ELECTROLESS DEPOSITION OF Ni-P-TiO_2 and Ni-P-CeO_2 COATINGS ON ALUMINUM ALLOY

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Electroless plating is a chemical reduction process, which depends upon the catalytic reduction of a metallic ion in an aqueous solution containing a reducing agent and the subsequent deposition of the metal without the use of electrical energy. The co–deposition of fine particulate matter: organic or inorganic with electroless coatings produces electroless composite coatings providing wear–resistance, corrosion resistance or self lubrication. In the present study, electroless Ni–P (EN) coatings enhanced with CeO_2 and TiO_2 microparticles were deposited on 6061 aluminum alloy in order to enhance the mechanical and corrosion properties of this widely used alloy.

The coated specimens as well as those that underwent only the pretreatment process were characterized under optical and scanning electron microscope (SEM) and by means of X–ray diffractometer (XRD) regarding surface morphology and the effect of the pretreatment on the aluminum substrate. The pretreatment plays an important role especially in the aluminum plating and is a key factor for a successful procedure, as it is quite specific to these metals and depends on the alloying elements as well.

Surface roughness measurements were conducted in order to demonstrate the improved properties of the specimens and to compare and explain the differences between composite and plain coatings. For the same purpose, microhardness measurements were also carried out on the specimen surface employing a load of 150 g for a period of 10 s.

Emphasis is given on the corrosion resistance of the deposits and the alloy. Immersion tests in 3.5% w/w $NaCl_{(aq)}$ were carried out in order to record weight fluctuations and changes in the appearance of the surface, such as blisters and possible discoloration. Potentiodynamic polarization measurements were also employed to evaluate the effect of the coatings on the corrosion resistance characteristics of the aluminum alloy. The corrosion potential, E_{corr}, and corrosion current density, i_{corr}, were calculated from the intersection of the cathodic and anodic Tafel curves extrapolated cathodic and anodic polarization curves. The results indicate that the corrosion potential of the system is shifted to much nobler regions whereas among the electroless coatings, the composite Ni–P–CeO_2 and Ni–P–TiO_2 ones demonstrate lower corrosion rates and nobler corrosion potentials than the plain ones, even though the differences are small in the latter values. The corrosion characteristics of the composite deposits are somewhat improved compared to the plain ones, due to the embedded particles that not only decrease the effective metallic area prone to corrosion but create a more compact structure as well (Figure 1).

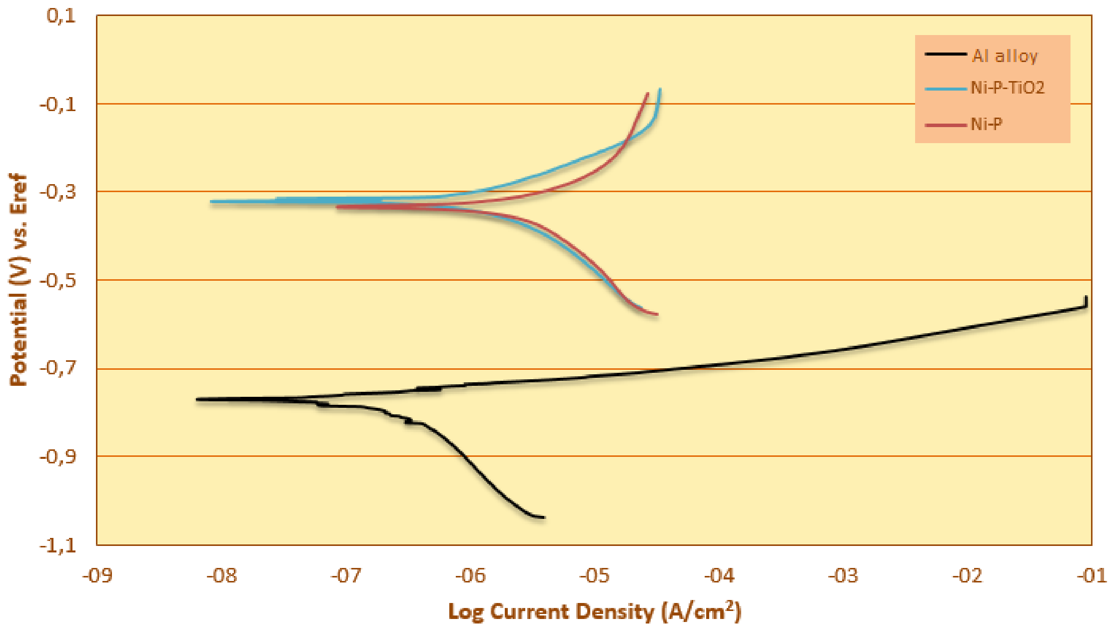

Figure 1: Comparative polarization curves for the Al alloy substrate and the composite Ni–P–TiO_2 deposits.

Indicative references and previous relevant studies

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