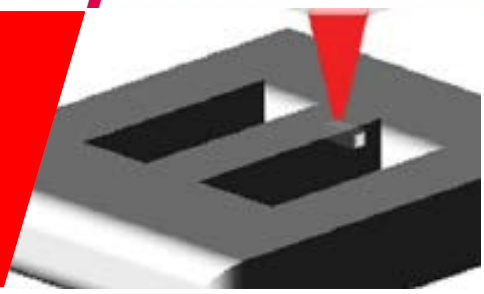
# Laser ablation of complex vascular structures

**Student project assignment**



## Introduction

In our lab we have the FEMTOprint setup that uses a femtosecond laser to ablate or modify materials. Currently the modification of glass is mostly used, this results in nanogratings inside the glass which have a higher etching rate than the surrounding glass. After etching the modified material is removed leaving an open structure. The design of these structures is a complex problem since trajectories have to be programmed in a sequential order to maintain optical access to the part that still has to be machined. A working protocol for these complex geometries has still to be defined.

The system also allows for direct laser ablation of material either by normal ablation or 2 photon ablation (2P). The parameters for this are not known for the hydrogels we wish to use and have to be investigated.

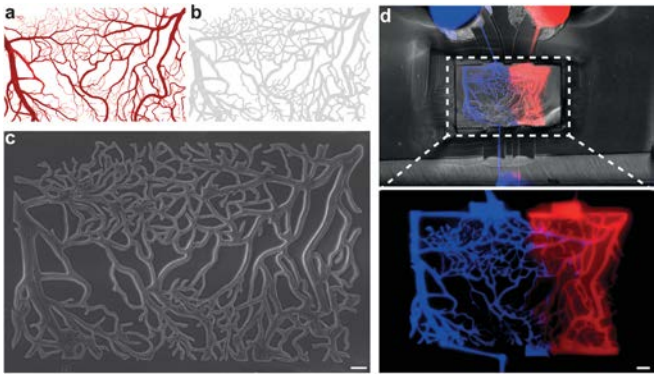



*Fig. 1 Laser ablated networks inside a hydrogel [1].*

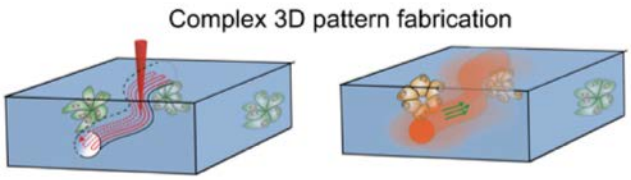



*Fig. 2 Laser ablation routing to fabricate circular channels that can be perfused afterwards [2].*

## Project

For this project the focus will be on optimising the settings for ablation in glass and eventually in hydrogels. The parameters that can be changed are pulse frequency and energy resulting in different modifications to the material. The routing of the laser has to be optimised for complex geometries and needs to be easily adaptable to different geometries. The eventual goal would be to have complex perfusable structures inside glass and possibly inside hydrogel materials.

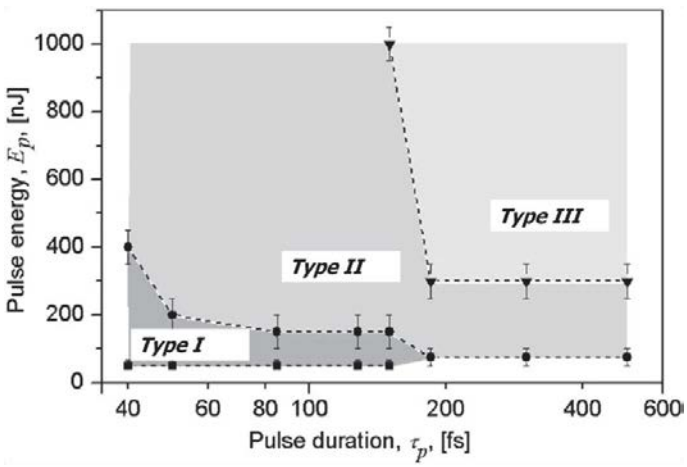



*Fig. 3 Regimes of material modification based on pulse duration and pulse energy for glass. Type 1: continuous modification, Type 2: nanogratings, Type-3: ablation*

**References**


[1] N. Brandenberg - In Situ patterning of microfluidic networks in 3D cell-laden hydrogels -2016
[2] S. Pradhan- Fundamentals of Laser-Based Hydrogel Degradation and Applications in Cell and Tissue Engineering - 2017


**/ Interested? → Prof. Jaap den Toonder (j.m.j.d.toonder@tue.nl), GEM-Z 3.130**