RESUMO - BIOMATERIAIS

COMPARATIVE ASSESSMENT OF MG-10ZN AND MG-20ZN ALLOYS AS POTENTIAL BIODEGRADABLE IMPLANTS

Israel Ramos Rodrigues (israel.ramos@unesp.br)

Carlos Roberto Grandini (carlos.r.grandini@unesp.br)

Sophia Alexandra Tsipas (stsipas@ing.uc3m.es)

Sandra Carolina Cifuentes Cuéllar (sandra.cifuentes@urjc.es)

Magnesium (Mg) alloys are increasingly recognized as advanced biomaterials, offering an ideal combination of biodegradability, biocompatibility, and mechanical properties that mimic bone. The incorporation of zinc (Zn) is a common strategy to enhance the biological response, as Zn is known to promote cell proliferation and provide antibacterial effects. This investigation focuses on the production of Mg10Zn and Mg20Zn (in wt.%) alloys via the powder metallurgy (PM) route. The resulting materials were extensively evaluated for their corrosion behavior and in vitro biocompatibility to determine their suitability for biomedical applications.The Mg10Zn and Mg20Zn alloys were synthesized using a conventional PM process. The initial powders were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM) to determine phase composition and morphology, respectively. The powders were uniaxially pressed into green compacts at 500 MPa, followed by sintering at 500°C for 5 hours in an inert argon atmosphere.Corrosion performance was assessed in 3.5 wt.% NaCl solution via electrochemical methods, including open-circuit potential (OCP) monitoring, polarization resistance (Rp), Tafel polarization (scan parameters: 1 mV/s from -1.5 V to -0.8 V), and electrochemical impedance spectroscopy (EIS). The biological response was evaluated by monitoring pH changes during immersion in PBS for 7 days and by assessing cell viability at 24 and 72 hours using an MTT assay.Microstructural analysis confirmed the formation of MgZn intermetallic phases, which are known to affect degradation and mechanical behavior. SEM observations highlighted differences in powder processing: atomized powders exhibited a homogeneous Zn distribution, whereas mechanically mixed powders resulted in Zn agglomeration. The electrochemical evaluation focused on polarization resistance (Rp) to compare corrosion behavior. After 30 hours of immersion, the Mg10Zn alloy (Rp 201.6 $\Omega \cdot cm^2$)demonstrated greater corrosion resistance than the Mg20Zn alloy (Rp 183.1 $\Omega \cdot cm^2$). The Mg20Zn sample exhibited a decline in Rp over time, indicating a less stable protective layer. This reduced stability is likely attributable to the higher Zn concentration, which may promote the formation of secondary phases that accelerate localized galvanic corrosion.In terms of biological performance, MTT assays showed favorable cell viability for both compositions at 24 and 72 hours, with the Mg10Zn alloy demonstrating a slightly superior result. Furthermore, pH monitoring in PBS confirmed controlled degradation, remaining within a physiologically acceptable range. In summary, the Mg10Zn alloy presented a superior overall balance between electrochemical stability and biocompatibility compared to the Mg20Zn alloy. These results suggest that Mg10Zn is a more promising candidate for use in biodegradable medical devices. The study underscores the critical importance of optimizing both the Zn content and the PM processing route to achieve the desired control over corrosion kinetics and biological performance in Mg-based alloys

Palavras-chave: magnesium-zinc alloys powder metallurgy biocompatibility.