Co-electrodeposition synthesis and characterization of Ni-Al2O3-Cr hybrid nanocomposite.

ABSTRACT

Ni-Al203-Cr metal matrix hybrid composite coatings were developed in a conventional Watt electroplating solution, containing suspended nanoparticles of alumina and chromium. The characterization of the composite layer was carried out by scanning electron microscopy (SEM), X-ray diffractometry (XRD) and Energy-dispersive X-ray spectroscopy (EDX) facilities. SEM, XRD and EDX studies showed that a nove l hybrid Ni-Al2O3-Cr metal matrix composite (MMC) coating formed successfully on a pure copper substrate with about 11.5 % and 4.4 % vol. Al2O3 and Cr dispersed nanoparticles respectively. A texture modification and grain refinement were found in composite layers. The incorporation of nanoparticles of Al203 and Cr changed the preferential nickel growth orientation from (220) to the (200) plane. The SEM studies on the morphology of a Ni- Al2O3-Cr composite surface illustrated that the nickel column growth slowed down in the composite film and thecomposite coating had a more condensed and smoother surface compared to pure nickel coatings. The mean grain sizes of the pure nickel and composite coats were determined as 103 and 19 nm respectively. The SEM micrographs showed that the nano particles were uniformly dispersed in the electrodeposited nano-structured Ni matrix and the alumina particles agglomerated in sizes of above 100 nm. The micro-hardness and wear resistance test results showed a remarkable improvement in the mechanical properties of the electroplated nickel by creating a nano composite structure of Ni-Al2O3-Cr.

Keyword: Nickel Electroplating; Nanocomposite coating; Co-electrodeposition synthesis; Hybrid nanocomposites.