Cell Mechanics in Geometrically Defined 3D-Environments

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Cell behavior and differentiation are not only influenced by biochemical cues but also by physical properties like adhesive geometry, topography, and stiffness of the 3D extracellular environment [1,2]. Correspondingly, cells exert, sense, and respond to physical forces by a variety of mechanisms. My lab is using microcontact-printing (µCP) and direct laser writing (DLW) to produce biofunctionalized, geometrically defined 2D and 3D cellular microenvironments. By varying the adhesion geometry, we study the interplay between extracellular physical factors and cell function in a systematic approach.

In my talk I will:

1. Give a short introduction into bio-functionalization techniques for 2D-surfaces and explain how direct laser writing can be applied to design 3D scaffolds for the analysis of single cells [3].
2. Explain how cell shape can be explained by combined experimental and modelling approaches [4], and how cellular forces can be measured in 3D-scaffolds.
3. Describe the impact of extracellular force application on the architecture and molecular composition of the cytoskeleton on fibroblasts growing in 3D-scaffolds [5].
4. Discuss how self-renewal and differentiation of embryonic stem cells might be controlled by geometrically defined 2D and 3D microenvironments.
5. Give an outlook on recent approaches to develop stimuli-responsive resists for DLW [6]. These materials change their mechanical properties upon an external stimulus and thus have great potential for applications to study cellular mechanobiology.

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[5] A Scheiwe et al., **Biomaterials** 44:186-94 (2015)
[6] M Hippler et al., **Nature Communications** doi: 10.1038/s41467-018-08175-w (2019)