THE INFLUENCE OF DOUBLE LAYERED OXIDE (Fe/Al LDO) NANOPARTICLES ON THE PROPERTIES OF COPPER-BASED COMPOSITE COATINGS

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Abstract

In this study, the co-electrodeposition (CED) method was utilized to produce copper metal matrix composite coatings (Cu-MMC) using lab-made sulfate electrolyte and lab-made synthesized nanoparticles of ferrite-aluminum layered double oxide (Fe/Al LDO) as reinforcement. Copper coatings and co-electrodeposited Cu-MMC coatings with Fe/Al LDO nanoparticles had thicknesses of 5, 10, 20, and 50 μm. The Fe/Al LDO nanoparticles were produced using the co-precipitation process from aqueous solutions, which are used for the synthesis of Fe/Al LDH (hydroxide form). After LDH synthesis, the calcination method (600°C in the oven for 3h) was applied for synthesis in their oxide form. The Field Emission Scanning Electron Microscopy (FE-SEM), an Atomic Force Microscopy (AFM), and an X-ray powder diffractometer (XRD) were used for the investigation of the morphology, topography, roughness, and texture of Cu and Cu-MMC coatings. The Vickers microindentation hardness tester and static sessile drop technique were used to analyse microhardness and wettability features of the Cu coatings that were electrodeposited galvanostatically both with and without a low concentration (0.3 wt. %) of Fe/Al LDO nanoparticles on brass sheets. Since all Cu coatings were microcrystalline and fine-grained (with a preferred orientation of (220)), the degree of the roughness and preferred orientation increased with coating thickness. Fe/Al LDO nanoparticles were uniformly distributed throughout the coating's interior, according to the cross-section study of coatings electrodeposited with these particles. Cu coatings electrodeposited with Fe/Al LDO nanoparticles had a significantly higher hardness than the coating made from the reinforcement-free electrolyte, according to a hardness analysis of the coatings conducted using the Chicot-Lesage (C-L) composite hardness model. The wettability properties of the Cu coatings were also altered by the addition of Fe/Al LDO to the electrolyte. The hydrophilic character of the Cu coating derived from the reinforcement-free electrolyte was replaced by hydrophobic coatings resulting from the addition of Fe/Al LDO nanoparticles. The Fe/Al LDO nanoparticles were very stable in acidic sulfate electrolyte and as such they are an excellent choice for reinforcing thin metal coatings deposited electrochemically.

Keywords: *Fe/Al layered double oxide, copper coatings, roughness, texture, hardness, wettability.*