Effects of phosphating bath compositions on the formation and structure of zinc phosphate conversion coatings on magnesium alloy AZ31

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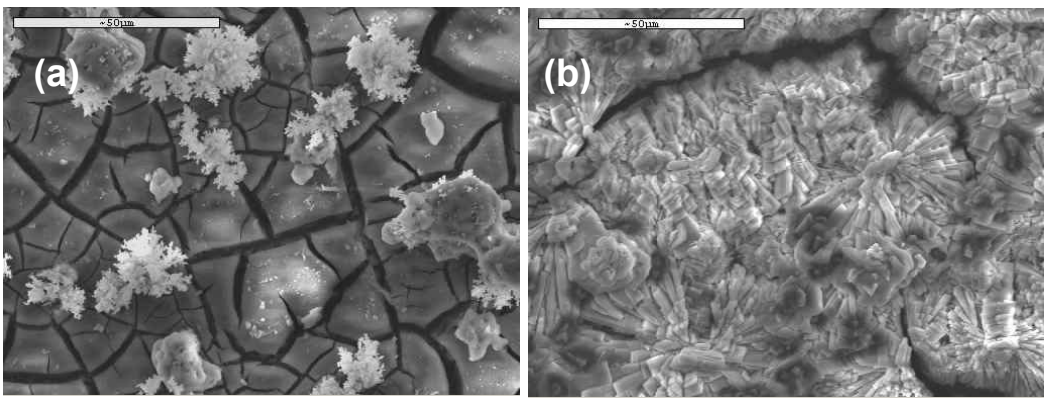
Abstract

This study discussed the formation of phosphate conversion coatings on AZ31 Mg alloy (AZ31) from the zinc phosphating bath with various concentrations of sodium fluoride (NaF). The effects of NaF on the formation, structure, composition and electrochemical behavior of the phosphate coatings were examined using scanning electron microscopy (SEM), X-ray diffraction (XRD) weight balances, open circuit potential (OCP) transients, potentiodynamic polarization curves and immersion test. The coatings were composed of two layers: an outer $Zn_2(PO_4)_3.4H_2O$ (hopeite) crystal layer and an inner amorphous of $MgZn_2(PO_4)_2$. NaF concentration is emphasized to be highly effective in the formation of the hopeite crystal and etching and coating rates. Potentiodynamic polarization and immersion test showed that the coatings formed in the zinc phosphating bath with addition of NaF have much higher corrosion resistance than bare AZ31.

Experimental results



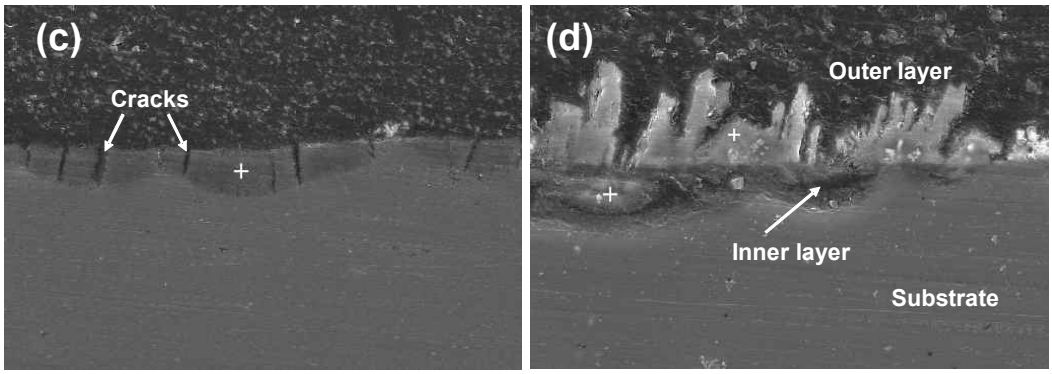


Fig. 1. SEM photographs of the phosphate coatings (a, b) and cross-sections (c, d) formed in the zinc phosphating solution with 0 g/L (a, c) and 1 g/L (b, d) NaF.

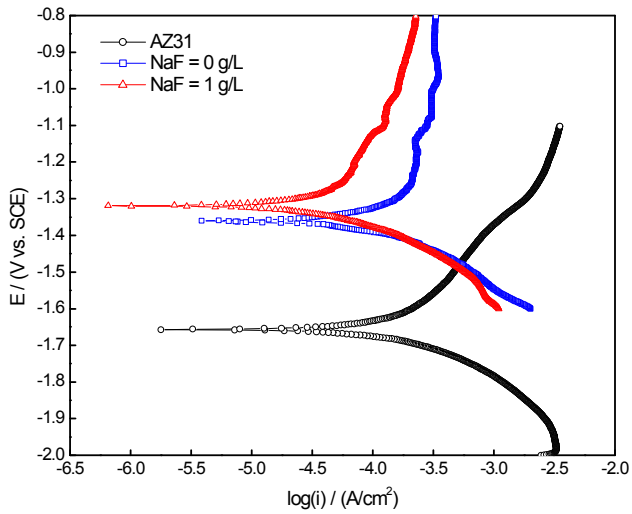


Fig. 2.
Potentiodynamic polarization curves of bare Mg AZ31 and phosphate coatings on Mg AZ31 treated in zinc phosphate bath with 0 and 1 g/L NaF immersed in borate solution (0.93 g/L H_3BO_3 and 9.86 g/L $Na_2B_4O_7$) at pH9.2.