Development of micro-alloyed Bio-Mg alloys with promising degradation behavior

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Abstract Magnesium (Mg) and its alloys have attracting rising attention as one of biodegradable metallic materials due to its low density, high specific stiffness, high specific strength and good biocompatibility, which have been preliminarily applied in clinic. However, its rapid degradation rate and serious localized degradation can result in the rapid failure during service, which greatly limits its large-scale safety application. In this study, mico-alloying Mg0.5Zn-based alloys with high corrosion resistance were selected, for example Mg0.5Zn0.2Ge alloy[1, 2]. The addition of Ge can inhibit the cathode hydrogen evolution reaction, therebying improving the corrosion resistance of the alloy. Further micro-alloying of Ca into Mg0.5Zn0.2Ge alloy was also explored to further enhance the corrosion resistance and alleviate the localized corrosion of the alloy [3]. The addition of Ca leads to the transformation of the cathodic Mg_2Ge phase in Mg0.5Zn0.2Ca alloy into anodic MgCaGe phase in Ca-containing alloys, thereby changing the galvanic couples in alloys during immersion and improving the mechanical properties of the alloy. The preferential dissolution of MgCaGe phase promotes the participation of Ca and Ge into the formation of corrosion products, which stabilizes and passivates the corrosion product layer on Mg alloy surface. These factors confer a slower and more uniform corrosion on micro-alloyed Mg-Zn-Ge-Ca alloy, which provides favorable candidates for the suitable biodegradable Mg alloys.

Keywords Magensium alloy; Micro-alloyed; uniform degradation; cathodic phase

Reference

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