Yihong Zhan received her BS in Polymer Materials Science and Engineering from Zhejiang University of China in 2004, where she received the Outstanding Graduate Award. During 2004-2007, she studied in the Department of Chemical Engineering in University of Wyoming, conducting research in designing functionalized polymer material for drug delivery. She has been working in Dr. Chang Lu's lab on microfluidic tools for cell analysis since 2007. She is the recipient of 2009 PGSG Travel Grant Award. Her dissertation work focus on developing new microfluidic methods for studying cellular genomics and proteomics. After finishing the degree at Purdue, Yihong will pursue a career in academia.

Agricultural & Biological ENGINEERING

Dissertation Defense

Speaker: Yihong Zhan

Title: Microfluidic Electroporation for Gene Delivery and Cellular Analysis

Major Professor(s): Chang Lu

Date: Monday, December 05, 2011

Time: 9:30 am

Location: ABE 301

Abstract:

Electroporation based on a microfluidic platform has great potential for genomics and proteomics studies. External electric field has been applied for generating nanoscale pores in the cell membrane. Then the exogenous molecules such as DNA can be delivered into cells through these pores. On the other hand, electropores also allow extraction of intracellular molecules for analysis. My research mainly focuses on two main parts, including microfluidic devices for gene delivery and cellular analysis. We utilized a flow-through electroporation technique that employed continuous 10-10k Hz ac field for electroporation of cells. Our results reveal that electropermeabilization becomes weaker with increased frequency while transfection efficiency reaches its maximum at medium frequencies in the range. We postulate that the relationship between the transfection efficiency and the ac frequency is determined by electrophoretic movement of DNA in the ac field and variation of transfection under different electropermeabilization intensities.

Conventional biochemical analysis mainly focuses on the expression level of cellular proteins from entire cells. However, it has been increasingly acknowledged that the subcellular location of proteins often carries important information. We applied microfluidic electroporation on cells cultured in the microfluidic channel to breach cell membranes and selectively extract proteins in a single step. Laser induced fluorescence detection method was used to quantify the release of subcellular proteins. We demonstrated that this approach allowed monitoring the translocation of the transcription factor NF-κB from the cytosol to the nucleus without subcellular fractionation. We also found that it was possible to selectively release intracellular proteins for analysis while keeping cells alive.