Characterization and Corrosion Behavior of PEO Coatings on pre-Anodized Al alloys

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Plasma Electrolytic Oxidation (PEO) involves anodic polarization at high voltages, such that dielectric breakdown occurs in the form of a large number of short-lived plasma microdischarges over the surface. The oxide layers developed by PEO on Al alloys are hard, well-adherent to the substrate and improve both corrosion and wear properties. Coating properties are influenced mainly by the electrolyte composition and processing parameters such as treatment time, electrical regime, frequency and electrical wave design. Compared to conventional and hard anodizing, the energy expenditure per micron of film thickness is relatively high in PEO coatings, which limits its widespread application. Recent studies have shown that precursor films by conventional anodizing can be used to reduce energy consumption involved in formation of PEO coatings by up to 50%. In this work, PEO coatings are developed in phosphate/silicate-based electrolytes under voltage-controlled mode on aluminum alloys with and without pre-treatment by conventional anodizing in sulphuric acid. The effect of electrolyte and pre-anodizing treatment on energy efficiency were investigated, revealing considerable energy savings with the precursor porous films due to the faster establishment of the so-called "soft sparking" regime. The electrochemical corrosion properties were evaluated for uncoated and coated materials using electrochemical impedance spectroscopy (EIS) in 3.5 wt% NaCl solution.