Lab 4: Magnetic trap microrheology

PI: Peter So
Lab Instructors: Judy Su and Heejin Choi

Summary

Information regarding cellular rheology is needed to understand a variety of cellular processes including intracellular transport and migration. Because changes in cellular mechanical properties trigger a cascade of biological responses, an understanding of cellular rheology has implications in understanding many biomedical problems, such as the development of cardiovascular diseases (e.g. atherosclerosis) and the development of tissue engineering constructs (such as promoting cell growth over artificial surfaces). In addition, the ability to regulate cellular mechanical properties has important implications in a wide variety of fundamental processes ranging from wound healing to cellular biosensors. Magnetic tweezers belong to a class of active microrheological techniques designed to probe the rheological properties of cells. Fibronectin coated magnetic beads are dropped on the surface of the cell and allowed to internalize overnight. The tweezers are an electromagnet that generates a magnetic field which exerts a quantifiable constant force on a paramagnetic or ferromagnetic object. By varying the current through the electromagnet, the amount of force applied to the bead may be controlled. The displacement of the bead as a function of time may be modeled as a Voigt element in series with a dashpot. Based on this analysis, the viscoelastic behavior of the cell may be characterized by three mechanical parameters. In this lab you will use magnetic tweezers to measure the viscoelastic parameters of NIH3T3 fibroblast cells and compare these obtained results with values reported in the literature.

Recommended Reading

A. R. Bausch *et al.*, "Local Measurements of Viscoelastic Parameters of Adherent Cell Surfaces by Magnetic Bead Microrheometry," *Biophys J*. **75**.

H. Huang *et al.*, "Three-Dimensional Cellular Deformation Analysis with a Two-Photon Magnetic Manipulator Workstation," *Biophys J*. **82**.