Electroplaters

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Abstract

Electroplating is a process using electric current to reduce metal cations resulting on a thin coherent metal coating on an electrode. The term is also used in electrical oxidation of anions to a solid substrate. Electroplating is usually used to coat or manipulate surfaces of particles, but it can also be used to thicken undersized parts or even form new objects via electroforming.

Keywords

Cyanides · Electroplating · Irritant dermatitis · Occupational skin disease

1 Introduction

Main aims are to provide decoration, resist corrosion, and improve mechanical and electrical properties of objects made from metal, rubber, and plastics. Brass, bronze, cadmium, copper, chromium, gold, silver, and tin are used in electroplating.

In electroplating the surface is first cleaned by removing fats, oils, and grease. This can be done with washing, pickling, chemical processes, as well as processes during electroplating itself.

Electroplating is performed in baths, of which there are hundreds of different ones. The object to be plated is placed in an appropriate solution and connected to one end of an electric circuit. The other end is connected to the plating material. The amount of metal applied to the final product

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is controlled by the flow of electricity by electroplaters.

Changing the proportions of chemicals in the bath results in different kinds of coatings. Luster-enhancing additives and surfactants are used to get the right color and thickness to the plate. Inhibitors are used to avoid escape of mist into air. As compositions of bath solutions affect greatly the end result, the composition of these solutions is usually a trade secret by the manufacturing company, but usually they are amines (Kiilunen et al. 1997).

For defatting the subjects, two types of solutions are used. The first method is alkali treatment with quite strong sodium hydroxide solutions. The second method includes chlorinated and aromatic hydrocarbons. The most common solvents are trichloroethylene, perchloroethylene, trichloroethane, methylene chloride, trichlorotrifluoroethane, benzene, toluene, and xylene. The defatting process can be speeded up by higher temperatures, emulsifiers, and ultrasound.

After the objects have been defatted, they are rinsed in water baths at least three times. After this, they enter pickling processes, where strong inorganic acids are utilized. Phosphating baths are used in chemical plating. Methods used include ammoniac treatment, oxidation, passivation, anodic treatment, and treatment with chrome mordants (Burgess 1981).

Various soluble salts of chromium, nickel, zinc, copper, cadmium, gold, tin, and others are used in electrolytic plating. The particles can also be preplated before use in coating, e.g., with a nickel or copper undercoat for chromium treatment. Cyanides, that are irritating, are used sometimes in gold plating.

Workers are exposed to abovementioned salts of chromium, nickel, zinc, copper, cadmium, and zinc. Most common occupational skin disease is irritant dermatitis. Baths are heated up to 40–70 °C also. Chromium acid is very corrosive and can cause chrome ulcerations in mucous membranes when evaporated to the air (Langård and Norseth 1989). Patients with chrome ulcers are not necessarily allergic to chrome (Lee and Goh 1988). Solvents are natural irritants and cause also irritant reactions in skin and mucous membranes.

Nickel allergy was first detected in nickel-plating industry over 120 years ago (Blaschko 1889). During that time, until 1930, nickel dermatitis was a common problem in nickel platers, but after that improved techniques and work safety have reduced the rate of sensitization (Fischer 1989). Under modern safety conditions, nickel-allergic patients can work in nickel plating (Kanerva et al. 1997).

There have also been concerns on carcinogenicity of fumes in electroplating (Wultsch et al. 2017).

Local and general ventilation diminishes amount of aerosol to the air. Concentration levels have been reduced until less than occupational exposure limits.

Occupational diseases due to electroplating continue to decrease due to better safety measures, machine improvements, and robotics.

2 Irritants

Abrasive metal dust
Chromic acid fumes
Cyanide salts
Defatting solutions (metal cleaners; alkaline soaks and alkalis (sodium hydroxide, potassium hydroxide, sodium carbonate, trisodium phosphate); hydrocarbons (trichloroethylene, perchloroethylene); 1,1,1-trichloroethane, methylene chloride, isopropylbenzene, toluene, methylbenzene, xylene)
Heat
Luster additives (aromatic and heterocyclic aldehydes; vanillin; anisaldehyde, benzaldehyde, cinnamaldehyde, polyvinyl alcohol, 2-butyne-1,4-diol, 2-propyne-1-ol)
Pickling solutions (acids and dichromates)
Plating solutions (acids and alkalis)
Soaps and detergents
Surfactants
Sodium lauryl sulfate

3 Allergens

Carba mix
Ethylenediamine dihydrochloride
Formaldehyde
Nickel sulfate
2-mercaptobenzothiazole
Mercapto mix
Potassium dichromate
Paraphenylenediamine
Thiuram mix
Coumarin
Dioxane
Gold sodium thiomalate
Hydrazine sulfate
Platinum chloride
Triethanolamine

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