TAILORING CELLULAR MICROENVIRONMENTS BY ADVANCED POLYMER BRUSH-BASED BIOINTERFACES IN 2 AND 3 DIMENSIONS

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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 dedifferentiation. While early work focused on studies of cell behavior on essentially 2D platforms, in which the effect of various biochemical cues, incl. their spacing, the substrate elastic modulus and surface topography were investigated, the interest has shifted to the much more relevant 3D scenario. 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. But similar to naturally derived porous matrices, such as Matrigel, these do not possess deterministic control of the position of biochemical cues, absolute control over local elastic properties etc.

The aim of our work in this context is to develop is the development of polymer-based platforms to afford asymmetric microenvironments for cell-matrix interaction studies. A central element of our approach are polymer brush functionalized microcompartments and assemblies of building blocks (Figure 1).[1,2] In this presentation the versatile fabrication of functional, stimuli responsive biointerfaces will thus be summarized with a particular focus on the control of biochemical functionality, elastic moduli and micro structuring in 3D. Specifically, brushes of oligo(ethylene glycol)methylether methacrylate (OEGMA) and acrylamide (AAm) synthesized by surface initiated atom transfer radical polymerization to precisely control surface chemistries, grafting densities, interfacial mechanical properties and protein patterns will be discussed. The surface driven temperature-switchable control of cellular adhesion and the accessibility of a variety of surface properties, as well as various patterns, are shown to be attractive for the design of new biomaterials for wound healing and tissue engineering applications.

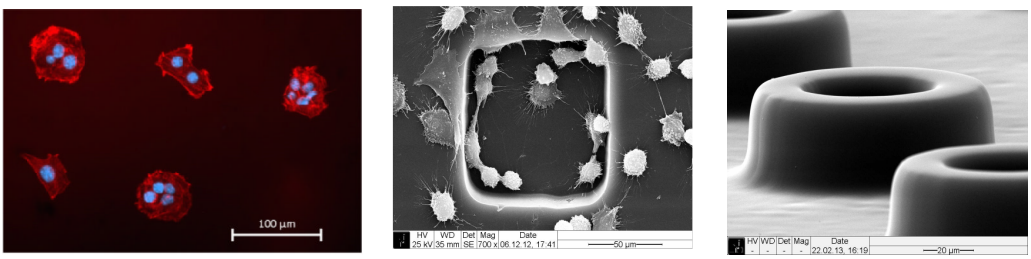

Fig. 1: (left) Fluorescence microscopy image of NIH 3T3 cells on micropatterned polyacrylamide brush, stained with Phalloidin-Rhodamine (red) and DAPI (blue) for cytoskeleton and nucleus respectively; (middle) SEM image of fixated cells in a microwell (right); master pattern for advanced 3D platform for cell-surface interaction studies in 3D.

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References:

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