Laser Modification of Microcavities

Fabrication, Characterisation and Modeling of Cellular Response

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Laser Modification of Microcavities: Fabrication, Characterisation and Modeling of Cellular Response

Project Phase Report
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Public Summary

The thesis addresses the growing need for advanced in vitro platforms that mimic the in vivo environment. The work explores the fabrication and the characterisation of microsieves in NOA81 photopolymer with defined topographical cues to study cell behaviour. Furthermore, this work focusses on advances in nervous systems' disease models derived from human stem cells, so called Nervous system on Chips (NOC). The research entails a thorough optical characterisation and details the design of different structural environments using computational methods.

The devised microsieves with varying topographical features apply passive mechanical stimuli to cells. By means of fluorescence microscopy the characterisation of the fabricated three-dimensional structures reveals a route for their application in live-cell imaging, since the transparency of the material allows for direct visualisation of cells and their interaction with the substrate. In addition, a structural finite element model is developed for simulating cellular response to the fabricated structures. This model will help in predicting which structures show promising potential for applying these devices in NoCs.

The structural finite element model shows promising results for simulating cellular response to micropores. Although the model is currently highly simplified compared to the complexity of a real cell, it offers initial insight in how cells respond to the topographical features.

In conclusion, this research provides a novel approach to studying cell-topography interactions, invaluable for the design of future in vitro models that closely mimic physiological conditions.