KNH101

Electrochemical Properties of Hybrid Coating Systems on Mg-based alloys with Plasma Electrolytic Oxidation Process as Pretreatment

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Magnesium and its alloys are the most electrochemically-active metals amongst engineering alloys. Surface preparation by plasma electrolytic oxidation (PEO) process prior to the application of organic layers on the surface of Mg alloys leads to the desired electrochemical properties. The oxide layer formed by the PEO process due to the in-situ growth mechanism has high adhesion strength to the surface and, owing to the process mechanism, consists of two dense inner and outer porous layers. Micro-pores and micro-cracks in its structure can act as suitable sites for mechanical interlocking to enhance the adhesion strength of organic layers to Mg substrates. Furthermore, a variety of corrosion inhibitors such as rare-earth (RE) elements (such as Ce, La, ...) were used as an additive in its structure to provide active corrosion protection properties. Another solution involves chemical optimization of the surface by introducing coupling agents to improve the chemical bond between the coating and the substrate. Coupling agents (such as silanes) act as a molecular bridge between the substrate and the coating and are capable of establishing covalent bonding or physical interaction or both, thereby enhancing adhesion. The performance of the silane layers can be further enhanced with the addition of components with corrosion-inhibiting properties. The effects of adding RE salts as dopants, as well as nanoparticles with inhibitory properties in silane solution, to produce a film with active corrosion protection and self-healing properties, have been investigated in our group. This paper introduces new milestone for surface treatment of Mg using PEO/Silane coatings with active corrosion protection and investigate their effects on the anticorrosion properties and adhesion strength of epoxy layer on Mg-based substrates. PEO process shows itself a suitable method for pretreatment of Mg-based alloys to design and fabricate suitable coating systems with superior corrosion resistance.

Keywords
Plasma Electrolytic Oxidation
Corrosion
Magnesium
Pretreatment
Conversion Coating