

Effect of SnO₂ sol on peculiarities of electrochemical deposition and properties of copper coatings on zink, aluminium and their alloy

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Copper plating on zink, aluminium and their alloys is used for finishing manufactured articles and corrosion stability improvement, but there are principal difficulties in deposition of uniform metal layers with high adhesion and protective ability [1]. This work carries on the previous studies [2, 3] and is devoted to the elucidation of SnO₂ sol effect on the peculiarities of electrochemical deposition, microstructure and properties of copper coatings on zink, aluminium and their alloy.

Copper coatings were plated on zink, aluminium and Zn–Al alloy from slightly alkaline diphosphate copper plating solution containing nanoparticles of hydrated tin dioxide sol 2–4 nm in size which were stable in the electrolyte. It was found that at a small SnO₂ concentration of 0.5–1.0 g/l in copper plating solution there exists a confined range of current densities providing coatings deposition with the rate equal to that in the absence of sol. This optimal range depends on the substrate nature. At the increased sol concentration the rate of copper deposition diminishes and coatings become rough and friable. The intercalation on tin dioxide in coatings is insignificant and its content in copper matrix does not exceed 1 at. % according to EDX data. Nevertheless, the presence of SnO₂ sol in copper plating electrolyte provides deposition of very fine-grained uniform and dense copper coatings (Fig). Average size of copper grains in Cu–SnO₂ coatings deposited on zink, aluminium and Zn–Al alloy is 2–3 times less as compared with the copper grain size in the absence of tin dioxide. Fine SnO₂ powders consisting of particles 20–100 nm introduced into the electrolyte under investigation did not exert such strong modifying effect on the coatings microstructure.

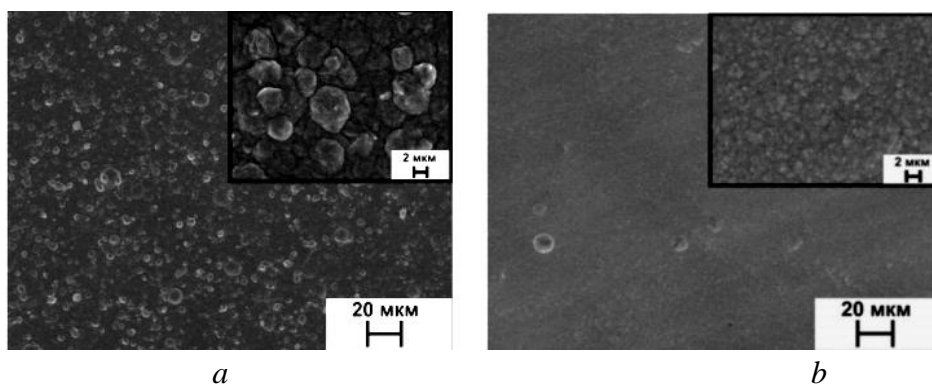


Fig. SEM images of Cu (a) and Cu–SnO₂ (b) coatings on Zn–Al alloy

Voltammetric studies of the anodic behavior of zink, aluminium and Zn–Al alloy in the media of diphosphate copper plating electrolyte showed the diminution of anodic current density and the charge spent on Al, Zn and Al–Zn anodic oxidation in the presence of SnO₂ sol. Corrosion tests of the samples covered with copper doped with SnO₂ showed the heightened ability to retard Zn–Al alloy corrosion in the acid and chloride media compared with corrosion of the samples covered with coatings deposited in the absence of SnO₂.

References

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