Multi-material bio-printing facilities

Citation

Year
2017

Version
Publisher's PDF (version of record)

Link to publication
TUTCRIS Portal (http://www.tut.fi/tutcris)

Take down policy
If you believe that this document breaches copyright, please contact tutcris@tut.fi, and we will remove access to the work immediately and investigate your claim.
Dispenser printing provides a method to produce 2D and 3D patterns from basically any liquid phase material. Dispensing considered here is a form of extrusion of material through a narrow diameter needle. An advantage of dispensing technique over conventional printing techniques is the avoidance of complicated ink formulation, which generally requires hazardous organic solvents that may be harmful to biological objects. Dispensing also allows materials with rather different properties such as different viscosity to be printed in the same process. Combining the dispensing printing of liquid phase materials and 3D printing of solid materials, complex structures with new functional properties can be fabricated, which is very challenging if not impossible using conventional manufacturing techniques.

**Dispenser system for bio-printing**

Fig. 1 shows a dispenser robot (EFD Nordson) capable for printing liquid phase materials, e.g. hydrogel or nanocellulose dispersions. The robot is controlled by a PC software and the actual liquid volume with dispensing controllers (three dispenser seen in Fig. 1). The working area of this dispensing robot is 400x400x200 mm with a repeating accuracy of 10 µm. The needle diameter can be varied between 50 µm and 2000 µm. Figs. 2 and 3 show the dispenser-printed tracks of cellulose nanofibril (CNF) gel (Fig. 4).

1. **Nanocellulose printing & aerogels**

Aerogels can be prepared by freeze-casting or freeze-drying process. Freeze-casting is a method where aqueous dispersion is deposited and solidified by simultaneous freezing the water molecules (freezing-stage in Fig. 5). The solidified water crystals the retain the shape of the casting even though the solid material concentration is very low (~1 wt-%). After the structure is solidified by freezing water is removed with a freeze-drying process. If done properly the water removal won’t affect the solid components and an aerogels structure is remains (Fig. 6). Dispenser printed aerogel (Fig. 7) which has been freeze dried can be seen. Nanocellulose aerogels [1] are potential lightweight materials for example in biomedical or membrane applications.

Reference:


