

UNITED STATES PATENT OFFICE

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ELECTRODEPOSITION OF NICKEL

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1

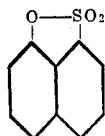
This invention relates to the electrodeposition of nickel and is more particularly concerned with nickel plating compositions, nickel plating baths, and processes for the electrodeposition of nickel wherein there is employed as an organic addition agent a sultone.

It has already been proposed to electrodeposit nickel directly from a plating bath in a bright condition. Processes for the direct deposition of bright nickel are particularly advantageous in the production of undercoats for chromium plating. By depositing the nickel in a bright condition the necessity for buffing is eliminated and metal is, therefore, not removed as when an article is buffed. The time required for obtaining a finished product is reduced by producing bright nickel deposits directly from the bath and, perhaps most important of all, recesses inaccessible for buffing are given a bright coat of nickel suitable as an ornamental finish or suitable as an undercoat for chromium.

It is an object of this invention to produce bright nickel deposits. It is a further object to provide dry plating compositions which upon being dissolved in water can be used for the electrodeposition of nickel deposits of improved character. It is a still further object to provide nickel plating processes which are simple and economical in operation and which produce bright ductile nickel deposits. It is a still further object to provide compositions, baths, and processes which permit the electrodeposition of nickel with a wider permissible range of electroplating bath constituents. Further objects will appear hereinafter.

The foregoing and other objects of the invention are attained by employing as an organic addition agent in nickel plating compositions, baths, and processes a sultone. More specifically, it has been found desirable to use 1,8-naphthosultone-4-sulfonic acid.

The addition agents for use in nickel plating, according to the present invention, are characterized by the presence of the sultone group, as seen in 1,8-naphthosultone:



2

As illustrative of sultones, there may be mentioned 1,8-naphthosultone, 1,8-naphthosultone-4-sulfonic acid, 1,8-naphthosultone-3-sulfonic acid, and 1,8-naphthosultone-3,6-disulfonic acid.

The sultones may be added to nickel plating baths as such or in the form of suitable salts, such as a sodium, potassium, ammonium, or nickel salts. Whether or not the sultone is present in the bath as a salt or as a free acid will depend upon the pH of the bath, and for the purposes of this application when reference is made to a sultone, it will be understood that any soluble salt may alternatively be used.

It will ordinarily be desirable to use from about 1 to 10 grams per liter of a sultone. More specifically, it has been found desirable to use from about 2 to 5 grams per liter of 1,8-naphthosultone-4-sulfonic acid in a sulfate-nickel plating bath and about 3 to 8 grams per liter of the same agent in a high chloride nickel plating bath.

The sultones may be used as addition agents in any of the nickel plating baths known to the art. There may be used for instance baths containing nickel sulfate, or nickel chloride, or mixtures of these nickel compounds preferably together with boric acid. Some of the best results are obtained with high chloride baths but the addition agents are quite satisfactory in sulfate baths containing relatively small amounts of chloride.

While the sultones are quite effective alone and may satisfactorily be used as the sole organic addition agent for a nickel plating bath, it may sometimes be found desirable to use them in conjunction with organic addition agents, wetting agents, or metal brighteners in accordance with the practices already well known in the art.

Plating compositions, according to the present invention, may be offered to the trade containing a sultone and one or more of the chemicals required to make up or to replenish a bright nickel plating bath. A sultone may, for instance, be packaged in a dry, prepared composition containing nickel sulfate, nickel chloride, or both, and may additionally contain wetting agents, other organic addition agents, or other desired bath additions. A typical dry packaged composition of the invention would contain from about $1/200$ to $1/50$ part by weight of a sultone and the balance nickel sulfate, nickel chloride, or a mixture of them.

3

In order that the invention may be better understood, reference should be had to the following illustrative examples.

Example I

Nickel sulfate	grams per liter	350
Nickel chloride	do	15
Boric acid	do	35
1,8-naphthosultone-4-sulfonic acid	do	3
Temperature	°C	50
pH		3.8

Example II

Nickel chloride	grams per liter	250
Nickel sulphate	do	15
Boric acid	do	50
1,8-naphthosultone-4-sulfonic acid	do	4
Temperature	°C	50
pH		3.5

Example III

Nickel sulfate	grams per liter	350
Nickel chloride	do	15
Boric acid	do	35
1,8-naphthosultone-4-sulfonic acid	do	2
M-sulfo benzaldehyde	do	1
Temperature	°C	50
pH		3.8

Example IV

Nickel chloride	grams per liter	250
Nickel sulfate	do	15
Boric acid	do	50
1,8-Naphthosultone-4-sulfonic acid	do	2
M-sulfo benzaldehyde	do	2
Temperature	°C	50
pH		3.5

Example V

Nickel sulfate	grams per liter	350
Nickel chloride	do	15
Boric acid	do	35
1,8-naphthosultone	do	2
M-sulfo benzaldehyde	do	2
Temperature	°C	50
pH		3.8

Example VI

Nickel chloride	grams per liter	250
Nickel sulfate	do	15
Boric acid	do	50
1,8-naphthosultone	do	2
M-sulfo benzaldehyde	do	2
Temperature	°C	50
pH		3.5

The deposits obtained using the baths of the above examples are of increased brightness and

4

ductility and the bright current density range is broadened by reason of the inclusion of a sultone.

I claim:

1. A nickel plating composition comprising a nickel compound selected from the group consisting of nickel sulfate, nickel chloride, and mixtures of nickel chloride and nickel sulfate, and $\frac{1}{200}$ to $\frac{1}{50}$ parts by weight of a sultone.

2. A nickel plating composition consisting of a nickel compound selected from the group consisting of nickel sulfate, nickel chloride, and mixtures of nickel chloride and nickel sulfate and $\frac{1}{200}$ to $\frac{1}{50}$ parts by weight of 1,8-naphthosultone-4-sulfonic acid.

3. In a process for the electrodeposition of nickel, the step comprising electrodepositing nickel from an aqueous solution containing as electrolyte a nickel compound selected from the group consisting of nickel sulfate, nickel chloride, and mixtures of nickel sulfate and nickel chloride in the presence of one to ten grams per liter of a sultone.

4. In a process for the electrodeposition of nickel, the step comprising electrodepositing nickel from an acidic aqueous solution containing as electrolyte a nickel compound selected from the group consisting of nickel sulfate, nickel chloride, and mixtures of nickel sulfate and nickel chloride in the presence of about 1 to 10 grams per liter of a sultone.

5. In a process for the electrodeposition of nickel, the step comprising electrodepositing nickel from an acidic aqueous solution containing as electrolyte a nickel compound selected from the group consisting of nickel sulfate, nickel chloride, and mixtures of nickel sulfate and nickel chloride in the presence of about 1 to 10 grams per liter of 1,8-naphthosultone-4-sulfonic acid.

6. In a process for the electrodeposition of nickel, the step comprising electrodepositing nickel from an acidic aqueous solution containing as electrolyte a major amount of nickel sulfate and a minor amount of nickel chloride in the presence of one to ten grams per liter of a sultone.

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