

Hybrid Sol-Gel Coatings for Corrosion Protection of AA6111-T4 Aluminium Alloy

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Abstract : Hybrid sol-gel coatings are the blend of both advantages of inorganic and organic networks have been reported as environmentally friendly anti-corrosion surface pre-treatment for several metals, including aluminum alloys. In this current study, Si-Zr hybrid sol-gel coatings were synthesized from (3-glycidoxypropyl)trimethoxysilane (GPTMS), tetraethyl orthosilicate (TEOS) and zirconium(IV) propoxide (TPOZ) precursors and applied on AA6111 aluminum alloy by dip coating technique. The hybrid sol-gel coatings doped with different concentrations of cerium nitrate ($\text{Ce}(\text{NO}_3)_3$) as a corrosion inhibitor were also prepared and the effect of $\text{Ce}(\text{NO}_3)_3$ concentrations on the morphology and corrosion resistance of the coatings were examined. The surface chemistry and morphology of the hybrid sol-gel coatings were analyzed by Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). The corrosion behavior of the coated aluminum alloy samples was evaluated by electrochemical impedance spectroscopy (EIS). Results revealed that good corrosion resistance of hybrid sol-gel coatings were prepared from hydrolysis and condensation reactions of GPTMS, TEOS and TPOZ precursors deposited on AA6111 aluminum alloy. When the coating doped with cerium nitrate, the properties were improved significantly. The hybrid sol-gel coatings containing lower concentration of cerium nitrate offer the best inhibition performance. A proper doping concentration of $\text{Ce}(\text{NO}_3)_3$ can effectively improve the corrosion resistance of the alloy, while an excessive concentration of $\text{Ce}(\text{NO}_3)_3$ would reduce the corrosion protection properties, which is associated with defective morphology and instability of the sol-gel coatings.

Keywords : AA6111, $\text{Ce}(\text{NO}_3)_3$, corrosion, hybrid sol-gel coatings

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