

## Student Speech Contest 2025

# Effect of calcium-based bio ceramics addition on biological performance and bio degradation rate of Mg-based scaffolds for bone tissue engineering applications



**Name of the student.** Maryam Mehdizade

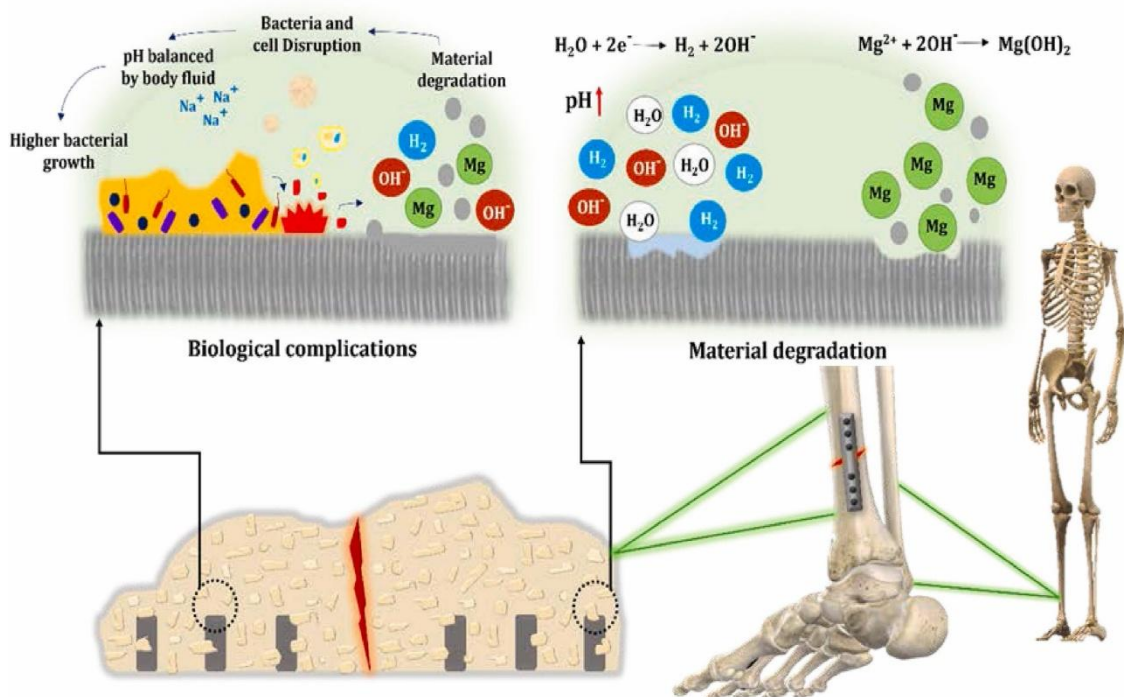
**Contact mail.** Maryam.mehdizade@pg.edu.pl

**Institution(s) / lab.** Department of Functional Materials Engineering

**Project.** calcium-based bio ceramics for improvement biocompatibility of metallic biomaterials

**Topic / keyword.** Ca-based bioceramic, biocompatibility, bioactivity, biodegradation

### Abstract.



Mg based biomaterials due to their bio absorbability are promising candidates for temporary orthopedic implants. The main issue in their medical application is related to making a balance between biological performance, biodegradability rate, and mechanical integrity simultaneously during the healing period. The present research tries to improve biological performance, control the biodegradation rate and increase mechanical properties by addition of Ca-based bioceramic particles and microstructural modification. For this purpose, Hydroxyapatite ( $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$ ), Wollastonite ( $\text{CaSiO}_3$ ), Akermanite ( $\text{Ca}_2\text{MgSi}_2\text{O}_7$ ), and Hardystonite ( $\text{Ca}_2\text{ZnSi}_2\text{O}_7$ ) were added to the Mg matrix by friction stir processing (FSP). SEM characterization showed that applying 6 passes of FSP resulted in significant grain refinement of Mg matrix, fragmentation and uniform redistribution of secondary phase particles, and homogenous dispersion of bioceramics which play a vital role in reducing biodegradation rate and corresponded improved cellular activity and mechanical properties. The addition of

Ca-based bioceramic with Ca, P and Si release increased the bioactivity and resulted in the formation of apatite compounds on the surface of samples which was beneficial for biocompatibility and cellular activity, as well as controlling biodegradation rate. Indeed, fabricated composites in contact with MC3T3-E1 mouse osteoblast cells showed improved cell attachment, cell viability, and ALP activity. Our findings propose that fabricated Mg-based composites are biocompatible and strong enough for use inside human body.

In addition, the controlled release of calcium ions not only enhanced bioactivity but also promoted favorable conditions for osteoblast proliferation and differentiation, which are key factors in bone tissue regeneration. The combination of improved mechanical properties with biological functionality highlights the ability of these composites to provide temporary structural support during the healing process while gradually resorbing in a controlled manner. This avoids complications commonly associated with permanent implants and eliminates the need for secondary surgical removal. Altogether, these outcomes confirm that Mg-based composites reinforced with Ca-containing bioceramics are promising candidates for next-generation biodegradable implants, capable of meeting the complex requirements of orthopedic and dental applications.

## References.

1. Maryam Mehdizade, Pooneh Rostamian, Omar Esmailzadeh, Morteza Tayebi, Vahab Dehlaghi, Ali Reza Eivani, Biofunctionalization of WE43 Mg Scaffolds with Calcium-Based Bioactive Ceramics for Enhanced Bone Regeneration, Results in Engineering, 2026, 30, 110025, <https://doi.org/10.1016/j.rineng.2026.110025>.
2. Maryam Mehdizade, Ali Reza Eivani, Hamed Asgari, Yashar Naghshin, Hamid Reza Jafarian, Assessment of microstructure, biocompatibility and in-vitro biodegradation of a biomedical Mg-Hydroxyapatite composite for bone tissue engineering, 2023, 27, 852-875, Journal of Materials Research and Technology, <https://doi.org/10.1016/j.jmrt.2023.09.245>.