European Cells and Materials Vol. 10. Suppl. 1, 2005 (page 26) ISSN 1473-2262

# A High-Throughput-Screening Approach for Surface Morphology - Easy way to the cell's preferred topography?

T.P. Künzler, T. Drobek, N.D. Spencer

*LSST (Laboratory for Surface Science and Technology), ETH Hönggerberg, Zürich, Switzerland*

**INTRODUCTION:** Surface morphology plays an important role in cell growth, proliferation and attachment to the surface [1,2]. Cells behave differently on smooth surfaces compared to rough ones, but also different kinds of cells favour surfaces with different roughness. However, investigations considering the effect of morphology are often limited to either rough or smooth surfaces. The aim of the current work is to develop roughness gradient surfaces for studying cell-surface interactions of specific cell types in vitro experiments systematically. Characterization of the gradients will be performed by SEM, stereo-SEM and laser profilometry.

**METHODS:** Morphology gradients were fabricated using a two-step roughening and smoothening process. In a first step, pure aluminium sheets were bead blasted using spherical ceramic beads with a diameter of 125-250 micrometers. With this blasting process a homogeneous roughness was created. In a subsequent chemical polishing process, the sheet was immersed into a hot acidic solution, consisting of phosphoric, nitric and sulphuric acid [3], and continuously withdrawn by means of a linear motion drive. The polishing solution, depending on the residence time of a specific surface location, preferentially removed features with a small radius of curvature and thus led to the smoothing out of the surface topography.

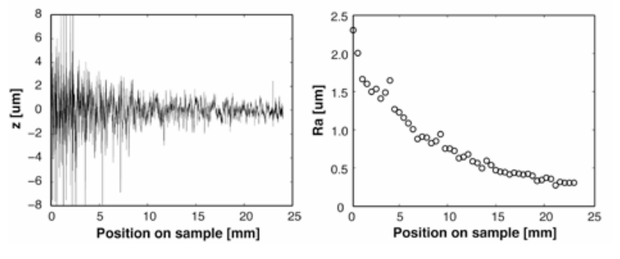


*Fig. 1: Laser profilometry measurements: Profile of the roughness gradient, showing the maximal amplitude (left), calculated roughness values Ra along the gradient axis (right).*

**RESULTS:** Following the gradient axis from rough to smooth, the roughness was found to decrease monotonically (Figure 1). Calculations of the standardized integral roughness values from data obtained with laser profilometry showed values of 2.3 micrometer for Ra (arithmetic average) and 3.4 micrometer for Rq (root mean square roughness) at the rough end and 0.3 micrometer and 0.4 micrometer at the smooth end of the gradient (Figure 1). Figure 2 shows SEM images of the roughest and the smoothest part of the gradient. From studies with the SEM it is revealed that after short polishing time only very small features were removed whereas after polishing the sample for longer time also larger features were removed. This observation could be quantitatively confirmed by stereo-SEM measurements.

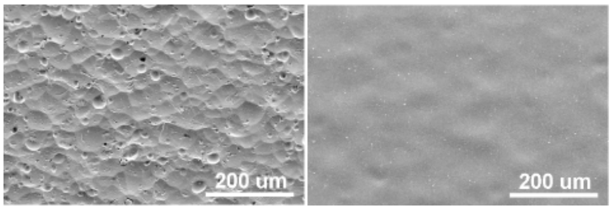


*Fig. 2: SEM image of the bead blasted (left) and the polished part (right) of the gradient.*

**DISCUSSION & CONCLUSIONS:** The method presented in this work allows for the production of well-defined surface morphology gradients on a centimeter scale with topographical features in the micrometer and sub-micrometer range. Typically, roughness values (Ra) of surfaces used in cell studies lie between 0.2 micrometer for polished and 3.4 micrometer for blasted surfaces [4]. A roughness gradient produced with the presented method covers most of the roughness values in-between this range on a single surface.

**REFERENCES:** [1] G. Abrams, et al (1998) Effects of Substratum Topography on Cell Behavior in *Biomimetic Materials and Design*, Springer, pp 91-137 [2] R. Flemming, et al (1998) *Biomaterials* **20**: 573-588 [3] S. Wernick, et al (1987) Chemical polishing in *The surface treatment and finishing of aluminium and its alloys* Vol.1, ASM International, pp 95-154 [4] K. Anselme, et al (2000) *J Biomed Mater Res* **49**: 155-166

**ACKNOWLEDGEMENTS:** The authors would like to acknowledge C.M. Sprecher and R.G. Richards (AO Research Institute, Davos, Switzerland) for their assistance with SEM. This work was supported by the Swiss National Science Foundation (SNF).