

Press release

Defence on 27 January 2022

Nanocellulose 3-D Materials

Title of the doctoral thesis	Structuring of Nanocelluloses in 3-D Functional Materials
Content of the doctoral thesis	<p>This thesis investigates fundamental and practical aspects of the materials and methods used to assemble 3D structures from bio-based materials using mono- to multi-component systems through bottom-up and other processes. Fused Deposition Molding (FDM, to prepare 3D molds) and Direct Ink Writing (DIW) were used to fabricate structures with controlled geometries and properties. Nanocellulose from both microorganisms and wood featured promising biocompatibility and was investigated as primary subjects for the studies. We discuss the rheological requirements to process hydrogels by direct ink writing and address the effect of compositions and water interactions in the swelling of 3D-printed materials. The essential factors associated with cellular activities in biomedical applications were considered. The shear-thinning behavior of nanocellulose hydrogels facilitated the printability of the inks into defined shapes, which were investigated by using a wide range of needle sizes, lengths, and profiles. We discuss the effect of printing parameters and post-processing techniques on structural fidelity and properties. The nanocellulose-based mono and multi-component functional structures presented the advantages of inexpensive and fast production, dimensional retention and stability, ease of drying and rewetting process, thus facilitating packaging, transportation, and material sterilization while displaying excellent compatibility with cells. Material characterizations (for example, morphology, microstructure, mechanical performance, shrinkage, swelling, and degradation) were studied to define suitable applications for the developed structures. Our findings in this thesis are expected to facilitate future work to address standing challenges in constructing 3-dimensional bio-based materials.</p>
Field of the doctoral thesis	Bioproduct Technology
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Opponent(s)	Professor Carmen S.R. Freire, University of Aveiro, Portugal
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