ABSTRACT

Cu-SiC nanocomposite coatings have been deposited from an aqueous sulfate electrolyte using the technique of pulse reverse electrodeposition. The effects of cathodic current density, anodic current density, anodic current time and different concentrations of nano SiC particle (~20nm) in the electrolyte on codeposition, surface roughness, hardness and resistivity have been studied both in the absence and in the presence of three different types of surfactants (anionic, cationic and nonionic). In all the cases, it has been observed that the surface roughness, hardness and resistivity increase with the increase in the cathodic current density. However, they have been observed to decrease with the increase in the anodic current density and anodic current time. In the presence of surfactants, most attractive hardness values have been observed in the composites prepared from an electrolyte containing 5 g/L nano SiC particles. The variation in the amount of incorporated reinforcement in the composite with different deposition parameters has been observed to be dependent on the presence and the nature of the surfactants. The cationic surfactant has been observed to be the most capable surfactant in incorporating SiC particles into the copper matrix. Samples prepared under higher anodic current density have been observed to possess lower stress, but intense texture. An increase in cathodic current density has been observed to lower the extent of texturing.

Dry sliding wear and friction behavior of a selected Cu-SiC nanocomposite coating has been evaluated using a ball on disk wear instrument. The effect of variation in normal load and sliding speed on wear and friction behavior has been studied. This behavior has been compared with two other pure specimens; one prepared under similar conditions as that of the composite and the other by casting and rolling. The wear rate of the nanocomposites has been observed to increase with the increase in normal load, whereas it has been observed to decrease with the increase in sliding speed. The coefficient of friction has been observed to increase with the increase in the sliding speed. However, with the normal load variation, it has been observed to show a minimum at an intermediate load. In all the tests, the composite has been observed to show lowest wear rate and coefficient of friction, except at the highest load tested. At the highest load it has

been observed to show coefficient of friction similar to that of the electrodeposited pure copper.

The effect of pulse reverse electrodeposition parameters on the corrosion, impedance and oxidation behavior has been studied from the viewpoint of amount of incorporated reinforcement, crystallite size, texture and surface roughness. The composite has been observed to show better corrosion and oxidation resistance as compared to that of the pure copper deposited under similar conditions. The corrosion resistance of the composites prepared under higher cathodic current density, higher anodic current time, and lower anodic current density has been observed to be better than those prepared under lower cathodic current density, lower anodic current time, and higher anodic current density, respectively. These corrosion behaviors have been verified from impedance spectroscopic studies. The oxidation resistance of the composites containing higher amount of reinforcement has been observed to be better than those containing lower amount of reinforcement.

Keywords: Cu-SiC; Nanocomposite; Electrodeposition; Pulse reverse; Electrical contact.