A study of electroless copper–phosphorus coatings with the addition of silicon carbide (SiC) and graphite (Cg) particles

Abstract

Copper composite coating with graphite (Cg) and/or silicon carbide (SiC) particles were deposited by electroless plating. The surface morphology of the coatings that were analysed using scanning electron microscopy (SEM) showed that Cu particles were uniformly distributed. The obtained coating thickness was approximately ± 5 μm. X-ray diffraction (XRD) and differential scanning calorimetry (DSC) techniques were used to characterise the structure and to study the phase transition of the coatings, respectively. Phases such as Cu, Cu2O, Cu3P, Cu3Si, SiC and Cg were observed from X-ray diffraction patterns and the presence of Cu2O, Cu3P and Cu3Si was confirmed by differential scanning calorimetry (DSC) studies. The results demonstrated that SiC and Cg particles have little influence on the phase transition of the coating. The hardness and wear resistance of Cu–P composite coatings were improved with the incorporation of SiC particles. The friction coefficient of Cu–P composite coatings decreased with the incorporation of Cg particles. Atomic force microscopy (AFM) results of coatings showed that the roughness of the coatings increased with the incorporation of SiC to the Cu–P coatings and decreased with the incorporation of Cg. Cu–P–Cg–SiC composite coatings showed a moderate roughness, hardness between Cu–P–SiC and Cu–P–Cg coatings, had low friction and good anti-wear properties. The anti corrosion resistance of the electroless Cu–P composite coatings on carbon steel were studied in 3.5% NaCl and 1 M HCl solutions by the potentiodynamic polarisation technique. The study revealed that the corrosion resistance increased with the incorporation of SiC particles in the Cu–P and Cu–P–Cg matrix but reduced with the incorporation of graphite.