Spying on Cells: Cellular and Subcellular Analysis using Novel Polymeric Micro- and Nanostructures

Xin Zhang
Boston University, Boston, MA 02215
xinz@bu.edu

ABSTRACT

Micro/nanosystems have been a remarkably active area of research in the past decade. With all the promise shown by such systems, however, their ultimate success hinges on the development of new technologies to meet the demands of biomedical applications. In particular, the use of new materials, especially those enabled by micro/nanotechnologies, will lead to greatly enhanced functionalities and capabilities of miniaturized bioanalytical systems. One major area of research that we have been focusing on is the development of polymeric micro/nanosystems for in situ cellular and subcellular mechanics study. The mechanical interaction of cells with their neighboring extracellular matrix is believed to be of fundamental importance in various physiological processes such as division, growth, migration, and force transmission. The mechanical force generated by living cells is typically on the order of pN to μN and can be measured by soft material probes such as polydimethylsiloxane (PDMS) and polyacrylamide, due to their mechanical compliance and biocompatibility. We have established a strong collaboration with the cardiovascular researchers at Brigham and Women's Hospital and Tufts-New England Medical Center. We have been using cardiac myocytes and smooth muscle cells as a model to validate our approach; isolated cells have been extensively studied and proven to be invaluable in our understanding of contractile processes in the heart. We have developed a polymer-based system allowing for a simple way to accurately and repeatedly measure the mechanical forces in multiple contracting cells, and yet retain all the capabilities of standard molecular biology manipulation.