

*****Faculty Interview*****

Thursday, February 19, 2009

4:00 pm

in Room 303 MAE-A

“Micro/Nanosystems for Rapid Biomolecule Analysis and Stem Cell Research”

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Abstract

Micro/nanoscale systems are emerging as powerful high throughput tools for quantitative analysis of molecular and cellular functions. In this talk, I will present different examples of these microfabricated micro/nanoscale systems, for either rapid analysis of biomolecules (such as DNA and proteins) or directed differentiation of adult human stem cells. Specifically, I will first describe a new class of nanofluidic filter devices and their implementations as controllable molecular sieves for rapid analytical bioseparation. I will also discuss the theoretical studies of molecular sieving process in the context of periodic free-energy landscapes created by the patterned nanofluidic filter arrays. We constructed a kinetic model based upon the equilibrium partitioning theory and the Kramers rate theory that properly describes the field-dependent sieving behavior. This work represents notable progress beyond the existing equilibrium model in conventional gels. In addition, I will introduce a microfabricated anisotropic sieving structure comprised of a two-dimensional periodic nanofluidic filter array (anisotropic nanofilter array, ANA). The designed structural anisotropy in the ANA causes differently sized biomolecules to follow distinct migration trajectories, leading to efficient continuous-flow separation. Finally, I will conclude with an investigation of a novel set of microfabricated extracellular matrices (ECM) that can uncouple changes in matrix rigidity from other properties of the matrix (*e.g.* adhesive ligand, adhesion area). Using this microfabricated ECM system, we have implicated matrix rigidity as a critical mechanical signal that can switch the differentiation potential of mesenchymal stem cells between osteogenic and adipogenic fates. Mechanistic studies of pathways involved in mechano-sensing have revealed a role for RhoA/ROCK signaling in lineage specification of hMSCs by matrix rigidity.

Biography

Dr. Jianping Fu is currently an American Heart Association postdoctoral fellow in the Department of Bioengineering at the University of Pennsylvania. He received a B.S. degree (2000) from the University of Science and Technology of China (USTC) and a M.S. degree (2002) from the University of California at Los Angeles (UCLA), both in Mechanical Engineering. He earned his Ph.D. degree in Mechanical Engineering from the Massachusetts Institute of Technology (MIT) in 2007, with a major of biological engineering and a minor of micro/nanomechanics and engineering. Dr. Fu's current research interests focus on BioMEMS/NEMS, mechanobiology, stem cell biology, and applying microfabrication technology to illuminate biological systems, at both the molecular and cellular levels. For his doctoral research, Dr. Fu was awarded the Halen Carr Peake Research Prize for Bioengineering Research of Extraordinary Quality and the Senturia Prize for Best Thesis in MEMS/NEMS in 2007.

Refreshments served in 303 MAE-A beginning at 3:50 pm

