AMEND CONTINUE

British Orthopaedic Research Society Annual Meeting 2021

Submission ID

75

Title

Direct ink writing of polycaprolactone/Laponite composite for bone implants: 3D characterisation using X-ray micro-computed tomography writing of polycaprolactone/Laponite composite for bone implants: 3D characterisation using X-ray micro-computed tomography

Abstract

Objectives: Direct ink writing (DIW) has gained considerable attention in production of personalized medical implants. Laponite nanoclay is added in polycaprolactone (PCL) to improve printability and bioactivity for bone implants. The 3D structure of DIW printed PCL/Laponite products was qualitatively evaluated using micro-CT.Methods: PCL/LP composite ink was formulated by dissolving 50% m/v PCL in dichloromethane with Laponite loading of up to 30%. The rheological properties of the inks were determined using Discovery HR-2 rheometer. A custom-made direct ink writer was used to fabricate both porous scaffold with 0°/90° lay-down pattern, and solid dumbbell-shaped specimens (ASTM D638 Type IV) with two printing orientations, 0° and 90° to the loading direction in tensile testing. The 3D structure of specimens was assessed using a micro-CT. Independent t-tests were performed with significance level at $p<0.05$. Results: The addition of Laponite in PCL ink has significantly enhanced viscosity for shape fidelity and shear-thinning property facilitating extrusion for DIW. Uniform distribution of Laponite was illustrated by micro-CT. For the 32-layer scaffold, interconnectivity of pores is observed at all 3 planes. The variation of height and width of layers is within 6% except the bottom 2 layers which are significantly lower and wider than other layers for mechanical support. For solid specimens, no ditches/interfaces between filaments are observed in 90° orientation while they are distinctive in 0° orientation because deposited filaments contact each other sooner in 90° orientation. 90° specimens also have lower air gap fraction (0.8 vs 5.4 %) and significantly higher Young's modulus (235 vs 195 MPa) and tensile strength (12.0 vs 9.5 MPa). Conclusions: The mechanical properties and printability of PCL/Laponite composites can be improved by controlling printing parameters; Micro-CT is an important tool to investigate the structure and properties of 3D printed products for bone tissue engineering.

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Presentation

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Biomechanics

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- ○ Yes
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