**Microstructure and Microanalysis of Zn-Mg Alloys and Their Corroded Surface after Anodic Polarization in Potassium Hydroxide Solution**

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Zinc alloys containing magnesium (Mg) up to 5 wt.% have been prepared by melting and die casting. These alloys are expected to have improved electrochemical behavior in alkaline solution, so that they may be used as the anode in zinc-air batteries instead of pure zinc, which has a drawback during recharging. Scanning electron microscopy (SEM) and energy-dispersive X-ray spectrometry (EDS) were used to characterize the as-cast microstructure of pure zinc and the Zn-Mg alloys (Fig. 1). It was found that the as-cast microstructure of the alloys with less than 3 wt.%Mg are hypoeutectic containing dendrites of zinc-rich solid solution (Φ#183;-Zn) and the eutectic structure of zinc-rich solid solution together with a magnesium-rich phase, expected to be $Mg_2Zn_{11}$ (Figs. 1(b and c)). The alloy with 3 wt.%Mg is eutectic (Fig. 1(d)) and those with more than 3 wt.%Mg are hypereutectic containing primary $Mg_2Zn_{11}$ (Fig. 1(e)).

The electrochemical behavior of the zinc alloys was studied by hydrogen evolution reaction and potentiodynamic techniques at room temperature in 8.5 M KOH solution as the electrolyte. During hydrogen evolution reaction test, hydrogen overpotential decreased with increasing of the magnesium content (Fig. 2(a)). During the anodic range in the potentiodynamic polarization, corrosion on pure zinc occurred preferentially at grain boundary (Fig 3(a)), whereas with additional Mg contents, corrosion occurred preferentially on eutectic structure and formed zinc and magnesium oxides/hydroxide (Fig. 3(b-c)). From polarization curves (Fig. 2(b)), corrosion current density of the eutectic Zn-3wt.%Mg alloy is slightly higher than that of pure zinc, suggesting their alternative potential for use as the anode in zinc-air batteries.

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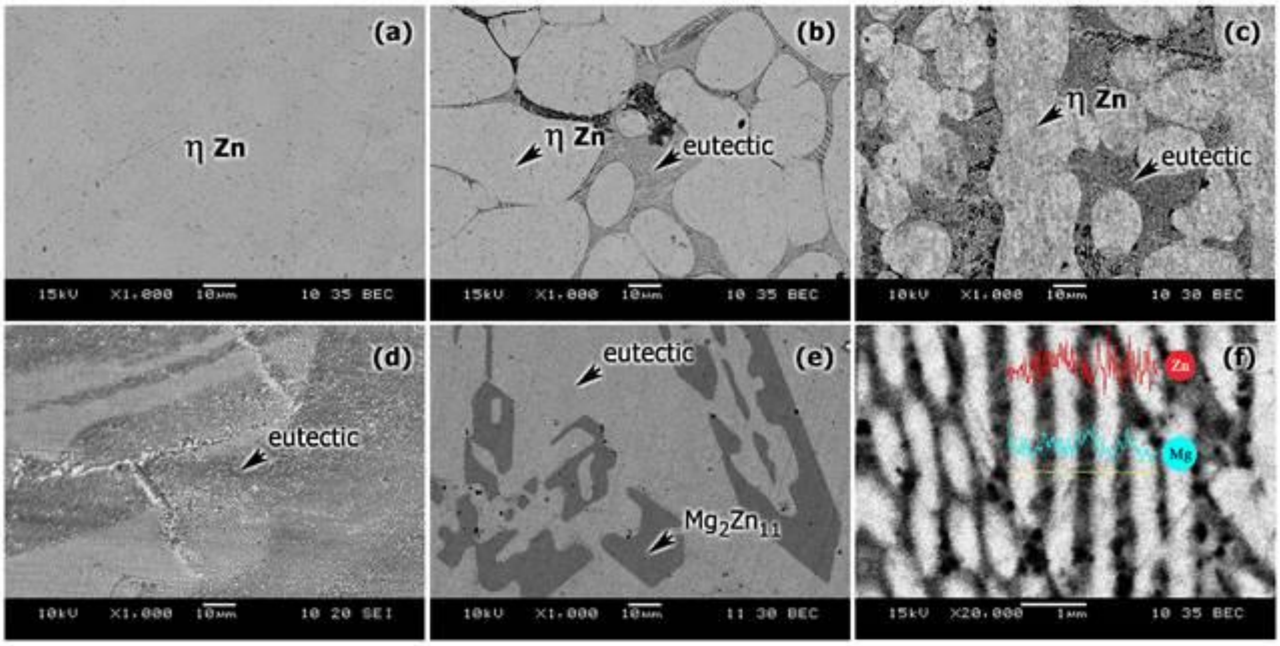


Figure 1 SEM-BEIs show the microstructure of Zn-Mg Alloys: (a) pure Zn, (b) Zn-0.1wt.%Mg, (c) Zn-1wt.%Mg, (d) Zn-3wt.%Mg, (e) Zn-5wt.%Mg, and (f) line scans across eutectic structure.

