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Microstructure and corrosion behavior of micro-arc oxidation coating on 6061 aluminum alloy pre-treated by high-temperature oxidation

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Abstract: In this paper, we investigate the microstructure and corrosion behavior of the micro-arc oxidation (MAO) coating on 6061 aluminum alloy that pre-treated by high-temperature oxidation (HTO). Microstructure, chemical and corrosion behaviors of the fabricated MAO ceramic coatings were studied by using scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS) and electrochemical corrosion tests. The results reveal that the pre-fabricated HTO film remarkably affects the formation of the MAO coating, leads to an enriched content of Mg, and decreases the compactness of the coating. The corrosion resistance of the 6061 aluminum alloy has been significantly improved by treatments of HTO, normal MAO (NMAO) and HTO pre-treated MAO (HTO-MAO), and the NMAO coating exhibits the best corrosion performance. The content of Mg in HTO pre-fabricated film is remarkedly higher than that in the substrate, which greatly influencs the formation of the MAO coating.

Key words: 6061aluminum alloy; high-temperature oxidation pre-fabricated film; micro-arc oxidation; corrosion resistance

1. Introduction

Micro-arc oxidation (MAO), also known as plasma electrolytic oxidation (PEO), is an effective surface modification technique to produce thick metallurgical oxide coatings on the surface of valve metals (aluminum, titanium, magnesium etc.) and their alloys via an electrochemical process with plasma discharges and melting-sintering in suitable electrolytes [1, 2]. In the particular case of Al and Mg alloys, MAO is a promising alternative to replace the conventional anodizing processes such as chromic acid anodizing and hard anodizing, by which to improve the mechanical and corrosion properties of the processed materials for applications in various industrial branches such as aerospace, automotive, biomedicine, electronics, energy, textile, etc [3, 4].

A number of efforts have been made to provide insight into the formation mechanism and improve the mechanical and corrosion properties of the MAO coating. In particular, it is significantly attractive to investigate the effect of the extra surface

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