Mechanical, Chemical and Materials Engineering
COLLEGE OF ENGINEERING

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

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The Department of Mechanical, Industrial and Nuclear Engineering and the Department of Chemical and Materials Engineering are pleased to offer the following research project for the summer of 2006. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

Evaluation of a Carbon Nanotube Immunosensor for Direct Electrochemical Detection of Antigen-Antibody Binding

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Abstract. Immunosensing has characteristically relied on standard sandwich bioaffinity assays in connection with enzyme, fluorophore, or nanoparticle labels to detect disease-related proteins and chemical toxins. The labeling process involves additional steps that slow detection and increase cost. Label-free techniques [1-3] directly respond to the analyte and are especially useful for applications that require an immediate response and cannot wait for samples to be sent to a lab for testing. This research opportunity involves evaluation and development of an electronic label-free biosensor platform based on carbon nanotube arrays (Fig. 1a). Electrochemical impedance spectroscopy (EIS) (Fig. 1b) is chosen as the analytical approach because the electrochemical impedance of the nanotube changes when the nanotube end or surface is blocked by a biomolecule (Fig. 1c). A post-doctoral research associate or a graduate student will train and work with the WISE student to prepare the electrode and perform the EIS measurements. Electrode preparation will involve the immobilization of anti-mouse IgG on the open-ends of the nanotubes. The EIS will be performed for different sensor geometries and concentrations of mouse-IgG. The end application of the biosensor is cancer detection. An engineering, sciences, or medical student interested in interdisciplinary work would be well suited to this project. A journal paper will be written based on the results of the work.

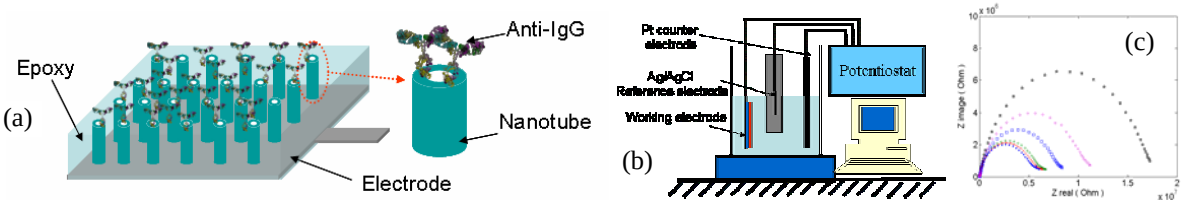

Figure 1. Electronic Biosensor: (a) structure of the immunosensor; (b) EIS experimental setup; and (c) example electrochemical impedance spectra for different concentrations of antigen on nanotubes.

References

1. Joseph Wang and Mustafa Musameh, "Carbon Nanotube/Teflon Composite Electrochemical Sensors and Biosensors" Anal. Chem., 2003, 75, 2075-2079
2. YeoHeung Yun, Ram Gollapudi, Vesselin Shanov, Mark J. Schulz, Zhongyun Dong, Abdul Jazieh, William Heineman, Brian Halsall, Danny Wong, Yi Tu, Srinivas Subramaniam, Carbon Nanotubes Grown on Stainless Steel to form Plate and Probe Electrodes for Chemical/Biological Sensing, in press, Journal of Nanoscience & Nanotechnology.
3. YeoHeung Yun, Vesselin Shanov, Mark J. Schulz, Zhongyun Dong, Abdul Jazieh, William R. Heineman, H. Brian Halsall, Danny K. Y. Wong, Adam Bange, Yi Tu, Srinivas Subramaniam, High Sensitivity Carbon Nanotube Tower Electrodes, submitted, Sensors and Actuators B.