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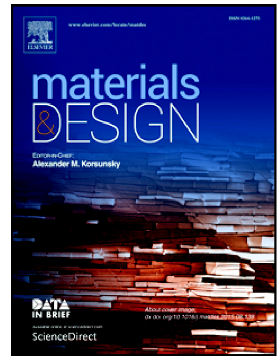

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3D-printed biodegradable gyroid scaffolds for tissue engineering applications

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Abstract

Fused deposition modeling (FDM), a low-cost and easy-to-use additive manufacturing technique, was used to produce poly(lactic acid) (PLA) gyroid scaffolds. Such morphology was selected for its spring shape, high porosity leading to good nutrient and waste diffusion, and favorable mechanical properties. Printing parameters were optimized and the need of a support material to improve printing was evidenced. The gyroid was compared to the common strut-based structure. Scaffold porosity was measured by micro-CT, and mechanical properties were determined by compression tests, taking into account the effect of geometry, printing resolution, and PLA crystallinity. The impact of scaffold geometry and crystallinity on its degradation was studied *in vitro*. Porosity of the gyroid structure was 71%, as expected from the printing model. The compression tests showed an isotropic behavior for the gyroid, in contrast with the strut-based scaffold. Upon aging in physiological conditions, gyroid scaffolds retained their integrity during 64 weeks, while control scaffolds lost struts starting from week 33, in a way that depended on crystallinity and printing resolution. Based on these results, the gyroid design is proposed as a suitable mesh architecture for tissue engineering scaffolds that can be elaborated using FDM techniques, to produce low-cost and personalized implants.

Keywords

Fused Deposition Modeling; poly(lactic acid); gyroid; scaffold