Citrate Gel Conversion Coating on AZ31 Magnesium Alloys

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On surface modification of magnesium alloys, chromate conversion coating was widely used for years due to its simplicity and outstanding corrosion protection. Regarding the toxicity of the hexavalent chromate, however, several kinds of conversion coating systems, including phosphate/permanganate, stannate, and cerium-based system, have been developed in recent decades. Nonetheless, these systems operated in aqueous solutions still have some common and inherent limitations, among which the formation of magnesium hydroxide is of the most importance. To overcome these limitations, a citrate gel conversion system is developed in this work.

Prior to conversion coating treatment, the AZ31 magnesium alloys were mechanically abraded up to 1200 grade emery paper. The specimen was then rinsed in deionized water and dried with an air stream. The citrate gel was basically prepared by dissolving supersaturated citrate with different amounts of cupric ion (Cu^{2+}) in glycerin. After applying the citrate gel on the specimen with a roller coater, the specimen was heated with a hot air stream to accelerate the reaction.

Citrate gel conversion coatings on the AZ31 were relatively thin because the scratches after abrading were still left visible. After the treatment without cupric ion added, as shown in Figure 1(a), small precipitates appearing in a flower-like shape were observed. Besides the flower-like precipitates, another kind of precipitates in a ball shape was formed as the cupric ion was added, as shown in Figure 1(b).

The results of potentiodynamic polarization curve are shown in Figure 2. This measurement was conducted by sweeping the potential from –100 mV vs. SCE to +500 mV vs. SCE at a scan rate of 1 mV/s after a steady open circuit potential (OCP) was reached. It was apparent that the citrate gel coating can efficiently inhibit the corrosion current density. Moreover, with the cupric ion added, the corrosion potential was markedly elevated. These results indicate that the citrate gel coatings on AZ31 alloys may provide enhanced corrosion protection.

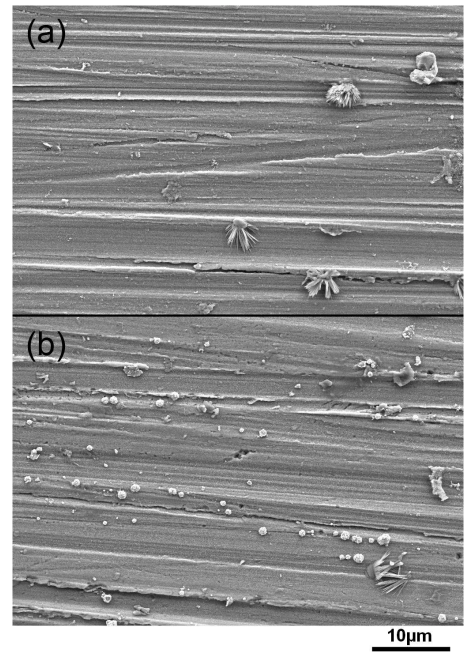

Figure 1 Surface morphology of the AZ31 alloy after citrate gel conversion coating with cupric ion concentration of (a) 0, and (b) 0.2 M added in gel preparation.

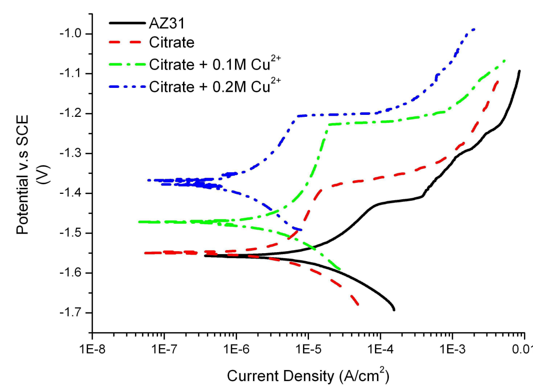

Figure 2 Potentiodynamic polarization curves of the various citrate gel coated AZ31 in a solution composed of 0.05 M NaCl and 0.10 M Na_2SO_4.

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