

Electroless ternary Ni-Co-P and quaternary Ni-W-Co-P coatings: Preparation and characterization

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ABSTRACT

Autocatalytic/electroless quaternary NiCoWP coatings were prepared by using an alkaline based bath. Ternary NiCoP coatings were also prepared for the comparison. Coatings were characterized for their morphology, composition, phase transformation behavior, microhardness and corrosion resistance. Surface of the both deposits exhibited nodular structure but W incorporation in NiCoP matrix had resulted in a marginal increase in nodularity. Roughness (R_a) values measured using Optical profilometer indicated that quaternary deposits exhibited more roughness ($0.08 \mu\text{m}$) compared to ternary deposits. Compositional analysis carried out on ternary deposit showed the presence of Ni (37 wt.%), Co (53 wt.%) along with about 10 wt.% of P. Whereas W (≈ 3 wt.%) incorporation in NiCoP matrix had resulted in decrease in Co (48 wt.%) and P (7 wt.%) contents. Microhardness measurements made on as-plated both coatings exhibited almost similar hardness (about $430 \pm 20 \text{ VHN}_{25\text{gf}}$). Similarly heat treated ($400^\circ\text{C}/1 \text{ h}$) deposits showed higher hardness values in the range $900 - 950 \text{ VHN}_{25\text{gf}}$. Phase transformation studies carried out using Differential scanning calorimeter (DSC) showed that both coatings exhibited two exothermic peaks. It was found that incorporation of W in NiCoP matrix showed a marginal improvement in thermal stability compared to the ternary coating system. Potentiodynamic polarization studies carried out in 3.5% NaCl solution showed that ternary alloys exhibited improved corrosion resistance ($0.4 \mu\text{A}/\text{cm}^2$) compared to quaternary coatings ($7.4 \mu\text{A}/\text{cm}^2$). Whereas passivated (permanganate bath) both coatings showed almost similar corrosion behaviour ($1.2 \mu\text{A}/\text{cm}^2$).