Reviews on Advanced Materials and Technologies, 2025, vol. 7, no. 2, pp. 71–78
DOI: 10.17586/2687-0568-2025-7-2-71-78

Effect of Mg Content on the Structure, Properties and Cytotoxicity of Biodegradable Zn-Fe-Mg Alloys

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Abstract. Interest in biodegradable materials for temporary implants based on zinc alloys has been growing annually. The Zn-Fe-Mg alloys are of special interest, as each of its constituent elements is independently considered as biodegradable metallic material. This study presents a comprehensive investigation of the Zn-1%Fe-1%Mg and Zn-1%Fe-5%Mg alloys subjected to high-pressure torsion. A comparative analysis was conducted on the microstructure of the alloys in both as-cast and deformed states, highlighting differences in their phase composition, strength and cytotoxicity. When the magnesium content exceeds 3 wt.%, an additional phase ($MgZn_2$) precipitates alongside the existing Mg_2Zn_{11} phase. Deformation processing of the Zn-1%Fe-1%Mg alloy effectively reduces its brittleness and promotes a more homogeneous distribution of the Mg_2Zn_{11} eutectic throughout the sample volume. In contrast, the Zn-1%Fe-5%Mg alloy retains excessive brittleness even after deformation. The addition of magnesium was found also to accelerate corrosion rates. Nevertheless, the strength, corrosion, and cytotoxicity properties of the Zn-1%Fe-1%Mg alloy meet the requirements for biodegradable materials.

Acknowledgements. The work was carried out at the expense of the academic leadership program of the Ufa University of Science and Technology (PRIORITY-2030). The research part of the work was carried out using the equipment of the Core Facility Centre “Nanotech” of Ufa University of Science and Technologies.

Citation: Rev. Adv. Mater. Technol., 2025, vol. 7, no. 2, pp. 71–78

View online: https://doi.org/10.17586/2687-0568-2025-7-2-71-78

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