

2008-2009 Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

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Jinjie Shi is a senior research assistant in the Biofunctionalized Nano-Electro-Mechanical-Systems (BioNEMS) Laboratory at the Pennsylvania State University under the tutelage of professor Tony Jun Huang, and expects to finish the Ph. D. program in spring 2009. He received both his B.S. and M.S. in microelectronics from Peking University. He has more than six years experience in designing, fabricating and testing MEMS/NEMS devices and systems. He has undertaken many interdisciplinary research projects in the fields of BioNEMS, Sensors and Actuators, Micro/Nano Acoustics, Microfluidics, Optofluidics, Active Plasmonics, Metamaterials and Microbial Fuel Cell (MFC). He is a member of American Society of Mechanical Engineers, IEEE, American Chemistry Society and American Association for the Advancement of Science. He is also the winner of Alumni Association Dissertation Award (2009, most prestigious for graduate students at PSU), Grand Prize (highest) in Graduate Research Symposium (2008) and Sabih & Guler Hayek Graduate Scholarship (2008). URL: www.esm.psu.edu/~juh17/

Thursday, Jan. 22, 2009 3:00 – 4:00 p.m. Room 112, ME-EM Bldg.

Acoustic Tweezers: Applying Surface Acoustic Waves (SAW) to Microfluidics and Active Plasmonics

Manipulation of micro/nano particles in microfluidics plays a key role in a series of bio-and chemical-related studies, including tissue engineering, microarrays and regenerative medicine. Thus far, a variety of patterning techniques—including microcontact printing, optical tweezers, optoelectronic tweezers, electrokinetic forces, evanescent wave/plasmon polariton, and hydrodynamic flows—have been demonstrated. However, none of these techniques can simultaneously meet the criteria on miniaturization, versatility, throughput, speed, and power consumption.

In this work, an active patterning technique named “acoustic tweezers” that utilizes standing surface acoustic waves (SSAW) to manipulate and pattern cells and microparticles will be presented. This technique is capable of patterning cells and microparticles regardless of their shapes, sizes, charges or polarizability. Its power intensity is ~500,000 times lower than that of optical tweezers and compares favourably to those of other active patterning methods. Its speed is among the highest reported in the literature, and its non-invasive nature was demonstrated through flow cytometry studies.

Moreover, a unique method to actively tune the localized surface plasmon resonances (LSPR) of gold nanodisk arrays, through charging/discharging effects caused by SSAW will be presented. Briefly, the propagation of SAW on a piezo substrate induces spatially periodic distribution of positive and negative charges, which modulate the electron densities of the gold nanodisks immobilized on the piezo substrate, resulting in the redshift/blueshift of their LSPR. As the LSPR of nanodisks can be locally tuned, the SSAW-based tuning of LSPR has applications in optical switches and displays, and it paves a new way to high-density nanophotonic data storage by storing/retrieving data in nanometric structures in a solid state device.

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