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Potentiostatic Growth of Hazenite Mineral Coating on AZ31 Magnesium Alloy in 0.1 M K_2HPO_4/0.1 M Na_2HPO_4 Solution

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Abstract : Hazenite conversion coating was deposited on AZ31 Mg alloy in a deaerated phosphate solution containing 0.1 M K_2HPO_4 and 0.1 M Na_2HPO_4 ($Na_{0.1}K0_{0.1}$) with pH 9 at −0.8 V. The coating mechanism of hazenite was elucidated by in situ potentiostatic current decay, scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR), electron probe micro-analyzer (EPMA) and differential scanning calorimetry (DSC). The volume of H_2 evolved during potentiostatic polarization was measured by a gas collection apparatus. The degradation resistance of the hazenite coating was evaluated in simulated body fluid (SBF) at 37℃ by using potentiodynamic polarization (PDP). The results showed that amorphous $Mg(OH)_2$ was deposited first, followed by the transformation of $Mg(OH)_2$ to amorphous $MgHPO_4$, subsequently the conversion of $MgHPO_4$ to crystallized K-struvite ($KMgPO_4 \cdot 6H_2O$), finally the crystallization of crystallized hazenite ($NaKMg_2(PO_4)_2 \cdot 14H_2O$). The deposited coating was composed of four layers where the inner layer is comprised of $Mg(OH)_2$, the middle layer of $Mg(OH)_2$ and $MgHPO_4$, the top layer of $Mg(OH)_2$, $MgHPO_4$ and K-struvite, the topmost layer of $Mg(OH)_2$, $MgHPO_4$, K-struvite and hazenite ($NaKMg_2(PO_4)_2 \cdot 14H_2O$). The PD results showed that the hazenite coating decreased the corrosion rate by two orders of magnitude.

Keywords : magnesium alloy, potentiostatic technique, hazenite, mineral conversion coating
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