3D printed biomimetic polylactic acid/graphene oxide scaffolds for bone tissue engineering

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Tissue engineering is a multidisciplinary science aimed to develop innovative solutions to promote tissue regeneration, specifically driven by instructive biodegradable scaffolds. A number of functional characteristics should be therefore provided to the seeded cells, including biomimetic and bioactive cues.
In this regard, the proposed study is focused on the optimisation of bone tissue engineered scaffolds, designed to morphologically mimic the bone trabecular microarchitecture, and on the assessment of graphene oxide (GO) as a potential nanofiller to enhance cell response. GO is a 2D carbon single layer covalently bonded to oxygen functional groups which concur to deal with a strongly hydrophilic material capable to modify the structural and interfacial properties of composites. In addition, this nanomaterial has been consistently evaluated for bone tissue engineering applications as may support tissue healing and contribute to the osteogenic stem cells differentiation.
Starting from these considerations, an experimental investigation was carried out preparing 3D printed biomimetic scaffolds by means of the fused deposition modelling (FDM) technique, processing a custom-made composite filament with two different GO contents, i.e., 0.05 wt% and 0.2 wt%, in a polylactic acid (PLA) matrix.
Raman spectroscopy was performed to verify the presence and distribution of GO powder within the fabricated models, while differential scanning calorimetry (DSC) allowed to analyse the thermal properties of the neat and composite devices. Biological assays were then carried out seeding human amniotic mesenchymal stromal cells (hAMSCs) onto 3D printed scaffolds to evaluate biocompatibility and cell-scaffold interaction.

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