Transactions on Additive Manufacturing Meets Medicine
Trans. AMMM, 2026, Vol. 8, No 1, Suppl. 1, Article ID 2782, 1 Page

Infinite Science Publishing

Abstract

Microstructural and corrosion characterization of dual α(Mg) + β(Li) phase Mg-Li-Ca alloy produced by PBF-LB

A. Zielińska[1*], A. Dobkowska[1*], F. D'Elia[2], Č. Donik[3], M. Godec[3], and W. Święszkowski[1]

[1] *Warsaw University of Technology, Poland*
[2] *Uppsala University, Sweden*
[3] *Institute of Metals and Technology, Ljubljana, Slovenia*
[*] *Corresponding author, email: aleksandra.zielinska3.dokt@pw.edu.pl, anna.dobkowska@pw.edu.pl*

Metallic bioabsorbable materials, especially those based on magnesium (Mg) are emerging as promising candidates for temporary bone implants. These metals are designed to degrade in a controlled manner once they have fulfilled their therapeutic functions, ensuring they are safely assimilated without causing adverse reactions in the human body [1]. While magnesium alloys have desirable Young modulus close to human cortical bone, their rapid corrosion rate limits their broader application. Despite this, there are examples of magnesium alloy implants that are currently in clinical use, like Magnezix compression screws or orthopaedic Mg-Ca alloy Resomet bone screws [2].

In this study, an ultralight dual-phase Mg-8Li-0.5Ca wt.% (magnesium-lithium-calcium) alloy was successfully fabricated using powder bed fusion - laser beam (PBF-LB). Processing parameters were optimized to minimize defects such as porosity or crack initiation. The resulting as-built microstructure consists of α(Mg) and β(Li) phases containing micro- and nano- scale precipitates. This dual phase structure is a great comparison between single α(Mg) and single β(Li) alloys, and provides good formability with optimized mechanical properties. Compared to cast counterparts, PBF-LB alloy exhibited a modified phase distribution and extreme grain refinement, achieving grain sizes below 2 µm. The impact of these microstructural modifications on the alloy's degradation profile was subsequently evaluated using electrochemical and immersion tests, as well as surface analysis of the corrosion products. Although degradation was primarily driven by microgalvanic coupling between the α(Mg) and β(Li) phases, the refined and homogeneous microstructure of the PBF-LB alloy resulted in significantly more controlled degradation kinetics relative to the cast material. In addition, the materials were tested for cytotoxicity. An indirect assay using L929 cells confirmed that the materials were biocompatible after 1, 3 and 5 days. These initial studies indicate the potential of additively manufactured Mg-Li-based alloys in the field of biomaterials.

Author's statement

Conflict of interest: Authors state no conflict of interest. Informed consent: Informed consent has been obtained from all individuals included in this study. Acknowledgments: This work was funded by the National Science Centre, Poland under the Preludium programme (project No. 2024/53/N/ST11/03437).

References

[1] A. R. Khan, N. S. Grewal, C. Zhou, K. Yuan, H. Zhang, Z. Jun, Recent advances in biodegradable metals for implant applications: Exploring in vivo and in vitro responses, Results in Engineering 20 (2023) 2590-1230,
[2] R. Karunakaran, S. Ortgies, A. Tamayol, F. Bobaru, M.P. Sealy, Additive manufacturing of magnesium alloys, Bioact Mater 5 (2020) 44–54.

DOI: 10.18416/AMMM.2026.26062782