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PREPARATION OF NON-CYANIDE ELECTROLYTE FOR 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 [1]. 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 [2]. 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 [3].

This electrolyte can be successfully used for gold plating in comparasion with expensive and risky cyanide bath. Final efects and characteristics pertaing decorative quality of gold coating are well satisfactory.

Decomposition and recovery of waste solution can simply be done. Toxicity is not identified. [3]

Key words: Gold plating, mercaptotriasole, gold plating baths

1. INTRODUCTION

Nowadays, the cyanide and ferrous cyanide solutions are used in practice for gold plating. Preciоius Metals and Galvanic Preparations Plant, that is in operation in the frame of Electrolytic Refinery Plant in Bor, produces preparations for decorative and hard gold plating and also carries out their testing. Those compounds are very toxic, and formation and maintenanceof cyanide baths is expensive and risky for technical personnel. Due to this reason, and specially in modern time, there is a trend of using the electrolyties without content of cyanides. Content of those cyanides is mainly based on some organic compounds. However, their usage has not found the satisfied industry use due to the low constant stability, what is demonstrated by complex destruction and extraction the elementary gold from electrolyte.

The organic gold complex based on mercaptotriasole, was investigated in this work, and that, contrary to the previous complexes, showed as sufficiently stable in shorter time interval. Due to this, it was necessary to carry out a detail investigations for the aim of finding out the optimum conditions for

obtaining the quality decorative gold plating from this electrolyte and to compare it with a quality of gold plating obtained from classic electrolyte. [2]

2. EXPERIMENTAL PART

Preparation of non-cyanide electrolyte for gold plating contains next phases:

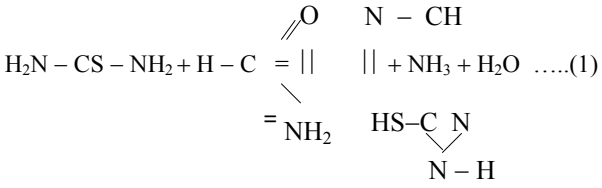
- Preparation of gold chloride high purity
- Preparation of 5 MT high purity
- Preparation solution of gold 5MT[3]

2.1. Preparation of gold chloride high purity

Gold chloride solution is preparation dissolution gold high purity in aqua regia. [3]

2.2. Preparation of 5 MT high purity

Simplest way for syntheses mercaptotriasole (5MT) is process by Beyeru i Krogeru (1.):



Reaction between tiosemikarbazide and formamide are getting molecule of 5MT.

Method by Beyeru i Krogeru for production 5MT have made in heating balloon with column for rectification illustrated on figure1.

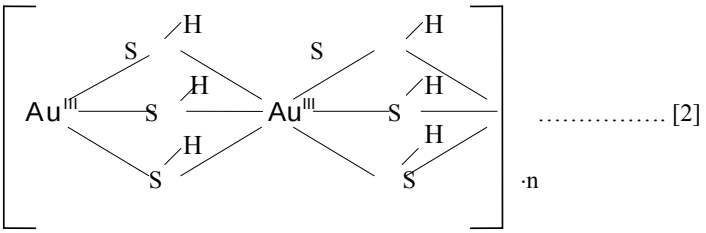
Figure 1. Heating balloon with column for rectification [3]

2.2.1. Preparation solution of gold 5MT

In the final phase of preparing solution of gold 5MT, are mixing solution of gold chloride and 11 % solution of 5MT.

On specific reaction condition, reaction between aqua solution of 5MT and Au^{3+} ione are geeting gold complex of mercaptotriasole.

Constitutional formula of gold complex may be present: [3]



……. [2]

3. CHARACTERIZATION OF ELECTROLYTE

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 cell electrochemical [3]

3.1 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 macrophoto.

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. [1]

4. RESULTS AND DISCUSSION

4.1. Determination of current density range- investigation in Hull cell

For the aim of determination the optimum concentrations of gold ions and optimum range of current densities, the investigations were carried out in the Hull cell. The plates, size 1x1 dm, were first of all mechanically prepared, then degreased and chemically polished. Such prepared plates were electrochemically nickel plated, and freshly nickel plated plates were decoratively gold plated from electrolyte based on organic gold complex with mercaptotriasole.

Originally, the complex gold compound based on mercaptotriasole, regarding to its content, importantly differs from cyanide gold salts, that were used in practice previously for the aim of determination the optimum parameters of electrolysis and possibility for usage the organic gold complex in the baths for decorative gold plating. [1]

The investigations in the Hull cell have pointed out the followings:

- Optimum gold ions concentration in electrolyte is 2.5 g/dm^3
- The best usage of current densities range from 0.41–1 A/dm^2 is for gold ions concentration of 2.5 g/dm^3
- The separated gold mass depends very little on current density– good power of this electrolyte distribution
- AUROCIN DB additive 2 has no effect on view and thickness of coating, such as further investigation have to be aimed to finding out the suitable surface active substances as the additive due to the noticed effect of poor soaking. [3]

4.2. Determination of limit current densities and exsperiments i electrochemical

Organic gold complex with mercaptotriasole presents electrolyte that is not even used in procedures of decorative and hard gold plating, this is electrolyte that is in investigation. Polarization curves were done for solution with various gold concentrations without presence of additives, and then polarization curves for solution with optimum gold concentration at various concentration of TC EHC additive.

The polarization curves were determined using the galvanostatic method, measuring the current densities in a change of cathode potential.

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.

Polarization curves for solution with C_{Au}= 2.5 g/dm^3 without additive and solution of the same concentration with various concentration of TC EHC additive show that the presence of additive even in the lowest investigate concentration (0.03 g/dm^3) significantly decreases limit current density, until further increase of concentration practically has no effect on value of limit current density. [3]

The investigations in the electroshemical cell have pointed out the followings:

- Optimum gold ions concentration in electrolyte is 2.5 g/dm^3, optimum current densities1 A/dm^2, without additives, pH= 9-12 and t= 23^{0}C.

Macrophot of gold plated plate at optimum parameters of electrolysis is shown in Figure 2. [3]

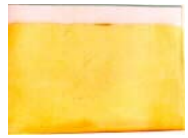


Figure 2. Macrophoto of gold plated plate at optimum determined parameters of electrolysis.

5. 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. [3]

6. REFERENCES

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