Microgel Arrays for Regulation of Cell Motility and Adhesion

Alexander Töpel[1,2], Antonio Sechi[3], Patrick Wünnemann[2] and Andrij Pich[1,2]

[1] DWI Leibniz Institute for Interactive Materials e.V., Aachen, GERMANY
[2] RWTH Aachen University, Institut für Technische und Makromolekulare Chemie, Lehr- und Forschungsgebiet Funktionale und interactive Polymere, Aachen, GERMANY
[3] Uniklinik RWTH Aachen, Institute of Biomedical Engineering, Department of Cell Biology, Aachen, GERMANY.

Topology and surface chemistry are powerful tools to affect cell adhesion and migration. In this work we focused on use of microgels as building blocks for the decoration of biointerfaces. Recently we developed a new technique that allows printing microgels on solid substrates. [1]
Using wrinkled PDMS templates we successfully printed stimuli-responsive poly(N-Isopropylacrylamide) (pNIPAm) microgels in form of colloidal arrays on glass supports. The microgels were chemically grafted onto the glass substrates by using low-pressure Argon plasma treatment. This process lead to highly stable microgel arrays in cell culture media. We could show with Liquid cell AFM investigations that surface-grafted microgels retained their swelling behavior and thermo responsiveness in aqueous media. By this technique we could also show, that extracellular matrix protein coating did not alter both their stability and topography. We demonstrated that our surface-grafted microgel arrays could serve as novel substrates for the analysis of cell adhesion and migration.[2] Microgel arrays influenced size, speed and dynamics of focal adhesions as well as cell motility forcing cells to move along highly directional trajectories. Modulation of microgel state or spacing served as an effective tool for regulation of cell motility.

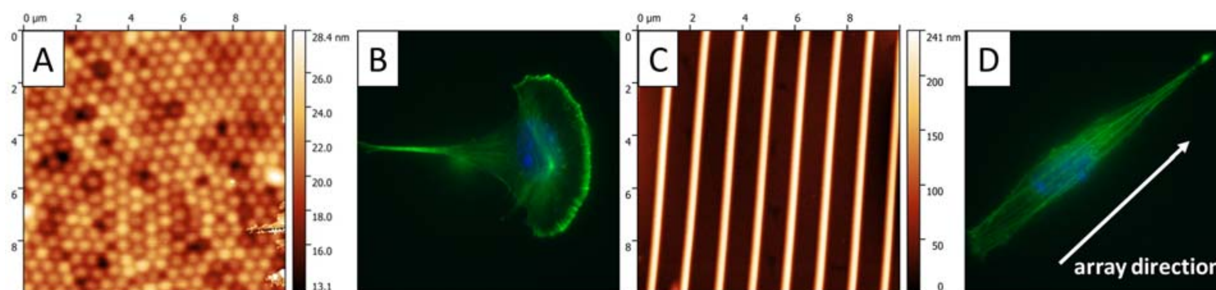

Figure 1. AFM image of pNIPAm microgel monolayer (A) and microgel array (C). Fluorescent microscopy image of a B16F1 (mice skin melanoma cells) on the monolayer (B) and the array (D). Cells were fixed and labelled with fluorescent phallodin. Nuclei were stained with DAPI (Blue). The cell form on the monolayer (B) typical a large fan-shaped lamellipodium which is characterised by several actin-rich microspikes and filopodia (Green). On the microgel array the cells change shape and stretch along the array direction (D).

[1] S. Hiltl, M. Schürings, A. Balaceanu, V. Mayorga, C. Liedel, A. Pich, A. Böker, *Soft Matter* **7** (2011),8231.
[2] A. S. Sechi, S. Ullmann, J. M. G. Freitas, R. P. Takehara, P. Wünnemann, R. Schröder, M. Zenke, A. Böker, G. Aydin, S. Rütten, Andrij Pich, *Adv Mater. Interf*. **3** (2016), 20.

Acknowledgement: This work was performed in part at the Center for Chemical Polymer Technology CPT, which was supported by the EU and the federal state of North Rhine-Westphalia (grant EFRE 30 00883 02). This work was supported by the Seed Funds programme of the DFG-RWTH Aachen (project OPSF363 to A.S. and A.P.). The authors acknowledge funding from DFG SFB 985 "Functional Microgels and Microgel Systems."