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Srinivasan Arthanari, Kwang Seon Shin

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A Simple One Step Cerium Conversion Coating Formation on to Magnesium Alloy and Electrochemical Corrosion Performance

Srinivasan Arthanari, Kwang Seon Shin*

Magnesium Technology Innovation Center, School of Materials Science and Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea.

Abstract

Environmental friendly cerium conversion coating (CeCC) as an alternate to hexavalent chromium (Cr(VI)) coating was prepared on to AZ31 magnesium alloy with varying Gelatin (Gel) content and coating durations. Influence of coating parameters on the surface and electrochemical corrosion performance in 3.5 wt.% NaCl solution has been investigated. X-ray diffraction and Raman spectroscopy studies confirmed that, the coating was mainly consisted of nano-crystalline CeO_2. CeO_2 coating appeared as particulates with several dry, mud-like crisscrossed cracks and the concentration of 'Cerium' decreased as the 'Gel' content was increased. Corrosion resistance increased as the Gel content was increased; it decreased as the coating duration was increased. Electrochemical impedance spectroscopy (EIS) results and equivalent circuit (EC) curve fitting analysis revealed that, the developed coating exhibited nearly 5 times improvement in the charge transfer resistance (R_{ct}) value compared to the uncoated alloy. The coating produced at lower coating duration exhibited better corrosion resistance, however corrosion resistance decreased at longer coating duration due to the formation of thick conversion coating which would initiate the localized attack. EIS studies in the coating solution revealed the coating growth was altered by Gel addition and influenced the corrosion performance.

Keywords: Magnesium alloy; EIS; Polarization; Oxide coatings; Interfaces.

*** Corresponding author**