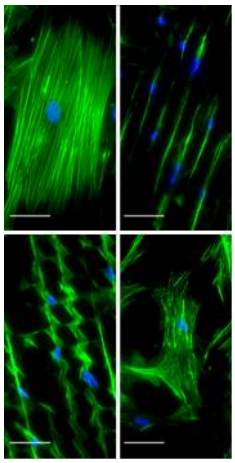
Biomedical engineering master student project

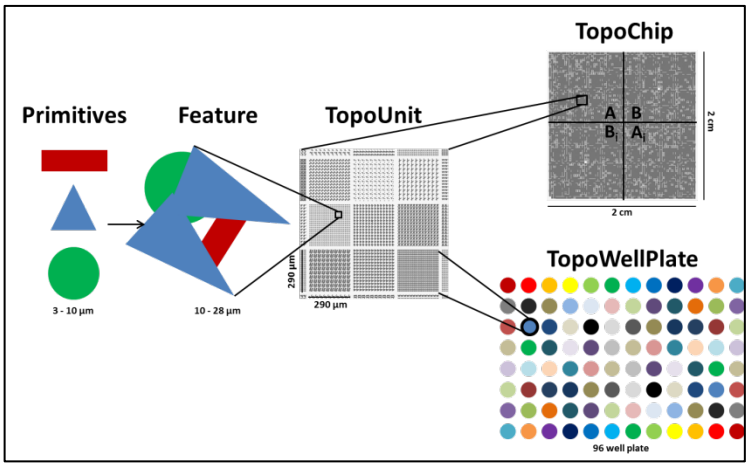
Keywords: cell-material interaction, assay development, polymer crafting, material property characterization.

Introduction

Changes in the surface structure of the substrate on which cells grow can have a dramatic impact on cellular parameters such as morphology (A), proliferation, gene expression and differentiation. However, the underlying mechanotransduction is only partly understood, and full elucidation of the mechanisms will have widespread implications for the development of the biomaterials field. To be able to study the interaction between cells and materials, or more specific the influence of micrometer scale surface topography on cell behavior, we developed the TopoChip.(B) Using this platform, we can perform immunohistochemistry based high-throughput screenings for biological responses. Testing 2178 unique surface topographies in duplicate, selected from an *in silico* library containing more than 150 million unique multiparametric features, in one run on a 2 by 2 cm chip.

(A) (B)





Project description

In previous work, we showed that surface topography can have striking effects on cell morphology. The next step will be to study the biological responses accompanying the observed phenotypical changes, but theretofore we need to be able to perform other assays than the immunohistochemistry used on the TopoChip. Enlarging the topography enhanced surface areas and isolating these large TopoUnits into separate wells will give us the opportunity to obtain enough cells, protein, RNA, etc. per unique condition, to use a wide variety of biochemical techniques.

The goal of this project is to develop the “TopoWellPlate”, a system allowing us to study the mechanisms of mechanotransduction in a medium-throughput manner. Different parts of the project are:

- Cleanroom production of micrometer scale topography enhanced substrates.
- Development of a method to assemble the different cleanroom produced polystyrene parts into a TopoWellPlate.
- Setting up cell culture protocols for the TopoWellPlate.
- Designing “plate reader based” assays to study the cell-material interaction using the TopoWellPlate.

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