

Evaluating the localized corrosion of Mg alloys by the mechanical integrity of corroded alloys

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Abstract The degradation behavior of biodegradable Mg alloys has become a research hotspot in the fields about biodegradable metallic materials. The localized corrosion caused by the interphase potential differences and incompleteness of the corrosion product layer results in the premature failure of Mg alloys. While the most of the related publications mainly focused on the degradation rate of Mg-based materials, but rare to care about the changes of their mechanical properties during the immersion period, which can significantly affect their service performance. The link between residual strength and Mg degradation is not appreciated enough. In this work, a series media were constructed based on Hanks' solution, the effects of inorganic ions and albumin on the degradation rate and mechanical integrity of Mg-Zn-Y-Nd alloy were investigated. Mechanical tests after corrosion were employed to indirectly but generally reflect the localized corrosion of Mg alloy in the protein-containing electrolytes. The results indicated that the degradation behavior of Mg alloy was mainly controlled by degradation products and there is no direct correspondence between the degradation rate change and mechanical integrity of Mg alloy. The albumin alters the Mg corrosion mode to uniform corrosion and an appropriate amount of protein is beneficial for maintaining its mechanical bearing capacity.

In addition, the effects of selected corrosion inhibitors on the corrosion rate and localized corrosion behavior of magnesium alloy were compared. It is found that some corrosion inhibitors fail to inhibit the localized corrosion of magnesium, resulting in the inability to effectively maintain the mechanical bearing capacity of the corroded magnesium alloy.

The relevant findings are beneficial for selecting the monitoring index in Mg corrosion tests, evaluating the service reliability of Mg alloys for biomedical applications, and establishing reasonable screening and evaluation criteria for magnesium alloy corrosion inhibitors.