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Impact of rare-earth elements on the corrosion performance of binarymagnesium alloys

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Abstract: The corrosion behaviour of Mg-0.3Ce, Mg-0.41Dy, Mg-0.63Gd, Mg-1.44Nd and Mg-1.43La (wt.%) alloys in3.5 wt% NaCl solution was investigated using electrochemical tests. The as-cast microstructures of theMg-RE alloys were characterized by the presence of second phases (MgxCe, Mg41Dy5 , Mg12Gd, Mg12Nd, Mg41Nd5, Mg24Nd and Mg12La) with different volume fraction and distribution. Results show that thecorrosion mechanism was altered from uniform to localized corrosion mechanism depending on thespecific RE alloying elements. The corrosion resistance of the Mg-RE alloys is increasing in the followingorder: Mg-1.43La, Mg-1.44Nd, Mg-0.3Ce, Mg-0.63Gd and Mg-0.41Dy. Accordingly, the corrosionmorphology in the best resistant Mg-0.41Dy alloy and the worst Mg-1.43La alloy were observed andcompared after 2h and 24 h of immersion using SEM-EDS, XPS and XRD analysis. The formation of theDy 2 O 3 oxide prevents the Mg-0.41Dy alloy from pitting corrosion and lead to an excellent corrosionsurface even after 24 h of immersion. Meanwhile, the presence of a high fraction of the Mg 12 La phasealong the grains boundaries in the Mg-1.43La alloy causes severe pitting corrosion by acting as anodicphase.

Keywords : corrosion resistance, Chloride ion, Magnesium Alloy, Rare earth element