EXPLOITING DESIGNER POLYMER BRUSHES FOR TAILORED CELLULAR MICROENVIRONMENTS WITH COMPLETELY DECOUPLED BIOCHEMICAL CUES, MECHANICAL PROPERTIES, NANOPATTERNS AND CONTROLLED TOPOGRAPHY IN 3D

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ABSTRACT

Over the past decade, the influence of a multitude of signals present in the microenvironment of cells on their activity and function has been unraveled and led to important breakthroughs in the areas of (stem) cell differentiation and cell de-differentiation. Compared to elaborated micro- and nanopatterns in 2D, the currently available 3D platforms still lack the deterministic control, even though 3D-scaffolds comprising electrospun fibers, self-assembling peptides and other approaches, including hydrogels, are known and show promising results in tissue engineering applications. The aim of our work in this context is the development of polymer-based platforms to afford novel microenvironments for emulating the cell - matrix and cell - cell interactions. The central element of our approach are polymer brush functionalized microcompartments and hydrogels that are either manufactured in top-down lithography or bottom-up self-assembly approaches.

In this presentation the versatile fabrication of functional, stimuli-responsive biointerfaces will be elucidated with a particular focus on the *fully decoupled*, i.e. individually independent control of biochemical functionality, elastic moduli and micro-nano structuring in 3D. To enable in this context systematic studies of cell attachment and proliferation, we investigated the synthesis and characterization of well-defined block copolymer brushes by surface-initiated atom transfer radical polymerization as *substrate-independent* means to control passivation, biochemical signaling and mechanical properties in a fully decoupled manner. By exploiting guided and spontaneous assembly of brush functionalized polymeric microobjects unprecedented complex microenvironments were obtained, to which various types of cells react differently, depending on the selected cues provided. The changes in cell morphology, focal adhesions and cell proliferation were unraveled and complemented by DNA analyses using polymerase chain reaction (PCR).

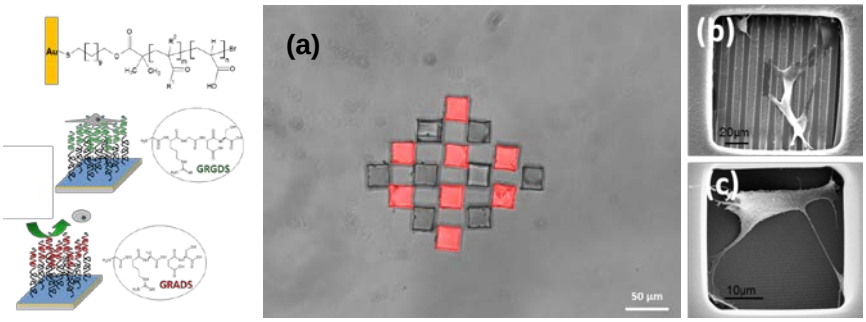

Fig. 1: Left: Scheme of exemplary block copolymer brushes. Right: (a) Fluorescence and (b, c) scanning electron microscopy images of hybrid polymer and nanostructured hydrogel microwells, in which the behavior of fibroblasts is tuned via an isolated topographic cue.

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