

Formation of Anodic Films on Pure Mg and Mg alloys for Corrosion Protection

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Abstract Mg and its alloys have been of great interest because of their low density of 1.7, 30% lighter than Al, but their wide applications have been limited because of their poor resistances against corrosion and/or abrasion. Corrosion resistance of Mg alloys can be improved by formation of anodic films using anodic oxidation method in aqueous electrolytes. Plasma electrolytic oxidation (PEO) is one of anodic oxidation methods by which hard anodic films can be formed as a result of micro-arc generation under high electric field.

PEO method utilize not only substrate elements but also chemical components in electrolytes to form anodic films on Mg alloys. PEO films formed on AM50 magnesium alloy in an acidic fluozirconate electrolyte were observed to consist of mainly ZrO_2 and MgF_2 [1]. Liu et al[2] reported that PEO coating on AM30 Mg alloy consists of MgF_2 -rich outer porous layer and an MgO-rich dense inner layer. PEO films prepared on ACM522 Mg die-casting alloy in an aqueous phosphate solution were also reported to be composed of monoclinic $Mg_3(PO_4)_2$ [3]. CeO_2 -incorporated PEO coatings were also reported to be formed on AZ31 Mg alloys in CeO_2 particle-containing Na_2SiO_3 -based electrolytes[4]. Magnesium tin hydroxide ($MgSn(OH)_6$) was also produced on AZ91D alloy by PEO process in stannate-containing electrolyte[5]. Effects of OH^- , F^- , PO_4^{3-} and SiO_3^{2-} ions and alloying elements of Al and Sn on the formation of PEO films on pure Mg and Mg alloys and their protective properties against corrosion have been investigated in this work. PO_4^{3-} , F^- and SiO_3^{2-} ions were observed to contribute to the formation of PEO films but OH^- ions were found to break down the surface films under high electric field. The effect of pulse current on the formation of PEO films will be also reported.

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