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DEVELOPMENT OF NON-CYANIDE TECNOLOGY IN GOLD PLATING

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ABSTRACT
Gold plating is very commonly used in different areas of techniques, for decorative purposes and corrosion protection. Electrolytes based on cyanide and ferrous cyanide solutions are still present in most of gold plating baths, in spite of large efforts to replace them by some less toxic substance. Gold plating from electrolyte based on cyanide is known as high-risk technology from ecological point of view. In this work the results of synthesis a new type of electrolyte based on gold complex on mercaptotriasole based are presented. Electrolyte itself is described elsewhere. The goal was to establish the optimal parameters for decorative gold plating for this type of electrolyte and compare the results with those obtained from cyanide electrolyte. The methods used were: recording of polarization curves to obtain limiting current densities, experiments in Hull cell and experiments in laboratory cell for gold plating. All experiments were performed with additives. The same experiments were conducted with the cyanide electrolyte but with all additives normally used for decorative plating .This electrolyte can be successfully used for gold plating in comparasion with expensive and risky cyanide bath. Final efect and characteristics pertaing decorative quality of gold coating are well satisfactory. Decomposition and recovery of waste solution can simply be done. Toxicity is not identfied.
Keywords: Gold plating, mercaptotriasole, gold plating baths

1. INTRODUCTION

All of investigation in this work are carried out for the replacment the clasic cyanide bath with organic complex, and all of this due to safe protetcion of enviroment. Cyanide bath for gold-plating that are in ude since 1840., are very toxic and formation and maintenance of those bath is expensive and risky for technical personnel.

Costs of waste water treatment are up 30% from toatal investments, and this technology is rated as a high risk technology, until waste water treatment from electrolyte based on mercaptotriasol is bought down to simply gold deposiition by hydrogen peroxide. Due to this reason, especially in a new time there is a trend towards electrolytes use without of cyanide content. Content of those electrolytes is mainly based on some organic complex. The usage of the same, however, has not found yet the suitable industrial use due to a low constant stabililty, what is manifestedby complex disintengration and leaching of elementary gold from electrolyte.

In this work, the organic gold complex was investigated, with the base of mercaptotriasol, that showed, contrary to the previous complexes, a good stability in longer time interval. Detailed stability investigation of this organic complex under various conditions woul present an important part of this work.

2. EXPERIMENTAL PART

2.1. Used methods

The following methods were used in experimental work:

1. experiments in the Hull cell
2. recording of polarization curves
3. electrochemical decorative gold plating in electrochemical cell

1. Experiments in the Hull cell

The Hull cell for electrolysis is a dish of specific form and standard size and due to this the Hull cell could be used in finding out the optimum parameters of electrolysis, first of all the current density and concentration of gold ions.

2. Recording of polarization curves

Limit current density was determined from polarization curves, that is. Curves of current density dependence on cathode potential. The polarization curves were determined using the galvanostatic method, measuring the current densities in a change of cathode potential. Test electrode was made of flat platinum, and a reference electrode was the saturated calomel electrode.

3. Electrochemical decorative gold plating

Electrochemical decorative gold plating, that is investigation of temperature effect on a view and thickness of electrode, was carried out in the electrochemical cell consisted of a laboratory glass, volume 400 ml, with two anodes of platinum titanium, surface 3x2.2x2.3 cm each, until the fresh nickel-plated brass plate, site 50x32x1.2 mm was used as a cathode.

2.2 Experimetal procedures

Samples, before taking into the bath for electrolysis, have to have the smooth surface, that is not greasy and coated with a layer of unvisible oxides. Due to this reason, the plates are prepared before gold plating.

Preparation consists of:

a) Mechanical preparation
b) Chemical degreasing of metal
c) Chemical polishing
d) Nickel plating

2.3 Characterization of plating

Decorative gold plated plates from the Hull cell and electrochemical cell are checked regarding to the external view and thickness of plating.

Checking of the external view is carried out visually, and the view of decorative gold plated plates with marked measuring points that present the points of various current densities are presented in macrophotos.

The coating thickness is measured using the apparatus type UPA XRF 200 A by X-rays reflection from the gold atom. The apparatus operates with an error that is in a function of coating thickness.

3. RESULTS AND DISCUSSION

A comparattive amnallysis of classic cyanide electrolyte and organic gold complex has be carried out in those investigation.

For the aim of detailed comparasion the conditions for electrolysis, that the determination of limit curren density for organic gold complex with mercaptotriasole (with and without additions) and solution of $KAu(CN)_2$ (with additions), a dependance of current density-cathode potencialhas been investigated. In the first stage of experimental investigations are determined the polarization cureves

and limit current densities for bouth solutions. Based on the existing literature data, higer curren densties are expested for organic complex

Based on recorded polarization curves for gold complex with mercaptotriasole with various gold concentrations without addition, it could be concluded that limit current density increases with an increase of gold ion concentration in electrolyte, as well as in cyanide baths, and that the values of limit current densities are lower regarding to cyanine of baths.

Regarding to the obtaining the preliminary data on electrolysis parameters, the investigation were carried out in Hull cell. Those investigation have shoved that the glow gold-plates with good adhesion are obtained in a very large range of current density (from 0,1-1 A/dm^2) what points out a very good power of cureent distribution (throwing power) of this electrolyte. Better throwing power of this electrolyte regarding to cyanide could be seen from macrophotos of catode back sides from the Hull cells (Figure 1- cyanide solution and Figure 2- organic complex) that show nearly complete covered the cathode back side obtained from organic complex.

Figure 1. macrophotos of catode back sides from the Hull cells from cyanide solution

Figure 2. macrophotos of catode back sides from the Hull cells from organic complex

The investigations in the Hull cell have pointed out the followings

- Optimum gold ions concentration in electrolyte is 2.5 g/dm^3 (for organic complex) and 1.5 g/dm^3 (for cyanide solution)
- The best usage of current densities range from 0.4–1 A/dm^2 is for gold ions concentration of 2.5 g/dm^3 (for organic complex) and 0.1-1 A/dm^2 is for gold ions concentration of 1.5 g/dm^3 (for organic complex)
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The optimum parameters of decorative gold plating are:

- Current density: 1 A/dm^2 (for organic complex and cyanide soluition)
- pH: 9-12 (for organic complex) and 9-14 (for cyanide bath)
- additives: AUROCIN DPB additive 1 and AUROCIN DPB additive 2 (for cyanide bath) ane without additive organic complex
- temperature: 20 °C

4. CONCLUSION

Based on experimental investigations, it could be concluded that the quality of decorative gold plating, obtained from organic complex of gold based on mercaptotriasole satisfies the all requirements of decorative gold plating, where current density effect on view and thickness of coating is much more less than in classic cyanide bath. The most important advantage of this electrolyte is ecologic, where gold could be regenerated by simple settling with hydrogen peroxide where sulphur is separated.

5. REFERENCES

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