Public Abstract

First Name: Yuanfang
Last Name: Gao
Degree: Ph.D.
Academic Program: Electrical and Computer Engineering
Advisor's First Name: Shubhra
Advisor's Last Name: Gangopadhyay
Co-Advisor First Name: Kevin
Co-Advisor last Name: Gillis
Graduation Semester: Fall 2006

Title: **Microfabricated Devices for Single Cell Analysis**

BioMEMS or lab-on-a-chip technology is promising technology and enables the possibility of microchip devices with higher throughput or better performance for single cell analysis. This technology is developed from the microfabrication technology in the semiconductor industry and very small sensor systems or structures can be built onto a tiny chip device. This miniaturization technology is such that it's possible to "shrink" a whole lab onto a chip with improved performance and much lower cost. We have designed and fabricated microdevices using similar technology for single cell analysis, first we developed impedance based microdevice which can used for fast cell screening such as detect abnormal blood cells and help diagnosis, then developed microchannel based flow systems for high throughput, high time resolution cell secretion measurement from a process called exocytosis. Exocytosis is a very important process for basic life function such as hormone secretion and intercellular communication. The microdevice can automatically trap single cells by differential fluidic forces inside microchannels such that single cells can be isolated from each other and measured individually yet multiple cells can be measured simultaneously thus increase the speed by many folds compared to the current manual manipulation of cells under microscope. Microelectrodes are patterned at automatic trap positions for electrochemical detection of the quantal release of hormones like catecholamines secreted by cells.

We also developed diamond-like carbon (DLC) microelectrodes onto chip device for low noise exocytosis measurement. The DLC is a hard material usually used for protective coating such as in the hard disk. Here we explore its new application in electrochemical detection as sensing microelectrodes. The DLC microelectrodes were deposited by magnetron sputtering, a common process in microfabrication to deposit thin films. In order to increase the conductivity for our application we used nitrogen doping and a bottom ITO conductive layer. Test results show the developed DLC can detect exocytosis with low noise and a stable background current which are comparable to that of carbon-fiber electrodes, the "gold standard" in electrophysiology. They are batch producible and much cheaper than those noble metals such as platinum and by integrating them to microchip device we can realize high-throughput on-chip measurement of cell secretion. The technology developed in this research can have wide ranging applications in electrophysiology, cell based sensors, high throughput screening of new drug development etc. by improving the speed, resolution and overall performance.