Title of Project: The Effect of Topography on Cellular Morphology

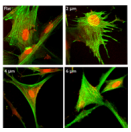

Figure 1. hMSCs on micropillar arrays in a hexagonal arrangement. Fluorescence images of the actin cytoskeleton (green) and nucleus (red) of hMSCs on flat epoxy, and on a hexagonal array of pillars (epoxy) at a height of 2,4, and 6m.

Morphology is often an important indicator of lineage commitment in stem cells. The interplay between biochemical signals and mechanical cues at the cell-substrate interface that result in changes in cell morphology is not well understood. The goal of the research project is to develop methods and/or materials to systematically vary the stiffness, chemistry, topography, and materials properties of a surface to understand their effect on cellular morphology. Our group has recently found that micropillar arrays made in stiff materials such as Si and epoxy result in the differences in cell morphology. To decouple the effect of topography and stiffness, our group will work on making the micropillar arrays in softer materials.

The working hypothesis of our research is that surface geometry, in addition to the stiffness of the surface, can have a pronounced effect on the morphology of cells and to their overall capacity for differentiation. The elasticity of human tissues is on the order of 1 kPa for brain tissues to 100 kPa for bone; consequently, the aim of this research study is to demonstrate that the geometry/spacing of the micropillar surface affects the morphology of human mesenchymal stem cells (hMSCs), even when the structures are produced in softer, biocompatible polymers such as poly(HEMA-co-DMAEMA) and polydimethylsiloxane (PDMS) using our developed

protocols.

References:

1. Bucaro, M., Vasquez, Y., Hatton, B. D., Aizenberg, J. (2012) Fine-tuning the degree of stem cell polarization and alignment on arrays of high aspect ratio nanopillars. ACS Nano 6, 6222.
2. Fu J., Wang Y. K., Yang M. T., Desai, R. A., Yu X., Liu, Z., Chen, C. S. (2010) Mechanical regulation of cell function with geometrically modulated elastomeric substrates. Nat. Methods 7, 733.
3. Hervas- Perez, J. P., Lopez-Cabarcos, E., Lopez-Ruiz, B. (2006) The application of methacrylate-based polymers to enzyme biosensors. Biomol. Engn., 23, 233-245.