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Comparative Study of the Corrosion Resistance of Magnesium and Zinc in Simulated Body Fluid

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Abstract

The use of metal plates currently available to fix bone fractures requires a second surgery to remove the plate, increasing the risk of infection, complicating recovery and increasing the cost of medical care. Stainless steel and cobalt-chromium (Co-Cr) alloys cause problems of compatibility with bone tissue, such as inflammation, corrosion and the release of metal ions that affect bone health and regeneration. In response to these problems, resorbable materials have been developed, with magnesium (Mg) standing out for its biocompatibility, mechanical properties and controlled degradation rate, which makes it suitable for temporary fixation devices and avoids the need for a second surgery. However, research continues on the addition of zinc (Zn) to magnesium alloys, as it can improve mechanical properties and control corrosion rates. Based on microstructural analysis, electrochemical and microhardness tests on three Mg and Zn alloys (Mg1.4Zn, Mg5.3Zn, and Mg7.8Zn), which were manufactured by levitation induction melting, it was determined that the samples have an α-Mg matrix with intermetallic phase precipitation in the microstructure of the samples. Furthermore, it has been demonstrated that corrosion resistance is enhanced by decreasing the Zn content, while Vickers hardness values are elevated by increasing Zn percentages. These findings suggest that, by carefully adjusting the zinc concentration in Mg alloys, it is possible to optimize the balance between corrosion rate and mechanical integrity, which is crucial for the development of resorbable implants that promote bone healing without the drawbacks associated with permanent metal implants.

Keywords: Mg-Zn alloys, Levitation induction melting, Microstructure, Corrosion, Microhardness