3d microfluidic bioprinting of foamed fibres for hierarchical fabrication of skeletal substitutes

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Recently, microfluidic-based systems have emerged as advanced tools to control micro-porosity with the production of tailored emulsions and foams. Particularly, the combination of microfluidic devices with 3D printing systems allows for an unprecedented micro- and macro-architectural control of 3D fabrication process. In this work, we report a new strategy for 3D printing fiber-based scaffolds with controllable intra-fiber porosity that harnesses a flow focusing microfluidic platform combined with a novel microfluidic-based printhead. The characterisation of the foaming process showed the potential to form air bubbles up 2 kHz with a size ranging from 24±1 to 73±3 µm. By modulating the biomaterial ink flowrate between 25 and 40 µL/min, the air volume fraction inside fibers was introduced up to 60% of the total volume. Notably, we reported the printing of single- and multi-porosity scaffolds to control mechanical properties and cell functionality for skeletal regeneration.