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Corrosion Response of Friction Stir Processed Mg-Zn-Zr-RE Alloy

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Abstract : Magnesium alloys are increasingly being considered for structural systems across different industrial sectors, including precision components of biomedical devices, owing to their high specific strength, stiffness and biodegradability. However, Mg alloys exhibit a high corrosion rate that restricts their application as a biomaterial. For safe use as biomaterial, it is essential to control their corrosion rates. Mg alloy corrosion is influenced by several factors, such as grain size, precipitates and texture. In Mg alloys, microgalvanic coupling between the α-Mg matrix and secondary precipitates can exist, which results in an increased corrosion rate. The present research addresses this challenge by engineering the microstructure of a biodegradable Mg–Zn–RE–Zr alloy by friction stir processing (FSP), a severe plastic deformation process. The FSP-processed Mg alloys showed improved corrosion resistance and mechanical properties. FSPed Mg alloy showed refined grains, a strong basal texture and broken and uniformly distributed secondary precipitates in the stir zone. Mg, alloy base material, exposed to In vitro corrosion medium showed micro galvanic coupling between precipitate and matrix, resulting in the unstable passive layer. However, FS processed alloy showed uniform corrosion owing to stable surface film formation. The stable surface film is attributed to refined grains, preferred texture and distribution of precipitates. The research results show promising potential for Mg alloy to be developed as a biomaterial.

Keywords : biomaterials, severe plastic deformation, magnesium alloys, corrosion
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