Effect of Current Density on Characteristics of 2024 Aluminum Alloy Microarc Oxidation Coatings with Titanium Dioxide Particles

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Ceramic coatings were deposited on a 2024 aluminum alloy by microarc oxidation (MAO) in a silicate electrolyte system containing 2 g/L nano-TiO₂ particles at different current densities (1, 2.5, 5, 7.5 and 10 A/dm²). The oxidation voltage, surface and cross-section morphologies and corrosion resistance of the coatings were studied. The results indicated that the voltage increased and facilitated the growth rate of MAO coatings so that the coatings thickened as the current density increased. The size of the micropores on the coating surface first increased and then decreased, and the shape changed from a strip-shaped hole to a round hole. The microhardness and the coating adhesive strength improved with increasing current density, whereas the corrosion resistance of the coatings decreased first and then increased. The coatings were mainly composed of γ -Al₂O₃, SiO₂, mullite, TiO₂ and a small amount of α -Al₂O₃. As a whole, the discharge energy increased with increasing current density, and the microarc oxidation reactions became more intense, which contributed to the variation in the characteristics of the coatings.

Keywords: Microarc oxidation; Current density; 2024 aluminum alloy; Nano-TiO₂ particles

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