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ELECTRODEPOSITION OF NICKEL FROM AN ACID BATH

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13 Claims. (Cl. 204—49)

This invention relates to the electro-deposition of nickel from an acid bath.

It is an object of this invention to produce a fine-grained, lustrous, ductile nickel deposit.

Another object of the invention is to decrease the tendency of the formation of pits in the plate, such pitting being detrimental from the standpoint of both appearance and corrosion-resistance afforded by the plate.

These objects are accomplished by the addition to a standard nickel sulphate plating bath (commonly called the "Watt's" type nickel plating bath) of certain organic compounds, to wit; halogenated aldehydes. The term "halogenated aldehydes" as used herein includes not only the halogenated aldehydes but also their hydrates and their acetals, the latter which in water solution regenerate the halogenated aldehydes or hydrates.

This application is a continuation in part of my prior application Serial No. 162,697, filed September 7, 1937.

These halogenated aldehydes, particularly the alpha halogenated aldehydes, have certain definite advantages over the ordinary aldehydes. Several of the ordinary aldehydes are very powerful brighteners, for example, furfural, croton aldehyde, and acrolein. These powerful aldehydes, however, tend to resinify in the plating bath and form products which adversely affect both bond and brightness. The alpha halogenated aldehydes are equally or more powerful brighteners and do not resinify in the warm acid bath. Consequently, the baths are more stable and require less attention. The baths can be left idle for long periods without the need of purification from resinous materials. Since no harmful products are formed, one does not need constant drag-out to keep the amount of such products within necessary limits.

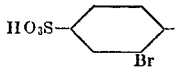
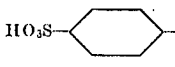
In general, therefore the substitution of halogens in the alpha position relative to the aldehyde group improves the effectiveness of the compound in the nickel bath. The bright plate range is widened and the ability of smoothing out polishing lines and other imperfections with the plating is greatly increased. The bromine atom is more effective than the chlorine atom except where it decreases the solubility unduly as in tribromobutyraldehyde hydrate.

The use of air agitation in the baths further increases the efficacy of the halogenated aldehydes more so than with ordinary aldehydes.

A number of compounds containing the desired group are listed in Table 1 in the order of their decreasing effectiveness and with their optimum concentrations in baths at 50° C. prepared from nickel sulphate, nickel chloride and boric acid and containing 60-75 grams per liter Ni, 15 grams per liter Cl, 30-37.5 grams per liter H₃BO₃ and pH=2-6 and at a current density of 1 to 5

amp./sq. dm. The temperature of the plating solution can range from 15° C. to the boiling point of the solution. The optimum temperature of the solution when plating, is between 15° C. and 55° C. The preferred temperature of the solution is about 50° C. The solution has better throwing power at lower temperatures and higher pH values than at higher temperatures and lower pH values. The optimum pH falls between 4 and 5.3 electrometric.

Table 1

	Opt. conc. g/l
α Brom, β chlor, crotonaldehyde hydrate, CH ₃ .C(Cl)=CBr.CH(O).H ₂ O	0.1-0.2
15 α Chlor, β chlor, crotonaldehyde hydrate, CH ₃ .C(Cl)=CCl.CH(O).H ₂ O	0.1-0.2
αα, Dibrom, β mono chlor butyraldehyde hydrate, CH ₃ .CH(Cl).CBr ₂ .CH(O).H ₂ O	0.1-.5
ααβ, Trichlorobutyraldehyde hydrate (butyl chloral hydrate), CH ₃ .CH(Cl).CCl ₂ .CH(O).H ₂ O	0.2-1.25
20 ααβ, Tribromobutyraldehyde hydrate (butyl bromal hydrate), CH ₃ .CH(Br).CBr ₂ .CH(O).H ₂ O	0.1-.4
Bromal hydrate, CBr ₃ .CH(O).H ₂ O	1-.7
p-Propionchloral hydrate brom benzene sulphonie acid,	
25 	3-4.0
p-Propionchloral hydrate benzene sulphonie acid,	
30 	3-4.0
p-Butyl chloral hydrate benzene sulphonie acid,	
	3-4.0
35 Chloral hydrate, CCl ₃ .CH(O).H ₂ O	0.5-1.5
Chloral acetal, CCl ₃ .C=(O C ₂ H ₅) ₂	0.75-2.0

Mixtures of two or more aldehydes widens the plating range. Desirable mixtures include: .3 g./l. bromal hydrate and 1 g./l. butyl chloral hydrate; .5 g./l. chloral hydrate and .4 g./l. dibromomonochlorobutyraldehyde hydrate; 1 g./l. butyl chloral hydrate and 2 ml./l. formaldehyde (40% solution).

The concentration of the halogenated aldehydes should not be allowed to increase above the upper limit of the optimum concentration as larger quantities tend to hurt the adhesion of the nickel coating and the covering power in recesses (now current density areas).

I claim:

1. A method for electrodepositing nickel to obtain a fine-grained deposit comprising the step of electrodepositing nickel from an aqueous acid nickel solution comprising essentially a material selected from the group consisting of nickel sulphate, nickel chloride, and a mixture of nickel chloride and nickel sulphate in the presence of an aliphatic polyhalogenated aldehyde soluble in the solution and having at least one halogen

