

EIS Study of Amine Cured Epoxy-silica-zirconia Sol-gel Coatings for Corrosion Protection of the Aluminium Alloy EN AW 6063

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Abstract

The organic-inorganic hybrid sol-gel films, the structure of which comprises interconnected inorganic and organic networks have been reported as an environmentally friendly anti-corrosion pre-treatment for several metals, including aluminium alloys. In this paper, an epoxy-silica-zirconia hybrid sol-gel coating was synthesized from glycidoxypyltrimethoxysilane (GPTMS) and zirconium n-propoxide (TPOZ) precursors and applied to EN AW-6063 alloy by dip-coating. To promote the organic network formation through the epoxy group polymerization at room temperature, two types of amine crosslinkers were added during synthesis: diethylenetriamine (DETA), in different concentrations, and a tri-functional amino-silane. The evolution of the curing process and the corrosion behaviour of the coated aluminium alloy specimens were evaluated by Electrochemical Impedance Spectroscopy (EIS) in 0.5 M NaCl. The morphology and surface chemistry of the hybrid coatings were characterized by Energy Dispersive Spectroscopy (EDS) coupled with Scanning Electron Microscopy (SEM) and by Fourier Transform Infrared Spectroscopy (FTIR). The results obtained revealed that the sol-gel coatings with lower amine ratios required longer curing times, but showed the best anticorrosive performance with time. The increase in amine concentration has led to a more cross linked organic network, resulting in higher initial coatings resistance; however it has turned coatings more hydrophilic, prone to rapid degradation in water.

Keywords: sol-gel hybrid coating, silane, corrosion, EIS, aluminium.

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