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Tailored Surface Properties via Hard-soft Translation of Nanopatterns for Induced Cell Ordering

Patrick Wuennemann[1,2], Marta Helmin,[1,2], Alexander Böker[1,2]
[1]DWI-Leibniz-Institute for Interactive Materials, RWTH Aachen University,
Forckenbeckstrasse 50, D-52056 Aachen, Germany
[2]Lehrstuhl für Makromolekulare Materialien und Oberflächen, RWTH Aachen University,
Forckenbeckstrasse 50, D-52056 Aachen, Germany
boker@dwi.rwth-aachen.de

Theo van Kooten, Philipp T. Kuhn, Patrick van Rijn*
Department of Biomedical Engineering-FB40,
W.J. Kolff Institute for Biomedical Engineering and Materials Science,
University of Groningen, University Medical Center Groningen,
A. Deusinglaan 1, 9713 AV Groningen, The Netherlands
p.van.rijn@umcg.nl

Extended Abstract

Cell-surface interactions are influenced by various factors such as surface stiffness, wettability/chemistry and topography. While these surface properties have been extensively investigated combined influences are generally not taken into consideration. Here we combine two influences which are important for biointerfaces and these are surface stiffness and surface nano-/micro-topography.[1,2] Concerning surface topography, materials are often used which are considered very rigid as far as cells are concerned. It is known that cell-surface interactions and cellular behavior like proliferation and alignment greatly depends on the stiffness of the surface and hence nanostructures cannot just be used in combination with "stiff" surfaces. Translation of nanostructures from "hard" materials to "soft" materials is therefore an important approach to further investigate the "fine-tuning" and controlling of cell-surface interactions and cellular behavior.

Here we use a lithography-free fabrication of nanostructured poly-dimethylsiloxane (PDMS) surfaces[3] which is translated to a nanostructured soft hydrogel surface by imprinting of a hydrogel precursor layer and subsequent polymerization creating identical surface topography but with an altered "stiffness". These nanostructures are used as a template for the investigation of directed cell growth which is correlated to different tissue stiffness. Through the different mechanical properties of the substrates, we investigate the cell-growth and alignment behavior of hard bone cells (SaOs), intermediate lens epithelial cells (LEC) and softer flexible skin cells (HskF) and correlate cell behavior to the stifness of nanostructured surfaces.

References

Gray, D. S., J. Tien, C.S. Chen, (2002) "Repositioning of cells by mechanotaxis on surfaces with micropatterned Young ' s modulus." J. Biomed. Mater. Res. A, 66A, 605–614.

Hatano et al. (2013) "Endothelial cells derived from embryonic stem cells respond to cues from topographical surface patterns."; J. Biol. Eng., 7,18.

Pretzl, M., A. Schweikart, C. Hanske, A. Chiche, U. Zettl, A. Horn, A. Böker, A. Fery (2008) "A lithography-free pathway for chemical microstructuring of macromolecules from aqueous solution based on wrinkling", Langmuir, 24, 12748-12753.