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Fabrication of superhydrophobic coating on magnesium alloy with improved corrosion resistance by combining micro-arc oxidation and cyclic assembly

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Abstract

A superhydrophobic composite coating was fabricated on AZ91 magnesium alloy by combining micro-arc oxidation (MAO) and cyclic assembly in phytic acid and $Ce(NO_3)_3$ solution. The influences of assembling cycles on surface morphology and wettability were characterized by scanning electron microscopy and atomic force microscopy. It showed that a micro-nano hierarchical structure was constructed after three cycles of assembly, resulting in a superhydrophobic surface with a contact angle of 159^o. Compared with the direct cyclic assembly on bare Mg alloy, the prior MAO treatment could notably reduce the cracks caused by hydrogen evolution during assembling process, and the following assembling process could in return repair the porous defects of MAO layer. Electrochemical tests indicated that the superhydrophobic composite coating increased the corrosion resistance of Mg alloy by three orders of magnitude in 3.5 wt. % NaCl solution. Furthermore, 72 h of electrochemical tests revealed that the composite coating could provide long-term corrosion protection for Mg alloy. It indicates that the combination of prior MAO and latter cyclic assembly will be a promising strategy to construct corrosion-resistant composite coating on Mg alloy substrate.

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