Surface Modification of Mg-Zn-Ca alloy by Plasma Electrolytic Oxidation for Biodegradable Implants

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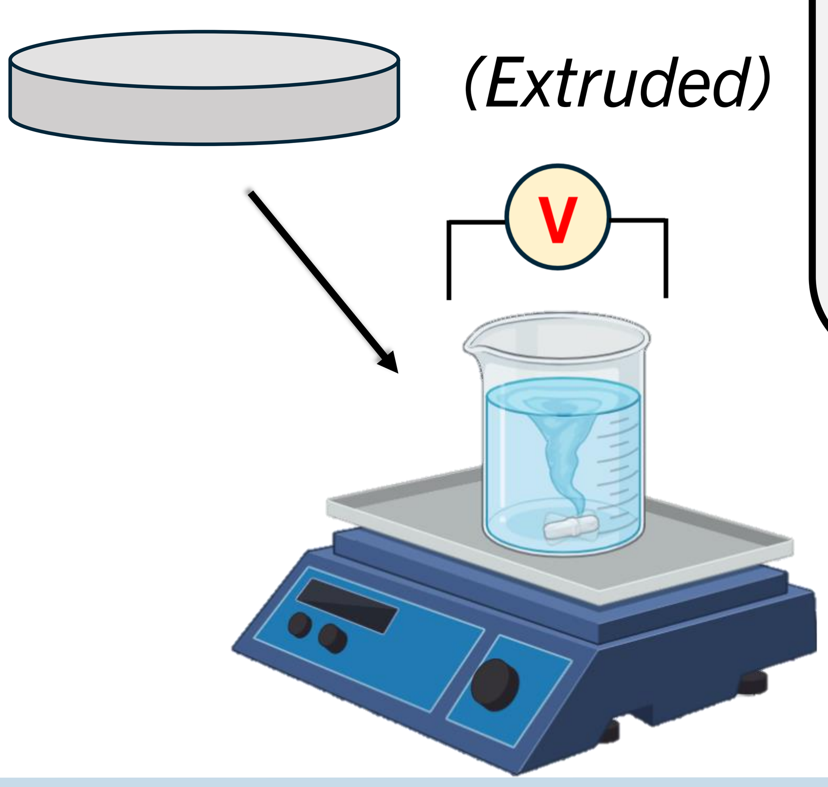
Biometals in Tissue Engineering

Metals used for tissue engineering applications, such as Mg alloys, seek to gradually degrade while the damaged tissue heals without any adverse response from the body[1]. Different strategies can be followed to tailor their corrosion and biological properties depending on the application, such as PEO surface treatments, to improve their corrosion resistance and cell-material interaction[2], or additive manufacturing techniques, to obtain complex shape devices.

PEO processing

Mg - 2.6Zn - 0.1Ca

(Extruded)