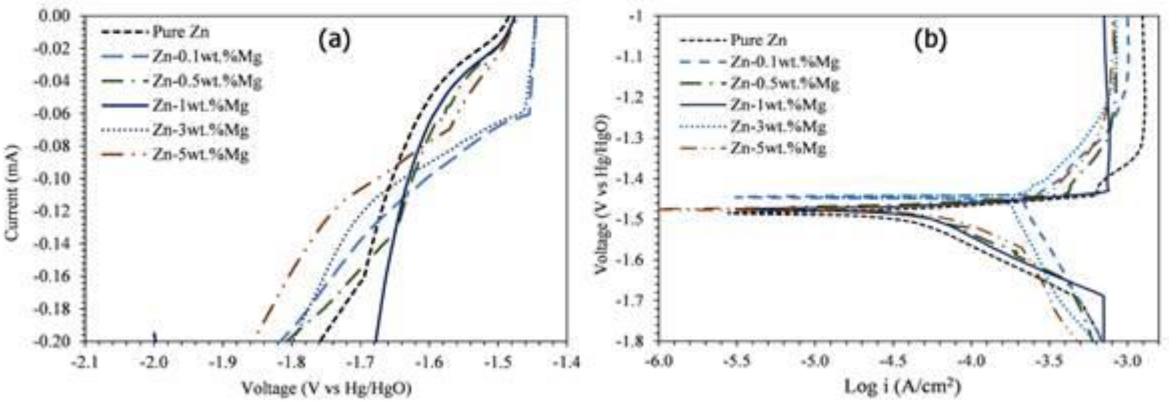


Figure 2 (a) cathodic polarization curves and (b) potentiodynamic polarization curves of pure Zn and Zn-Mg alloys at 1 mV/s in 8.5 M KOH solution.

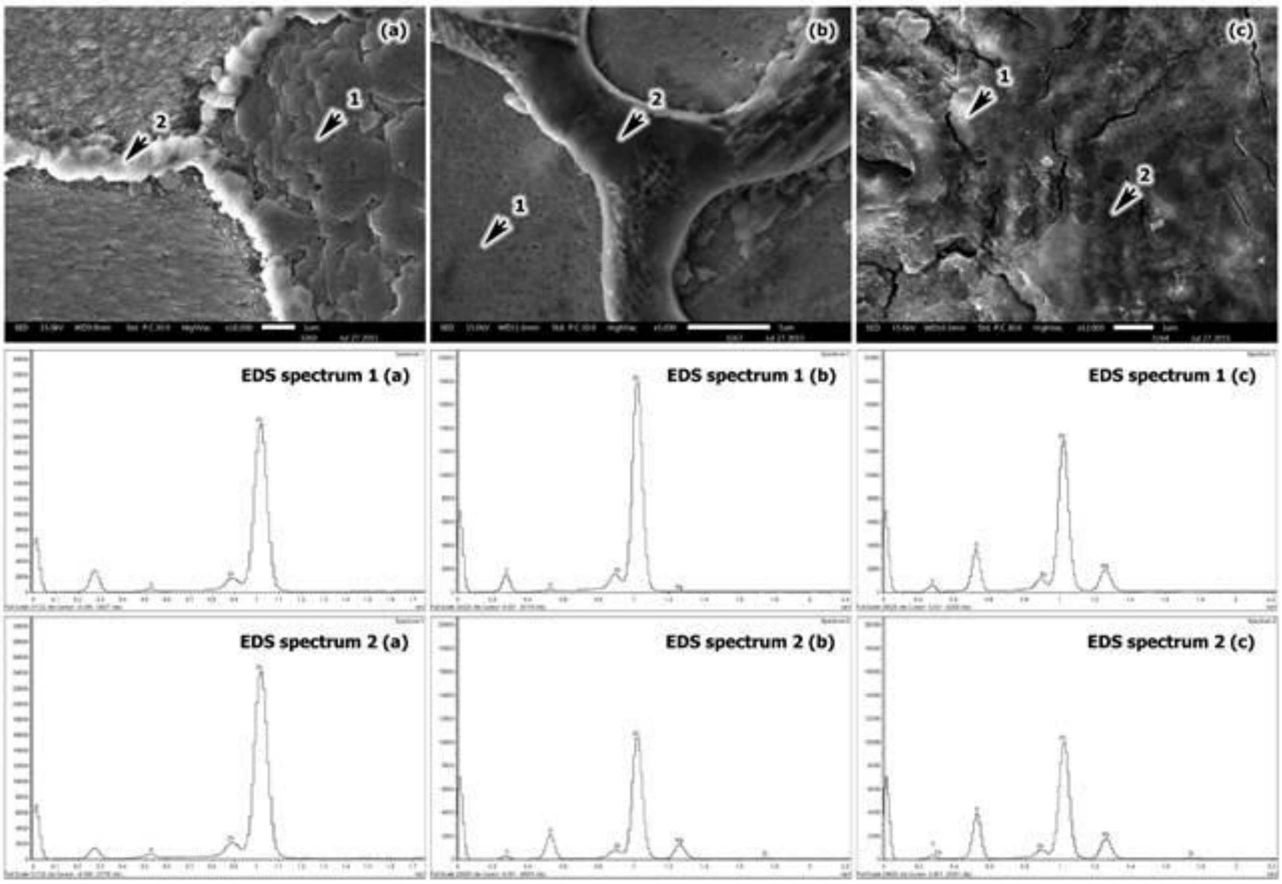


Figure 3 SEM-SEIs (a-c) show corroded surface after anodic polarization tests and EDS spectra from particular areas (marked 1 and 2). ((a) pure Zn, (b) Zn-1wt.%Mg, and (c) Zn-3wt.%Mg)