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Effect of addition of indium on corrosion resistance of AZ63-1.5La anode for seawater batteries

Ali Asghar Ebrahimi Valmoozi[a], **Amin Abedini**[a], **Reza Shamskhani**[a]

[a]*Department of Advanced Materials and Nanotechnology, Imam Hossein University, Tehran, Iran*

[*] *E-mail: aa.ebrahimivalmoozi@ihu.ac.ir*

Developing anodes for seawater batteries need to control anodic reaction kinetics, cathodic reaction kinetics, and self-peeling discharge product films. Alloy AZ63-1.5RE is a suitable choice as anode in seawater batteries. In spite of its impressive corrosion resistance, AZ63-1.5RE alloys cannot satisfy the increasing demands for higher corrosion resistance, especially for submersion in seawater. The addition of indium can improve the properties of AZ63-1.5RE anode. In this study, corrosion resistance of AZ63-1.5RE-0.5In is compared with the AZ63-1.5RE alloy. The open circuit potential, potentiodynamic polarization, and electrochemical impedance spectroscopy tests were used to examine the corrosion resistance of alloys. As can be seen in Fig. 1a, the corrosion potentials (E_{corr}) of AZ63-1.5RE alloy is –1.590 V vs. SCE, which the addition of In element causes a shift in the potential towards a more positive value (-1.632 V vs SCE). The 1.5RE alloy has lower corrosion current (i_{corr}) (7.58×10^{-5} mA cm^{-2}) and the lower anodic slope (β_a) (0.11 mV dec^{-1}), therefore it has higher corrosion resistance. The EIS plot (Fig. 1b) show that with an R_{ct} of 1552 Ω cm^2, the AZ63-1.5RE-0.5In alloy has the higher corrosion resistance than AZ63-1.5RE alloy. There are two essential factors which determine the corrosion resistance, namely the β-$Mg_{17}Al_{12}$ phase continuity along the grain boundary, the number of β-$Mg_{17}Al_{12}$ phase and rod like Al-RE phase particles in the α-Mg grains (Fig. 1c). The addition of In element helps in increasing the corrosion resistance of the alloy by reduction of contribution of β-$Mg_{17}Al_{12}$ phases.

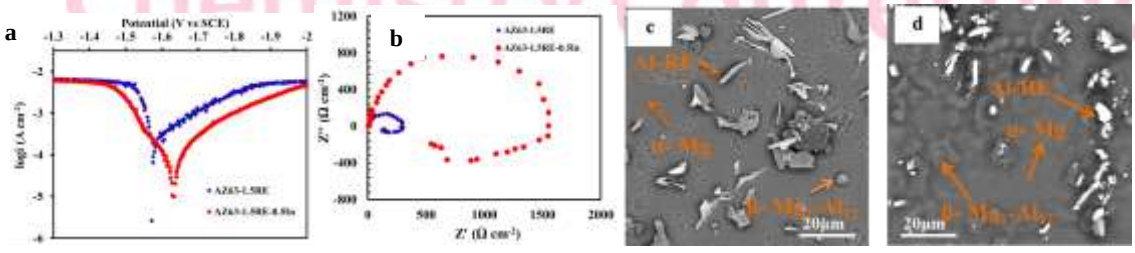


Fig. 1. (a) The potentiodynamic polarization curve, (b) the Nyquist plot of the AZ63-1.5RE and AZ63-1.5RE-0.5In alloys, FESEM images of (c) the AZ63-1.5RE alloy and (c) the AZ63-1.5RE-0.5In alloy

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