Effect of Nanosized Silicon Dioxide Additive on Plasma Electrolytic Oxidation Coatings Fabricated on Aluminium

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Plasma electrolytic oxidation (PEO) of AA1060 aluminium was carried out in aluminate electrolytes to develop corrosion-resistant coatings. Different concentrations (0, 2 and 4 g/L) of a SiO₂ nanoparticle (n-SiO₂) additive and different treatment times of 15 min and 30 min were employed in this investigation. The PEO coatings were characterized by using a scanning electron microscopy (SEM) equipped with energy-dispersive X-ray spectroscopy (EDS), and X-ray diffraction (XRD). The corrosion resistances of each coating was evaluated by electrochemical methods. Results showed that n-SiO₂ hindered the formation of the α -Al₂O₃ phase and promoted the generation of the γ -Al₂O₃ and mullite phases. The addition of n-SiO₂ in the electrolytes could shorten the breakdown time of PEO, enhance the breakdown voltage, reduce the number of pores in the electrolyte/coating (E/C) interface and enlarge the internal cavity. The coating formed after 15 min in a NaAlO₂ solution containing 4 g/L n-SiO₂ additive showed the best corrosion resistance, exhibiting the lowest corrosion current density of $\sim 8.7 \times 10^{-10}$ A/cm².

Keywords: Nanosilica; Plasma electrolytic oxidation; Pure aluminium

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