Abstract

Masters of Engineering Degree (Mechanical)

Project Title:

Modeling Cell Adhesion Forces on a Nanopatterned Surface

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Nanoscale patterns covered with fibronectin allow attachment and characterization of individual cells. Of particular importance is the adhesive force between the cell's integrin based focal adhesions (FA) and the extracellular matrix (ECM). Such a force not only anchors the cell to its surroundings, but is also involved in signal transduction pathways that regulate tissue growth and repair. Previously, it was found that on a nanopattern, there is a minimum area in which cells can produce stable bonds to a surface. I created a mathematical model to predict the adhesive force generated by a cell onto a surface with nanoscale geometry. This model involved equilibrating the forces and moments on a cell that barely adheres when exposed to a fluid shear flow. In this case, the shear stress on the cell is equal to the adhesion strength, the stress level that would cause half of the exposed cells to detach on average. The resulting forces were compared to those measured in previous studies using the same nanopattern. The model is in good agreement with the results, with some deviations for patterns with areas close to the minimum. Another task was to create designs for new nanopatterns to be used in future studies with individually separated cells. These designs were created in AutoCAD and fit into a circular profile suitable for patterning onto a microscope slide.