Influence of layered double hydroxide (LDH) lateral size on corrosion resistance of AZ31 Mg alloy

MgAl-layered double hydroxides (MgAl-LDHs) are produced on AZ31 Mg alloy with different surface treatments (etching, etching and anodizing, etching and plasma electrolytic oxidation) by in-situ hydrothermal treatment. pH of the LDH solution, and time of hydrothermal treatment were changed and effect of experimental parameters on lateral size was investigated for the first time by scanning electronic microscopy (SEM), X-ray diffractometer (XRD), energy-dispersive spectrum (EDS), Fourier transform infrared (FTIR), and X-ray photoelectron spectroscopy (XPS) before and after immersion in 0.1 M NaCl solution. Moreover, effect of lateral size on corrosion resistance of substrates are observed by electrochemical impedance spectroscopy (EIS), hydrogen evolution test, and pH measurements. A comparison is made between corrosion resistance of LDHs on different surface-treated substrates, as well. Results showed a decrease of size with increasing pH and hydrothermal treatment time. Also, improved corrosion resistance of coatings was observed with decreasing lateral size of LDH, as a result of more compact and denser structure, which can prevent penetration of corrosive ions into the substrate. Finally, the influence mechanism of pH and time on lateral size was proposed. Most of studies have focused on the LDH growth under different conditions (pH, hydrothermal treatment time, and temperature). However, detailed structural study of lateral size difference in LDHs which influence thickness and compactness of the coating and subsequently the corrosion mechanism, have been ignored.

Key words:

Magnesium alloy corrosion, layered double hydroxide, anodizing, plasma electrolytic oxidation, hydrothermal treatment