The new dimension in 3D printing

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Functional parts are getting smaller and more complex. This trend of miniaturization does not only place new demands on the parts itself but also on the respective manufacturing process. For this reason, multiphoton lithography is becoming increasingly important for academia and industry. This technique is based on 2-photon absorption, a non-linear process allowing the fabrication of parts ranging from micro- to mesoscale with structural details in the submicrometer range. This high resolution enables novel approaches in various fields of application. [1]
UpNano's high-resolution 3D printing system NanoOne combines this high resolution with unmatched throughput in a patented process. The system sections the printing geometry in high- and low-resolution areas and adapts the laser voxel size accordingly. This in turn increases the throughput up to a factor of 100 in comparison to competitors.

This system was developed with biological applications in mind. Both the printing process as well as offered materials are biocompatible, enabling high-resolution bioprinting and the production of complex scaffold structures for the first time (Figure 1a). Agnes *et al.* have shown that this technology allows printing in presence of living stem cells (Figure 1b). The printing process has no influence on the proliferation ability of the cells and thus allows long-term cell culture approaches. [2]
Using UpNano's non-linear printing process, structures can as well be fabricated within closed systems such as glass-bottom cell culture plates or microfluidic chips. Such a lab-on-a-chip application was demonstrated by Mandt *et al.* by using 2-photon polymerization for the fabrication of a semipermeable membrane within a microfluidic chip. (Figure 1c) The properties of the membrane, such as its permeability, were adapted by changing the printing parameters. In a second step, cells were seeded and cultivated on the sterile membrane. [3]
These recent developments in the field of high-resolution 3D printing enable new and innovative approaches and open up new areas of application, not only for biological research but also the industrial environment.

References

[1] Multiphoton Lithography: Techniques, Materials, and Applications, J. Stampfl, R. Liska, A. Ovsianikov (Eds.) John Wiley & Sons (2016)
[2] A. Dobos, … A. Ovsianikov, Thiol–Gelatin–Norbornene Bioink for Laser-Based High-Definition Bioprinting, Adv. Healthcare Mater. 1900752 (2019)
[3] D. Mandt, … A. Ovsianikov, Fabrication of placental barrier structures within a microfluidic device utilizing two-photon polymerization, International Journal of Bioprinting 4:2 (2018)

Figures

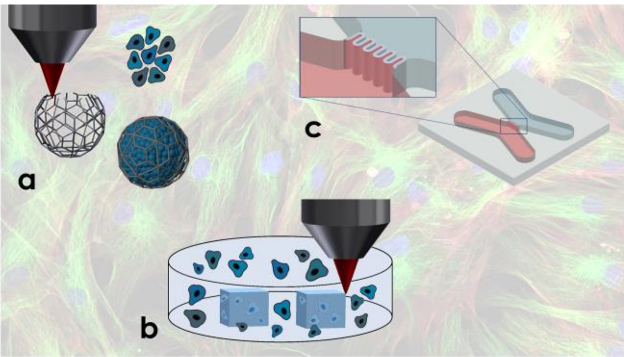

Figure 1: 2-Photon polymerization permits (a) the fabrication of complex sterile cell scaffolds as well as (b) the embedding of living cells in the course of printing. (c) Moreover, the fabrication of high-resolution structures within sterile microfluidic chips are possible.