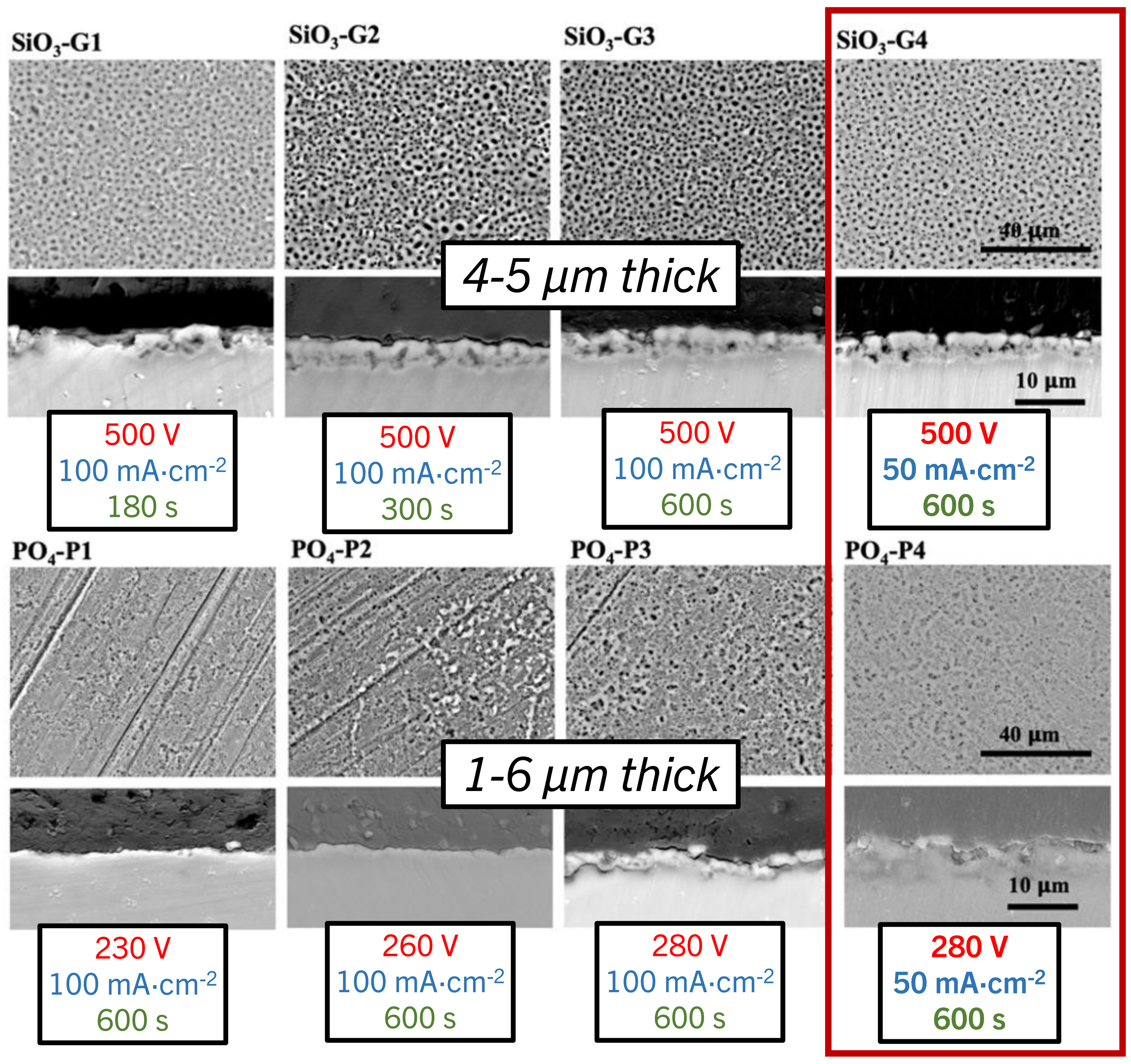


Optimized PEO parameters

Voltage
Current density
Time

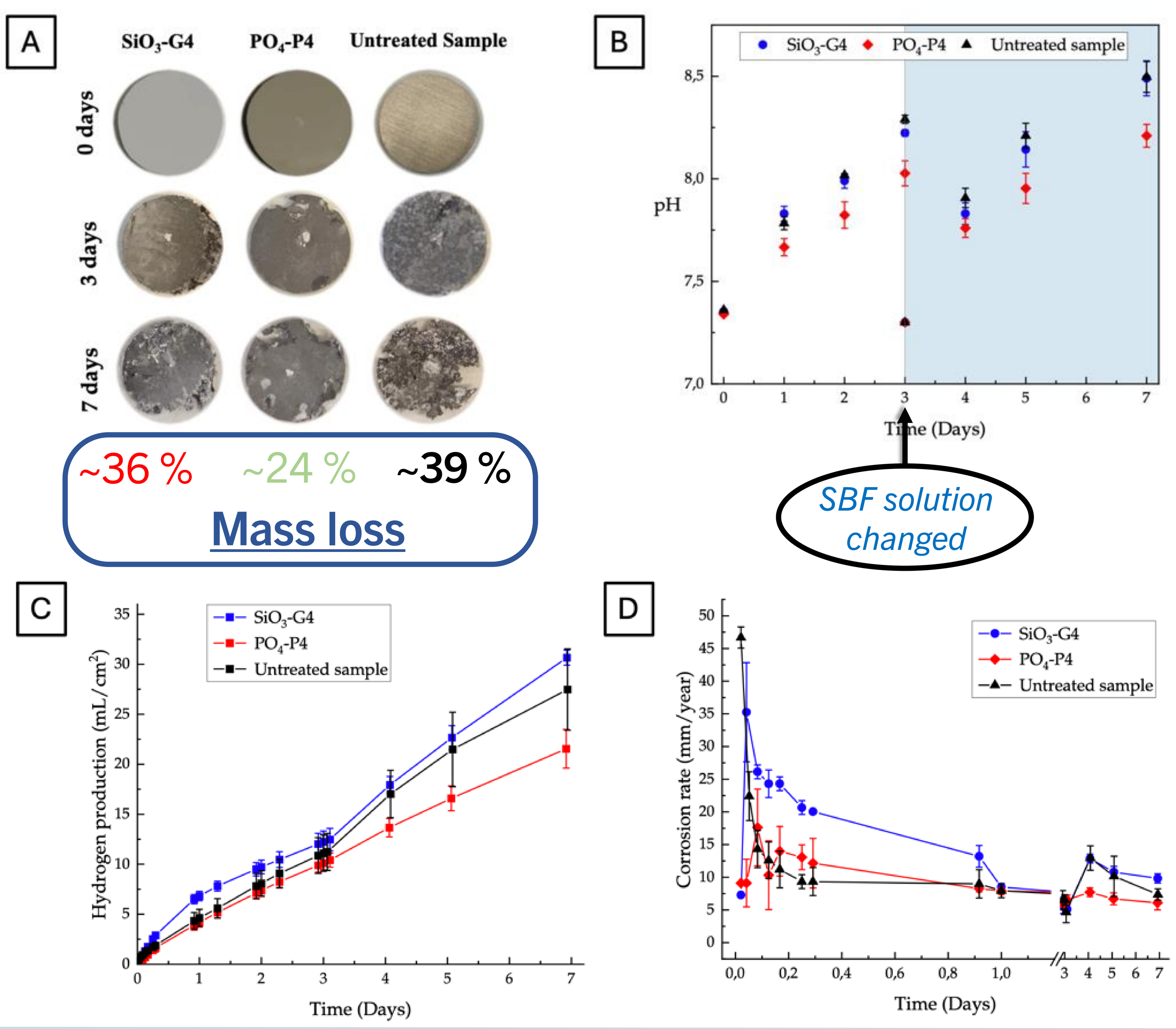
Electrolytes
SiO_3 based
PO_4 based

Surface & Cross-section

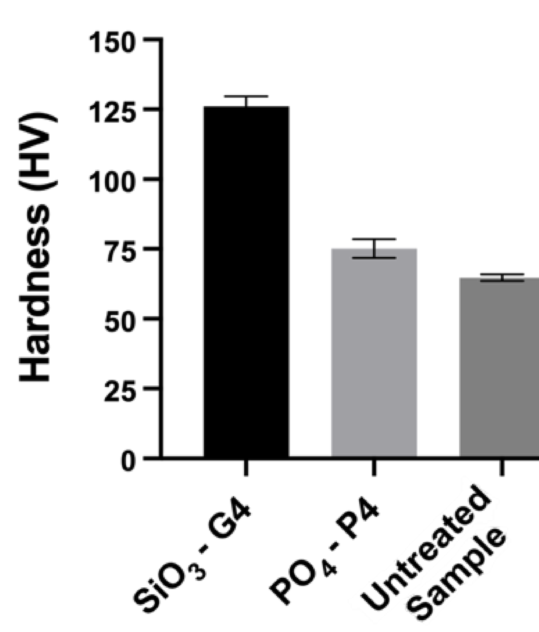


Selected for further characterization

Corrosion test



Hardness

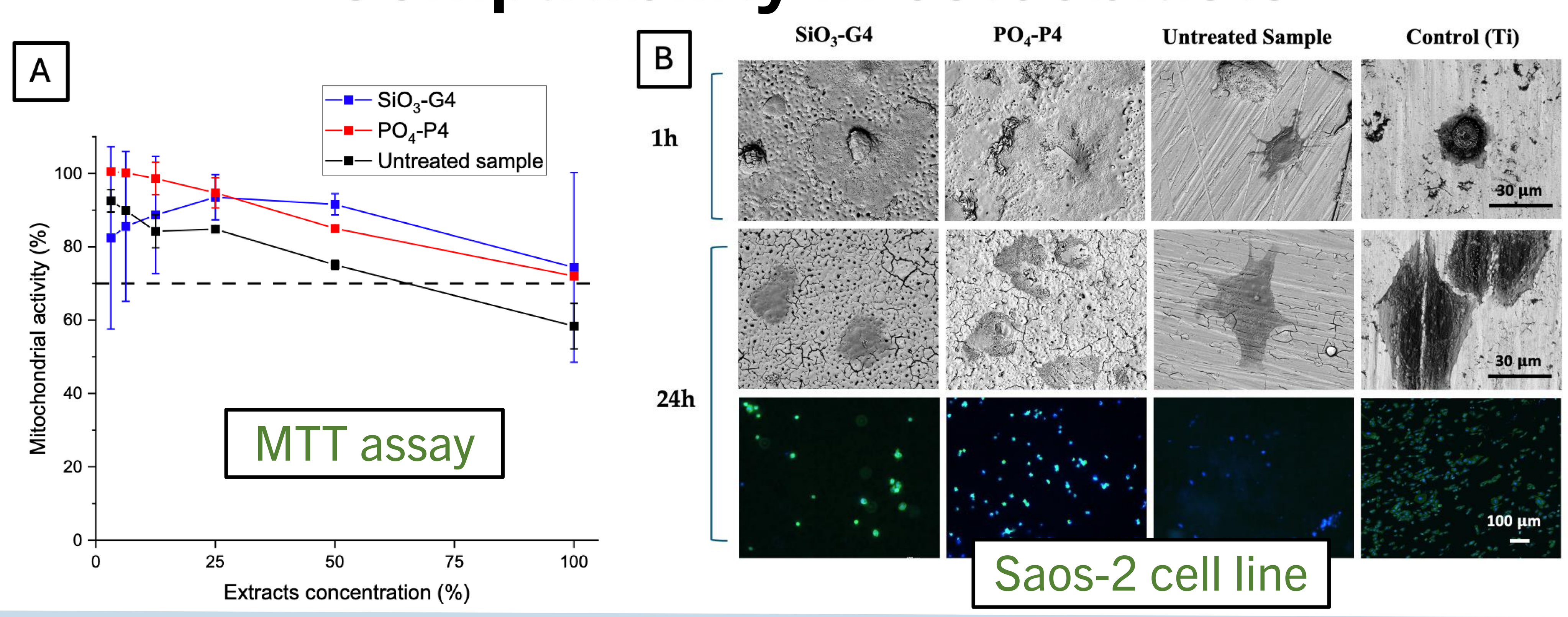


Hardness increase due to PEO

SiO_3-G4 → 95 %

PO_4-P4 → 16 %

Compatibility in osteoblasts



Conclusions

- The SiO_3-based PEO showed similar thicknesses after PEO parameters optimization, while for PO_4-based PEO the bigger thicknesses were obtained for higher voltages (280 V)
- SiO_3-G4 PEO almost doubled Mg-Zn-Ca alloy hardness
- Both PEO coatings decreased cytotoxicity and increased number of cells attach to the surface
- **PO_4-P4 PEO** increased corrosion resistance for the Mg-Zn-Ca alloy (**selected PEO for SLM**)

References

[1] M. Hedien et al, J Biotechnol Biomateri (2015), 5:2

[2] Esmaelli, M. Et al., Surface innovations (2021), 9(4): 184-198.

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