DESIGN AND FABRICATION OF CALCIUM PHOSPHATE SCAFFOLDS WITH CONCAVE SURFACES BY DIRECT INK WRITING

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☒ Oral presentation ☐ Poster presentation

ABSTRACT

Osteoinductive biomaterials are those capable to induce the osteogenesis process, by stimulating pluripotent stem cells to differentiate into bone-forming cells [1]. Such biomaterials hold great potential in bone regeneration applications. Recent studies have shown that osteoinduction is highly benefited from the presence of concave surfaces [2]. This represents a challenge for the application of extrusion-based 3D printing techniques in the fabrication of synthetic bone grafts, due to the convex surface of the extruded filaments. The aim of this project was to overcome this limitation by developing a novel method that relies on the fabrication of personalized calcium phosphate scaffolds with concave surfaces by the infiltration of sacrificial polymeric moulds and their subsequent dissolution. The goal was to obtain ceramic scaffolds with concave porosity which was the negative of the polymeric mould printed by direct ink writing (Figure 1). Printing parameters such as infill density and layer height were modified and their effect on scaffold porosity and mechanical properties was analysed. Infill density did not affect the pores' geometry or dimensions but increasing infill densities of the printed moulds increased porosity and decreased the compressive strength. Layer height affected pore size and their geometry, as oval pores were obtained for smaller layer heights. This translated into lower porosity values and, as a consequence, lower compressive strengths. We concluded that the use of sacrificial moulds is a promising approach to obtain ceramic scaffolds with concave porosities that could promote osteoinduction.

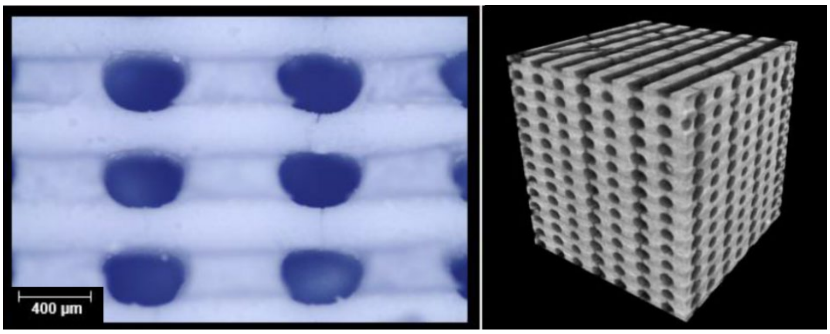

Figure 1: Representative overview of a ceramic scaffold with 40% infill and 0.3mm layer height with concave porostiy by optical microscopy (left) and microCT (right)

References

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[2] Barba, A., Diez-Escudero, A., Maazouz, Y., et al. ACS applied materials & interfaces, 9, 48 (2017) 41722-41736

Acknowledgments: Spanish Ministry of Science, Innovation and Universities through project PID2019-103892RB-I00/AEI/10.13039/5011000110 33