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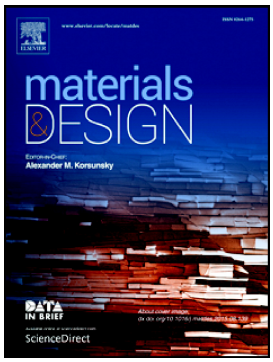

Light-based additive manufacturing of PolyHIPEs: Controlling the surface porosity for 3D cell culture applications

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Light-based additive manufacturing of PolyHIPEs: Controlling the surface porosity for 3D cell culture applications

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Abstract

Using stereolithography (vat photopolymerisation) to polymerise High Internal Phase Emulsions (PolyHIPEs) is a potent additive manufacturing route to produce materials with a hierarchical porosity. These multiscale porous materials have a microporosity (1-50 μm) dictated by emulsion templating and a macroporosity (100 μm upwards) controlled by additive manufacturing. The interconnected, hierarchical porosity of these structures is particularly desirable in the field of bone tissue engineering as it promotes tissue formation and allows efficient mass transport. However, due to the high light-scattering nature of the HIPEs, the achievable feature resolution is poor in comparison to other photocurable polymers, and they are prone to the formation of a closed porosity 'skin layer' at the surface. This study focuses on different methods of both improving the resolution of structures fabricated from HIPEs via stereolithography and minimising skin formation. The inclusion of 2-(2H-Benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol (commercially UV-234 or Tinuvin®234), a UV light-absorber, was found to significantly improve the achievable resolution of PolyHIPE structures fabricated via stereolithography with no cytotoxic effects and reduce the skin formation. Furthermore, in direct comparison with a non-microporous scaffold of the same architecture, the inclusion of a microporosity significantly promoted the proliferation of MLO-A5 murine osteoblasts and permitted superior bone-matrix deposition.