Selective Photoinduced Biofunctionalization of 2PP 3D Microstructures

Dalila Fontana[1], Enrico Domenico Lemma[1], Edoardo Rossi[2], Edoardo Bemporad[2], Martin Bastmeyer[3], Alberto Rainer[1,4]

[1] Department of Engineering, Università Campus Bio-Medico di Roma, Via Álvaro del Portillo 21, 00128 Rome, Italy
[2] Department of Civil, Computer and Aeronautical Engineering, Università degli studi Roma Tre, Via Vito Volterra 62, 00146 Rome, Italy
[3] Zoological Institute, Karlsruhe Institute of Technology (KIT), 76131 Karlsruhe, Germany
[4] Institute of Nanotechnology (NANOTEC), National Research Council, via Monteroni, 73100 Lecce, Italy

Recent evidence points at the three-dimensional (3D) spatial distribution of the extracellular matrix (ECM) proteins and at the geometric and mechanical constraints of the microenvironment as key determinants of cell fate and function. Two-photon polymerization (2PP) is an enabling technology for the fabrication of static and dynamic 3D structures, which can be selectively functionalized with bioactive molecules (e.g., ECM proteins, oligonucleotides, etc.). In turn, these facilitate cell anchorage and mimic the physiological extracellular microenvironment. In this work, we focused on the biofunctionalization of microstructures using widely used 2PP photoresists. The obtained structures were selectively functionalized by exploiting a light-induced reaction, allowing for the covalent binding of maleimide compounds, which in turn can be decorated with biologically active streptavidin. The patterning of 3D structures for protein immobilization has already been the subject of various complex approaches, that also require chemical modification of the resist using photo-reactive molecules, such as photoenols. Therefore, we simplify currently available approaches by extending the light-induced activation for protein binding properties on 3D structures to user-grade 2PP photoresists without introducing chemical modifications in the used materials. Results suggest that the obtained procedure can be used for the realization of free-shape responsive 3D microscaffolds capable of selectively anchoring cells and stimulating them by creating a physiological-like microenvironment.