MULTIPHOTON LITHOGRAPHY OF 3D HYDROGEL STRUCTURES WITHIN MICROFLUIDIC CHIPS

Aleksandr Ovsianikov, Institute of Materials Science and Technology, Vienna University of Technology
Austrian Cluster for Tissue Regeneration, Austria
Aleksandr.Ovsianikov@tuwien.ac.at

Key Words: 3D printing, multiphoton lithography, microfluidic, hydrogels

Multiphoton lithography (MPL) is a 3D printing approach based on localized polymerization of materials induced by femtosecond laser pulses. This technology can produce complex 3D structures with remarkably high spatial resolution, down to submicron range. Furthermore, in contrast to other 3D printing technologies, MPL produces structures within the volume of the sample, without the necessity to deposit the material layer-by-layer. Being an optical technology closely related to microscopy, MPL is also well compatible with microfluidic technology. We have used this capacity of MPL to produce 3D hydrogel structures directly within the microfluidic chips.

The photosensitive hydrogel formulations can be injected into the microfluidic channels, by this way enabling MPL within already assembled chips. In the subsequent step the microfluidic chip is perfused with PBS or cell culture medium in order to remove the unpolymerized material. This approach allows to test different materials, construct geometries and cell types with the same set of microfluidic chips without changing their initial design or fabrication process. Furthermore, by producing 3D cell traps, it is possible to position the cells at the desired location within the microfluidic channel. Our results demonstrate the general practicability of MPL for producing complex cell-containing 3D constructs within the microfluidic chips. This approach opens exciting perspectives towards realization of 3D tissue models and organ-on-a-chip devices.