ELECTRODEPOSITION OF BRASS FROM POLYLIGAND ELECTROLYTE BASED ON PYROPHOSPHATE

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The purpose of the research is to determine the conditions for brass electrodeposition from a polyligand electrolyte containing pyrophosphate and citrate metal complexes. Methods of cyclic voltammetry and galvanostatic deposition were used. It is determined the region of current densities, in which the current efficiency is the highest, the deposit is more uniform in the thickness, and alloy composition is practically unchanged.

Introduction. The colour of brass coatings varies depending on the composition of the alloy. There are green brass (60% Cu), yellow brass (67% Cu), tombac or red brass (90% Cu). The brass coatings are used as a sublayer before gumming, as protective-decorative treatment of haberdashery products, furniture accessories, office equipment, illuminating armature, jewellery.

The most promising for improving the properties of electroplating coatings are electrolytes based on polyligand systems. Polyligand electrolytes for brass coating based on potassium pyrophosphate are the most widely used in industry: pyrophosphate-sulfosalicylate and pyrophosphate-dihydrogenphosphate [1,2]. However, they are not yet an ideal replacement for cyanide electrolytes in operational parameters.

The aim of the study is to determine the conditions of copper and zinc codeposition from a polyligand pyrophosphate-citrate electrolyte.

Methods. Cyclic voltammetry and galvanostatic studies were performed using the MTech PGP-550M potentiostat. Electrodes made of Cu were used. The saturated silver chloride electrode was used as reference electrode. The elemental analysis was determined by XRF method.

Results and discussion. Two waves are observed on the cathode branch of forward part of cyclic voltammetric (CVA) dependence of the codeposition of copper and zinc from pyrophosphate-citrate electrolytes. First wave starts at the same potentials as copper deposition in the absence of zinc ions in electrolyte. Second wave starts at potentials that are close to the beginning of zinc deposition. Copper is deposited in the alloy with overpolarization, and zinc is deposited with significant depolarization. The anode branch of CVA in electrolyte containing both copper and zinc ions in equimolar concentrations begins at the same potential as the anode branch of CVA in the copper solution.

To obtain alloys with high zinc content, the coatings were deposited from the electrolyte with an increased $[Zn^{2+}] : [Cu^{2+}]$ concentration ratio. Additionally,

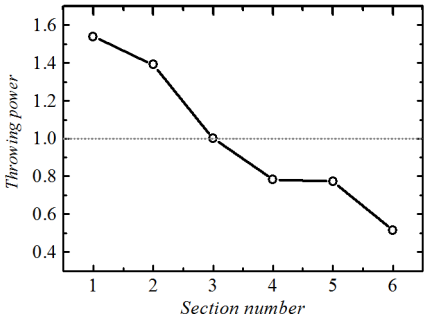

Fig. 2. Distribution of deposit in electrolyte containing ($[Cu^{2+}]$: $[Zn^{2+}]$) : $[Cit^{3-}]$: $[P_2O_7^{4-}]$ = (1 : 5.3) : 0.5 : 3 on the separate sections of the cathode in Hull cell.

taking into account the previously detected decrease in the rate of contact exchange of copper- and pyrophosphate-containing electrolytes with a substrate made of steel with a decrease in the copper ions concentration, a less concentrated electrolyte was used.

Primarily copper with a low content of zinc is deposited at low current densities. Further the composition of the coating is practically unchanged. The current efficiency is about 68% in the working range of the current density. The decrease in the CE at low current densities is due to the contribution of reaction of copper incomplete reduction. When the potential increases to –1.1 V, the current efficiency decreases due to hydrogen evolution reaction.

The throwing power of the electrolyte was evaluated using Hull cell. The cathode consisted of 6 sections. The average current density on the cell was 4.5 mA/cm^2. According to the current distribution on the plates of the cell (Fig. 2), the coating will be more uniform at current densities of 3–4 mA/cm^2.

Conclusions. The pyrophosphate-citrate polyligand electrolyte with ratios of metal ion concentrations $[Cu^{2+}]$: $[Zn^{2+}]$ = 1 : 5.3 is considered for the brass coating deposition. The current efficiency is about 68% in the working range of the current density, of the coating is practically unchanged. Region of the current densities corresponding to the deposition of coatings that are more uniform by thickness and composition is established.

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2. *Senna L.F., Díaz S.L. and Sathler L.* Hardness analysis and morphological characterization of copper-zinc alloys produced in pyrophosphate-based electrolytes Mater. Res. – 2005. – 8, № 3. – P. 275–279.