Sahar Sultan et al., Int J Adv Technol 2018, Volume 9
DOI: 10.4172/0976-4860-C1-002

3D printed cellulose nanocrystals based hydrogel scaffolds for biomedical applications

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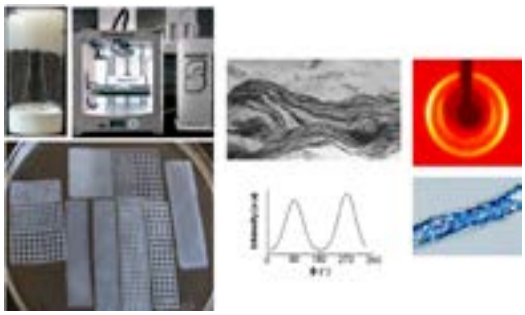
Cellulose nanoparticles extracted from natural resources are used extensively in biomedical field because of its favorable biological properties, such as, biocompatibility, biodegradability and low toxicity. However, the 3D printing of these nanoparticles have opened a new area of customization, personalization with better control over structural properties. Much work is devoted to cellulose nanofibers (CNFs) and its biomedical products are already commercialized. Recently the 3D printing of cellulose nanocrystals (CNCs) and the directionality induced in the 3D constructs due to shear-induced orientation of CNCs have open challenges for CNCs to get as much attention as CNFs in biomedical field. Therefore, CNCs based double crosslinked interpenetrating polymer network (IPN) hydrogel has been made and 3D printed into scaffolds with and without gradient porosity. The pore sizes are in the range of 80-2080 µm and 195-2382 µm in the wet and freeze-dried states respectively. The directionality studies showed that degree of orientation varies between 61-76 % depending on the point of measurement within the 3D construct. The nanoscaled roughness (visible for scanning electron images) and mechanical properties (in aqueous medium) are favorable for cell interaction. We believe that we have opened the route for CNCs to enter into the biomedical field. The interesting part of this study is that with a little optimization of pore size and ink composition, our 3D printed scaffolds will have potential applications in bone and/or cartilage regeneration.



Recent Publications

1. Sultan S, Siqueira G, Zimmermann T, Mathew A P (2017) 3D printing of nano-cellulosic biomaterials for medical applications. Current Opinion in Biomedical Engineering. 2:29-34.
2. Markstedt K, Mantas A, Tournier I, Martínez Ávila H, Hägg D, Gatenholm P (2015) 3D bioprinting human chondrocytes with nanocellulose–alginate bioink for cartilage tissue engineering applications. Biomacromolecules. 16(5):1489-1496.
3. Siqueira G, Kokkinis D, Libanori R et al. (2017) Cellulose nanocrystal inks for 3D printing of textured cellular architectures. Advanced Functional Materials. 27(12): 1604619.

Biography

Sahar Sultan is a second year PhD student in Stockholm University, Sweden. She is actively working with 3D printing of cellulose nanoparticles. She has also served the industry for 5 years by working as a researcher and Safety Officre in a solar cell company called Exeger, Sweden AB, Stockholm, Sweden. She is interested in researching 3D printing and cellulose nanoparticles.

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