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Industrial Keynote

Advances in 3D printing by Two-Photon Polymerization for life science applications

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Two-Photon Polymerization (2PP) is one of the most versatile techniques for additive microfabrication, allowing for the direct creation of true 3D meso- and microscale objects with sub-micrometer features, and either optically smooth or deliberately structured surfaces. After a short introduction of the technology, this presentation will show examples from the fields of cell scaffolds, tissue engineering, and organ-on-a-chip.

In recent years, we have developed some significant advancements in 2PP, which I will review, including Aligned 2-Photon Lithography (A2PL) [1], Two-Photon Grayscale Lithography (2GL) [2], and 3D printing by 2GL [3].

With A2PL, one can 3D microprint components onto pre-structured surfaces, e.g., into microfluidic channels or chambers. The components are printed with sub-micron positioning accuracy. The rotation and tilt of the substrate are detected and corrected for as well.

2GL overcomes the fundamental trade-off of 3D printing, the trade-off between printing speed and surface quality, by dynamically modulating the laser power and thus the size of the exposed volume pixel or "voxel". First introduced for grayscale image (undercut-free) based printing in 2019, we recently launched the generalization of the 2GL technique to 3D printing, considerably improving printing speed and surface quality for complex 3D microstructures.

To demonstrate the utility of 2GL for biological applications, I will show some results from a recent study of cell-material interaction with AI generated micro- and nano-surface topographies, inspired by Schamberger et al. (2022) [4], Unadkat et al. (2011) [5], and Callens et al. (2023) [6].

Author's statement

Conflict of interest: The author and coworkers are employed at Nanoscribe GmbH & Co. KG. Informed consent has been obtained from all individuals included in this study.

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