Conducting Polymer-Clay Nanocomposite Coatings for Corrosion Protection of Al 2024-T3

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Abstract

Clay-incorporated conducting polymers, polyaniline (PANi) and polypyrrole (PPy) were studied as corrosion protection coatings for Al 2024. Organically modified montmorilonite (MMT) clay was successfully incorporated into the conducting polymer matrix to form nanocomposite coatings. This kind of nanocomposites was formed by in-situ chemical oxidation of aniline/pyrrole monomer in aqueous suspension of clay. The powder form product was observed under transmission electron microscope (TEM) and the nanoscale structure was revealed. A layer of hydrolyzed epoxy silane was formed on the Al 2024 coupons before applying the nanocomposite coating. Experimental results showed that silane layer between the nanocomposite coating and Al 2024 substrate served as an adhesion promoter. In DC polarization test in 3.5% NaCl solution, it was shown that with the underlayer of silane, the nanocomposite coating PANi+clay provide drastically improved corrosion protection ability. From Figure 1, it can be seen that the PANi+clay nanocomposite coating showed three orders of magnitude decrease in corrosion current, while the same nanocomposite coating without silane layer showed much higher corrosion current. In this study, Fourier transform infrared spectroscopy (FTIR) was used to characterize the nanocomposite and to study the structure of silane, the interaction of silane layer with the substrate and the coating; Scanning electron microscope (SEM) was used to observe the nano-scale morphology of the nanocomposite coatings; X-ray diffraction (XRD) was used to study the structure of the nanocomposite coating; Lap-joint test were performed to measure the adhesion strength of the coatings. An interface reaction model, shown in Figure 2, was established to describe the mechanism of effects of silane underlayer as an adhesion promoter.

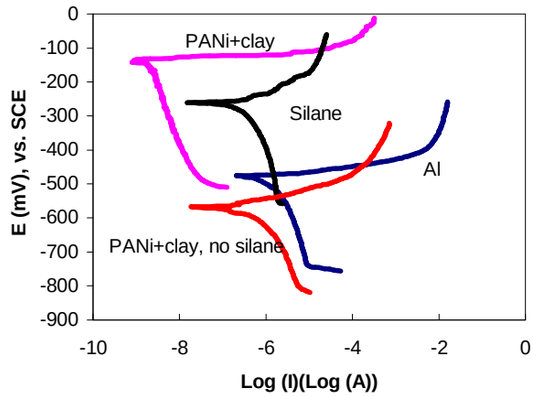

Figure 1 DC polarization results for a) Nanocomposite PANi+Clay coating with silane as the undercoating; b) Silane undercoating; c) Nanocomposite PANi+Clay coating with no silane undercoating; d) Al 2024 substrate

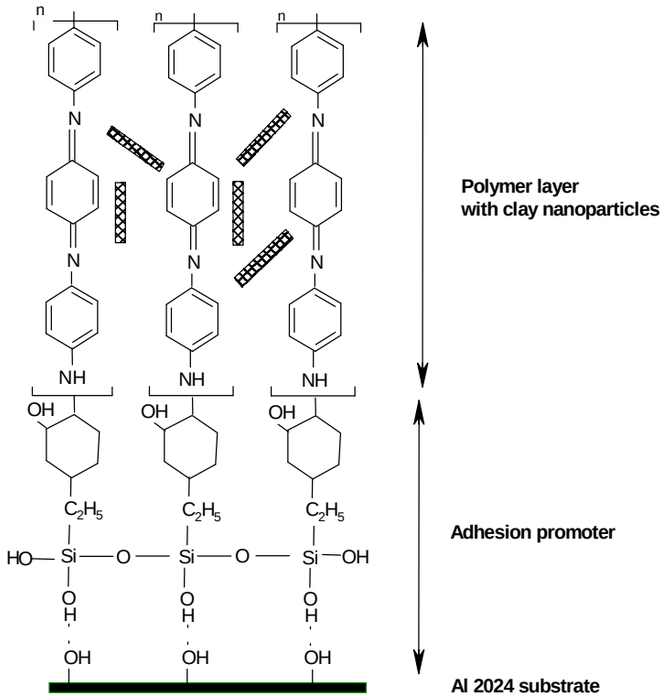

Figure 2. Interaction between silane layer, the polymeric coating and the Al2024 substrate

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