Corrosion resistance enhancement of AZ31 Mg alloy by the formation of layered double hydroxide on a TiO_2-incorporated plasma electrolytic oxidation coating

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Plasma electrolytic oxidation (PEO) has attracted attention as an environmentally friendly and inexpensive protection method for magnesium alloy substrates.

The chemical composition of the PEO layer is influenced by the electrolyte. The concentration of a new electrolyte containing KOH, $NaAlO_2$, and $Na_6P_6O_{18}$ along with TiO_2 nanoparticles was optimized from an anti-corrosion resistance point of view. Layered double hydroxide (LDH) was then formed on the PEO layer via in-situ hydrothermal treatment to seal the pores and cracks, without the addition of metal cations to the LDH preparing solution. TiO_2 nanoparticles were incorporated into the PEO layer directly by adding them to the electrolyte and their effect on LDH structure as well as the corrosion resistance of the substrate was assessed.

Scanning electronic microscopy (SEM), energy-dispersive spectrum (EDS), X-ray photoelectron spectroscopy (XPS), and X-ray diffractometer (XRD), were performed for investigating the morphology, chemical composition, and crystalline structure. In addition, electrochemical impedance spectroscopy (EIS), and Time-of-Flight Ion Mass Spectroscopy (ToF-SIMS) were used for corrosion characterizations. The results revealed the better anticorrosion performance of the substrate after the addition of TiO_2 nanoparticles to the PEO layer and the formation of LDH nanosheets due to their synergic effect. The prepared conversion coating can be further used as a surface pretreatment for applying organic coatings.

Keyword

Magnesium, corrosion, conversion coating, plasma electrolytic oxidation, layered double hydroxide