The study of LDH properties on different surface pretreatments for application of biobased benzoxazine resin

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Despite the considerable properties of magnesium alloys, their usage has been limited due to their poor corrosion resistance. To address this issue, active and passive protection can be applied to enhance the long-term protection of Mg alloys. Polymeric coatings provide passive protection by acting as a physical barrier to avoid the reach of corrosive species to the substrate. Polybenzoxazine is a new type of phenolic resin that has attracted attention for coating applications due to its low dielectric constant, thermal stability, alkaline resistance, and hydrophobic behavior. Active corrosion protection decreases the corrosion rate after the physical barrier is damaged. Layered double hydroxide (LDH) can be formed for this purpose. Previous studies were focused on the pre-formed LDH as nanocontainers for corrosion inhibitors distributed in the matrix of the polymeric coating or the post-treatment of LDH with organic coatings for medical applications. In this study, the substrates were first treated by etching and plasma electrolyte oxidation (PEO) separately and then Mg-Al/LDH was formed by in-situ hydrothermal treatment. For the final step, samples were coated with benzoxazine resin using solvent casting method. The purpose of the study aims to investigate the effect of surface pretreatment on the formation of LDH and corrosion resistance of benzoxazine-coated substrates. The morphological, chemical, and crystalline properties of the LDH were observed using related tests, and the corrosion resistance of the LDH coating with and without benzoxazine was assessed by electrochemical impedance spectroscopy (EIS) and salt spray tests. Results revealed enhanced corrosion resistance after the formation of LDH. However, LDH on the etched surface could form a more homogenous coating after applying resin on the surface which led to long-term protection, unlike LDH on the PEO layer. It was shown that LDH on PEO couldn't cover the holes thoroughly causing penetration of resin into the holes and decreasing the thickness of the polymeric coating.

Keywords:

Magnesium, corrosion, plasma electrolyte oxidation, conversion coating, layered double hydroxide, organic coating, benzoxazine resin.