Biomedical Engineering

Lecture Series Seminar

New Sensing and Imaging Techniques for Biomolecular Studies

Friday, September 3rd, 2010

1:00 pm, EC 2300

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NJ Tao joined the ASU faculty as a professor of electrical engineering and an affiliated professor of chemistry and biochemistry in August 2001. Before that, he worked as an assistant and associate professor at Florida International University. Since 2008, he has been serving as director of the Center for Bioelectronics and Biosensors, Biodesign Institute, leading an effort to develop sensors for health and environmental applications. He has published over 190 refereed journal articles and book chapters, which have been cited ~7400 times. He has given over 180 invited and keynote talks worldwide. He received Alexander von Humboldt Senior Research Award, Hellmuth Fisher Medal, National Science Foundation Special Creativity extension Award, Excellence in Research Award (Florida International University), AzTE Innovatorof the Year and Molecular Imaging Young Microscopist Award. His current research interests include chemical and biological sensors, molecular and nanoelectronics, nanostructured materials and devices, and electrochemical nanofabrications.

Various spectroscopic and microscopic tools have played critical roles in many important discoveries in life science. Continued advances in life science and biotechnology will benefit from new imaging and sensing techniques. An important sensing principle is electrochemical detection, which is based on detecting an electrochemical current or related electrical quantity by applying a potential to an electrode. Another detection method is electrochemical impedance spectroscopy for label-free analysis of biomolecules. These detection methods have been used for a wide range of applications, including chemical analysis, glucose and neurotransmitter monitoring, DNA and protein detections, and electrocatalysis studies. Measuring the total electrochemical current or other related electrical quantities of an electrode does not directly provide local reaction information of the electrode surface. Such information is critically needed for many applications, such as heterogeneous reactions, local activities of cells, and highthroughput protein and DNA microarrays.

We have developed a method to image local electrochemical current and impedance without a scanning probe or a microelectrode. Instead of measuring the current with an electrode, our technique determines the electrochemical current density from an optical signal of the electrode surface generated from a surface plasmon resonance (SPR). Important benefits of this approach include fast and non-invasive electrochemical current imaging of the surface. In addition, the measured local current signal is proportional to the incident light intensity, which does not scale with the area of a region of interest. We also demonstrate sensitive and selective trace analysis and single cell studies with the technique.