

Impact of rare-earth elements on the corrosion performance of binary magnesium 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 in 3.5 wt% NaCl solution was investigated using electrochemical tests. The as-cast microstructures of the Mg-RE alloys were characterized by the presence of second phases (Mg_xCe , $Mg_{41}Dy_5$, $Mg_{12}Gd$, $Mg_{12}Nd$, $Mg_{41}Nd_5$, $Mg_{24}Nd$ and $Mg_{12}La$) with different volume fraction and distribution. Results show that the corrosion mechanism was altered from uniform to localized corrosion mechanism depending on the specific RE alloying elements. The corrosion resistance of the Mg-RE alloys is increasing in the following order: Mg-1.43La, Mg-1.44Nd, Mg-0.3Ce, Mg-0.63Gd and Mg-0.41Dy. Accordingly, the corrosion morphology in the best resistant Mg-0.41Dy alloy and the worst Mg-1.43La alloy were observed and compared after 2h and 24 h of immersion using SEM-EDS, XPS and XRD analysis. The formation of the Dy_2O_3 oxide prevents the Mg-0.41Dy alloy from pitting corrosion and lead to an excellent corrosion surface even after 24 h of immersion. Meanwhile, the presence of a high fraction of the Mg₁₂La phase along the grains boundaries in the Mg-1.43La alloy causes severe pitting corrosion by acting as anodic phase.

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