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ELECTRODEPOSITION

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This invention relates to electrolytic baths and is more particularly directed to processes and electrodepositing solutions which employ a sulfamate as an electrolyte.

It has heretofore been the practice to conduct various electrolytic processes, such as the electrodepositing of metal, from aqueous solutions of such electrolytes as cyanides, chlorides, silicofluorides, or sulfates. Moreover, if a metal is to be electrodeposited it is the customary practice to use as an electrolyte a solution containing a soluble compound of the metal.

It is an object of this invention to provide novel electrolytes which may be used in the electrodeposition of metals. It is a further object of this invention to provide electrolytes in which most of the metals ordinarily electrodeposited are highly soluble. It is a still further object of this invention to provide electrodepositing solutions which may be used at either a low or a high pH, that is, either acidic or basic. It is a still further object to provide electrodepositing processes and solutions which are simple to operate and maintain. Still further objects of this invention will become apparent hereinafter.

The foregoing and other objects of this invention are attained by the use of an electrolyte containing a sulfamate. Sulfamates of the metals ordinarily electrodeposited are highly soluble and plating baths containing them are of unusually good character. Unlike cyanides which must be used in alkaline baths, and unlike silicofluorides which are ordinarily used in acid baths, sulfamates may be used in either acid or alkaline baths.

Sulfamates are compounds which contain the $-SO_3 \cdot NH_2$ group. It will be understood that I may use hydrogen sulfamate, or so-called sulfamic acid, as well as sodium, potassium, or ammonium sulfamates. The sulfamate of a metal to be plated may be used.

According to the processes of this invention metals such as zinc, cadmium, nickel, copper, lead, and iron may be electrodeposited from sulfamate electrolytes. Plating baths according to this invention may be made up using a sulfamate of the metal to be electrodeposited or by using another sulfamate together with a soluble compound of the metal. Any acid or alkali may be used to adjust the pH of the plating bath to the desired condition whether it be basic, neutral, or acidic.

It will be understood that compositions for electrodeposition may be offered to the trade in the form of mixtures of sulfamates with other constituents to be used in an electrodepositing bath. It may under some conditions be found desirable, for instance, to sell mixtures of sulfamic acid, which is a dry product, together with a soluble compound of a metal to be electrodeposited. Alternatively, it may be found preferable to offer to the trade a sulfamate of the metal to be electrodeposited either alone or together with other bath constituents.

The concentration of electrolytes employing sulfamates according to the present invention may be widely varied following considerations known to the art in conjunction with other electrolytes. In general, it may be said that electrolytes may vary in concentration from those barely strong enough to conduct an electrical current up to saturated solutions. More specifically, it will usually be preferable to use fairly concentrated solutions so that relatively large amounts of a metal to be electrodeposited may exist in the bath in the form of a sulfamate.

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

Example 1

An electrolyte for electrodeposition of copper was made up as follows:

	Grams per liter
Ammonium sulfamate ($NH_4 \cdot SO_3 \cdot NH_2$)	100
Copper sulfate ($CuSO_4 \cdot 5H_2O$)	130
Sodium hydroxide (NaOH)	7.5

Copper was deposited from this bath at a current density of about 35 amperes per square foot. The deposit was bright and pleasing in appearance.

Example 2

An electrolytic solution for the electrodeposition of lead was made up with the following:

	Grams per liter
Sulfamic acid ($H \cdot SO_3 \cdot NH_2$)	107
Litharge (PbO)	36.6

This bath contained no undissolved precipitate. Upon electrolysis, a grey-white deposit was obtained at moderately low current densities and a grey-black deposit was obtained at higher current densities.

Example 3

Another bath was made up as follows:

	Grams per liter
Sulfamic acid ($H \cdot SO_3 \cdot NH_2$)	107
Nickel carbonate ($2NiCO_3 \cdot 3Ni(OH)_2 \cdot 4H_2O$)	70

The bath constituents dissolved completely.

Nickel deposits were obtained upon electrolysis of the bath.

Example 4

A bath was made up as follows:

Ammonium sulfamate ($NH_3 \cdot SO_3 \cdot NH_2$)	grams per liter	50
Sulfamic acid ($H \cdot SO_3 \cdot NH_2$)	do	53.5
Nickel carbonate ($2NiCO_3 \cdot 3Ni(OH)_2 \cdot 4H_2O$)	do	35
Ammonium hydroxide (NH_4OH)	cc. About	10

The bath constituents all dissolved and nickel deposits from this bath were of better character than those obtained with the preceding bath. Bright deposits were obtained at current densities up to about fifty amperes per square foot.

While I have shown certain illustrative compositions and processes in the foregoing, it will be understood that one skilled in the art may readily devise numerous baths and processes employing a sulfamate as an electrolyte without departing from the spirit of this invention.

I claim:

1. In a process for the electrodeposition of lead, the step comprising effecting deposition by passing an electric current through an aqueous electrolyte consisting essentially of the metal cation and the anion—$SO_3.NH_2$.

2. An electrodepositing bath for the electrodeposition of lead, the bath being an aqueous electrolyte consisting essentially of the lead cation and the anion—$SO_3:NH_2$.

3. In a process for the electrodeposition of a metal selected from the group consisting of nickel, copper, and lead, the step comprising effecting deposition by passing an electric current through an aqueous electrolyte consisting essentially of the metal cation and the anion—$SO_3 \cdot NH_2$.

4. An electrodepositing bath for the electrodeposition of a metal selected from the group consisting of nickel, copper, and lead, the bath being an aqueous electrolyte consisting essentially of the metal cation and the anion—$SO_3 \cdot NH_2$.

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