric compound being 3 grams per liter or less of fluoboric acid for a solution containing 250 grams per liter CrO_3 , or equivalent of other fluoboric compound, and a proportionately higher or lower fluoboric acid content for a higher or lower CrO_3 content.

2. A process of electroplating chromium comprising passing an electric current through a solution containing chromic acid and a soluble fluoboric compound, the amount of fluoboric com-

pound being approximately 0.8 to 3 grams per liter fluoboric acid for a solution containing 250 grams per liter CrO_3 , or equivalent of other fluoboric compound, and a proportionately higher or lower fluoboric acid content for a higher or lower CrO_3 content.

3. A process of electroplating chromium comprising passing an electric current through a solution containing chromic acid and a soluble fluoboric compound, the concentration of chromic acid being approximately 150 grams per liter and the concentration of fluoboric compound as fluoboric acid being approximately 0.39 to 2. grams per liter.

4. A process according to claim 3, wherein the relations of the following are substantially as follows:—

Fluoboric acid	Temperature	Current density
0.86 grams per liter.....	20° C.....	$\frac{1}{4}$ amp. per sq. in.
0.86 grams per liter.....	30° C.....	$\frac{1}{2}$ amp. per sq. in.
1.15 grams per liter.....	40° C.....	$\frac{3}{4}$ amp. per sq. in.
1.43 grams per liter.....	50° C.....	1 amp. per sq. in.

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