STEVENS Institute of Technology

STEVENS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

Wednesday, April 2, 2008

note time change*   Carnegie Room 315, Time 11 am   *note time change

Integration of Biomolecules, Cells, and Soft Polymers in Microsystems for Biological Assay and Biodetection

Professor Katsuo Kurabayashi
Departments of Mechanical Engineering and Electrical Engineering & Computer Science
University of Michigan

Bio-microsystems hold great promise in future point-of-care clinical diagnostics, high-throughput biological assays, fundamental cell studies, and on-site biodetection. Microfluidic structures allow study of the behavior of bimolecules and cells in vitro within microscale environments mimicking a biological system. However, the development of a truly comprehensive “lab-on-a-chip” or “cell-on-a-chip” system that seamlessly allows tissue organization, sample manipulation, and analyte detection requires simultaneous packaging of fluidic, optical, electrical, and biological components into a single system. The ability to integrate biomolecules, cells, and polymers on a chip using CMOS-compatible materials processing is the key to successful hybrid packaging that is necessary to advance the technology. This talk describes our recent progress towards establishing a comprehensive microsystem for biological assay and biodetection. Our research develops foundations for protein/cell assembly, protein concentration, and spectral flow cytometric immunoassay in a microfluidic channel. Along with this technological development, we demonstrate (1) electrically programmable patterning of biological materials, (2) ATP-fueled biomolecular motor nanoscale mass transport, and (3) strain-tunable nanophotonic MEMS spectroscopy. These tasks are performed by successfully integrating both biological and non-biological nano/microstructures into a single microfluidic or silicon MEMS device across multiple dimensional scales, providing the functions of assembling, manipulating, and analyzing biomaterials and analytes with great simplicity, flexibility, sensitivity, and unprecedented multiplexing capability at low power, cost, and volume.

Dr. Kurabayashi received his Bachelor's degree in Precision Engineering at the University of Tokyo in 1992 and his M.S. and Ph.D. degrees in Materials Science and Engineering from Stanford University (specialized in devices and materials) in 1994 and 1998, respectively. Upon completion of his Ph.D. program, he was hired as a Physical Science Research Associate with the Mechanical Engineering Department at Stanford University and participated, for a year, in a DARPA funded project aiming to develop MEMS-based microfluidic technology for future IC cooling. In January 2000, he joined the University of Michigan where he is currently an Associate Professor of Mechanical Engineering and Electrical Engineering and Computer Science. His group at Michigan studies RF MEMS thermal reliability physics, biomolecular motor hybrid NEMS/MEMS technology, polymer-on-silicon MEMS photonics, micro gas chromatography (μGC), protein/cell patterning for bioelectronics and biosensors, funded by NSF, NASA, CIA, DARPA, and industries. He authored and co-authored more than 60 journal and conference papers, two of which received a best paper award (Semiconductor Research Corporation Best Paper Award in 1998, and International VLSI Multilevel Interconnection Conference Outstanding Paper Award in 1998). He is a recipient of the 2001 National Science Foundation (NSF) Early Faculty Career Development (CAREER) Award, the University of Michigan Robert Caddell Memorial Award (2004), and the Pi Tau Sigma Outstanding Professor Award (2007). Dr. Kurabayashi holds 3 U.S. patents.

For more information, please contact Prof. EH Yang at Eui-Hyeok.Yang@stevens.edu or 201-216-5574