Micromachined Sensors and Their Applications in the Study of Mechanical Response of Single Living Cells

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Abstract

Increasing evidence has shown that living cells respond to mechanical stimuli not only mechanically but also biologically. But how they respond to mechanical stimuli and the mechanisms through which they transduce the mechanical stimuli into biological response remain largely unclear. In this talk, I will present novel versatile and flexible micro electro mechanical systems (MEMS) sensors for measuring mechanical response of living cells. These sensors measure cell force response in the range of one nano newton to one micro newton, which is largely inaccessible for the current prevalent techniques for the study of cell mechanical response such as atomic force microscopy (AFM), optical tweezers, and magnetic twisting cytometry. These sensors have been used to study the mechanobiological response of fibroblasts, endothelial cells, neurons, and red blood cells. The major findings of the studies include: The force response of monkey kidney fibroblasts is strongly linear, reversible and repeatable under large deformations, with a small stiffening at the initial deformation stage; Actin filaments play a dominant role in taking the cellular internal force; Mechanical indentation/compression may induce actin agglomeration inside the cell; The *in vivo* stretch force response of *Drosophila* axons is linear, there is a rest tension in the axons and they maintain this rest tension, and tension in the axons is required for normal synaptic function and muscle twitches may be involved in tuning this tension.

About the Speaker

Shengyuan Yang earned his Bachelor of Engineering degree in Mechanical Engineering from the University of Science and Technology of China in 1993. He worked as a researcher at Tokyo University of Agriculture and Technology in Japan and Nanyang Technological University in Singapore before he came to the University of Illinois at Urbana-Champaign (UIUC) in 2002 for pursuing a Ph.D. degree with Professor Taher Saif. He is currently a Ph.D. candidate in the Department of Mechanical Science and Engineering at UIUC. He was a laboratory instructor for the GEM^4 (Global Enterprise for Micro-Mechanics and Molecular Medicine) Summer School on Cell and Molecular Mechanics in Biomedicine with a focus on infectious diseases held in August 2006 at Massachusetts Institute of Technology. His research interests include cell and tissue mechanics and mechanobiology, MEMS/NEMS (nano electro mechanical systems), and sensors and actuators.