MICROSTRUCTURAL CHARACTERIZATION OF BIOSILICATE SCAFFOLD OBTAINED BY MATERIAL EXTRUSION ADDITIVE MANUFACTURING

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SUMMARY

Biosilicate (BioS) glass-ceramic is distinguished by its high biocompatibility, bioactivity, and crystallinity, being a material widely investigated in the repair of bone and dental lesions [1]. This work aims to obtain BioS scaffolds from a ceramic ink based on a sacrificial hydrogel by material extrusion Additive Manufacturing (AM). Poly(ethylene glycol) (PEG-400) with 7.5% (w/w) of Laponite nanosilicate were used to obtain the sacrificial ink. Laponite was used as a rheological modifier of the PEG solution. Hydrogels are polymeric materials with cross-linked chains capable of retaining a huge amount of water in their structure without collapsing [2]. Despite the

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growing number of existing inks, there is a lack of studies specifically addressing sacrificial inks [3,4]. This is one of the most promising approaches to obtain ceramic structures for bone regeneration repair. In this way, bioceramic scaffolds based on Biosilicate were developed and characterized, using a hydrogel as a sacrificial ink for material extrusion AM. Initially, the rheological behavior of sacrificial ink and ceramic paste with 70% (v/v) Biosilicate content (PL-BioS) was evaluated. The viscosity of the sacrificial ink increased with the addition of Biosilicate, demonstrating appropriate pseudoplastic behavior for the material extrusion. 3D printed structures were dried at 20°C, and their dimensional characteristics were evaluated; they present a low degree of shrinkage and loss mass before sintering. Preliminary dilatometric tests were performed to define the sintering parameters, and thus, the scaffolds were sintered at 900 °C - 5h with a heating rate of 1 °C/min. The sintered scaffolds were analyzed by FTIR spectroscopy, X-Ray diffraction, and Scanning Electron Microscopy, demonstrating that the sacrificial ink is eliminated from the structure without changing the composition and remaining intact after this process, even with the formation of micropores inside the filaments. *In vitro* tests of fibroblasts (NHI-3T3 cells) adhesion on Biosilicate scaffolds were performed as a preliminary biological evaluation, showing good interaction after two days of culture. In conclusion, the use of sacrificial ink hydrogels combined with Biosilicate has shown to be promising for formulating a ceramic ink, which could be potentially used in bone tissue engineering through material extrusion AM.

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