A comparative study of different sol-gel coatings for sealing the plasma electrolytic oxidation (PEO) layer on AA2024

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Abstract

Due to the intrinsic porosity of the layers formed by the plasma electrolytic oxidation (PEO) process, the application of sol-gel coatings has allured by their eco-friendly and reliable protective characteristics. Various parameters affect their performance in which the type of sol-gel precursors plays a significant role. In this study, different combinations of sol-gel precursors including Tetraethyl orthosilicate (TEOS), Methyltriethoxysilane (MTES), (3-Glycidyloxypropyl)trimethoxysilane (GPTMS), (3-Aminopropyl)triethoxysilane (APTES), Zirconium(IV) propoxide (ZTP), and 3-(trimethoxysilyl)propyl methacrylate (MAPTMS) were employed to scrutinize the sealing ability and corrosion resistance properties of the duplex PEO/sol-gel coating system on AA2024 alloy. PEO layer on AA2024 was acquired at 5 A constant anodic current, 100 Hz frequency, and 30% duty cycle in an electrolyte containing sodium silicate and potassium hydroxide. Sol-gel solutions were applied by dip-coating. To this end, Electrochemical impedance spectroscopy (EIS), as well as scanning electron microscope (SEM), results reflected the sealing ability of sol-gel coatings for the microcracks and pores filling of the PEO layer. Although all duplex coating systems revealed better corrosion protection performance than the distinct PEO layer, different sol-gel formulations and various sol-gel network properties accordingly resulted in various anti-corrosion outcomes obtained upon exposure to the 0.1M NaCl solution.

Keywords: *Plasma electrolytic oxidation; Sol-gel precursors; Sealing; AA2024; EIS.*