Effects of Zn^{2+} concentration and pH on the formation and growth of zinc phosphate conversion coatings on AZ31 magnesium alloy

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초 록: Magnesium alloys exhibit many attractive properties such as low density, high strength/weight ratio, high thermal conductivity, very good electromagnetic features and good recyclability. However, most commercial magnesium alloys require protective coatings because of their poor corrosion resistance. Attempts have been made to improve the corrosion resistance of the Mg alloys by surface treatments, such as chemical conversion coatings, anodizing, plating and metal coatings. Among them, chemical conversion coatings are regarded as one of the most effective and cheapest ways to prevent corrosion of Mg alloys.
In this study, the effects of various Zn^{2+} concentrations and pH levels on the formation of zinc phosphate conversion coatings (ZPCCs) on AZ31 magnesium alloy were investigated, and corrosion resistances of the coated samples were evaluated by immersion test and potentiodynamic polarization experiment. The corrosion resistance of the coated AZ31 samples was found to increase with increasing Zn^{2+} concentration and the lowest corrosion rate was obtained for the samples coated at pH of 3.07, independent of Zn^{2+} concentration. The best coatings on AZ31 were obtained at $[Zn^{2+}]$ = 0.068 M and pH 3.07. At the conditions of $[Zn^{2+}]$ = 0.068 M and pH 3.07, the formation and growth processes of ZPCCs on AZ31 Mg alloy are divided into four stages: formation of a dense layer, precipitation of fine crystals on the dense layer, growths of the inner and outer layers, and reorganization of outer crystalline layer.