Agricultural & Biological ENGINEERING

Dissertation Defense

Speaker: Jonathan Claussen

Title: Biological Sensing with Nano-Bio Interface Systems

Major Professor(s): D. Marshall Porterfield & Timothy S. Fisher

Date: Thursday, June 23, 2011

Time: 3:00 – 5:00 pm

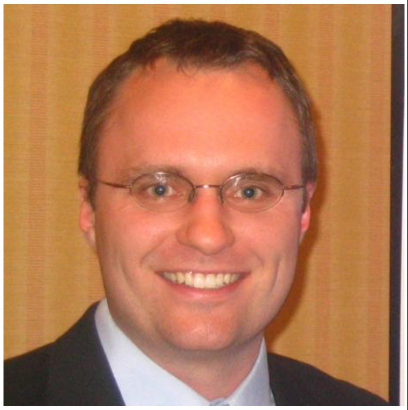
Location: Birck 1001

Abstract:

This research aims is to improve the versatility and manufacturability of nanostructured electrochemical biosensors by improving their performance (*i.e.*, detection limit, linear sensing range, selectivity, and lifetime) while reducing their fabrication complexity. The biosensor performance is enhanced by exploiting the electrochemical properties of nanoelectrodes (*e.g.*, more favorable Faradic-to-capacitive current ratios, higher current densities, and faster mass transport by convergent (radial) diffusion than macro/micro electrode) by developing nanoelectrodes in large networks or arrays to increase their overall measurable current signal and expand their efficacy in biosensing applications. This work utilizes large arrays of carbon nanomaterials [*e.g.*, single-walled carbon nanotubes (SWCTNS), graphene petal nanosheets (GPNs)] as templates for metallic nanoelectrode deposition. These templates reduce fabrication complexity by eliminating the need for lithography and etch back techniques typically used in nanoelectrode array design while facilitating charge transport between electrodes. Three distinct enzyme immobilization techniques including covalent linking, non-covalent drop coating, and electrodeposition are analyzed in order to understand and quantify their contribution to the performance of these newly developed nanoelectrode array biosensors. To understand the interconnected relationship between the nanoelectrode array transduction element and enzymatic biorecognition element and elucidate the tradeoffs between kinetics, mass transport, and charge transport a computational model is developed to assist in the biosensor development process.

Application:

These highly sensitivity biosensors enable non-invasive glucose sensing as they are capable of monitoring glucose levels in tear and saliva serums in addition to blood. Additionally, the biorecognition agent can be interchanged with other enzymes for the advancement of basic research and in-field biosensing associated with neurological disorders, patient trauma, food quality, and next generation bio-ethanol fuel technologies.



Jonathan Claussen received his Bachelor's in Mechanical Engineering and Bachelor's of Art in Spanish and Portuguese Studies from the University of Minnesota, graduating magna cum laude in 2006, and joined Purdue in the fall of 2006 for graduate school with funding support from the Laura Winkelman Fellowship. In the fall of 2008, Jonathan received his Master of Science from the Department of Mechanical Engineering and subsequently began his Doctoral studies in the Department of Ag. & Biological Engineering at Purdue. His PhD work is focused on nanostructuring electrode surfaces with carbon nanotubes, multi-layered graphene, and metallic nanoparticles for unique biosensing applications. Jonathan intertwines computational modeling with bottom-up fabrication protocols to optimize the size, spacing, and shape of nanomaterials grown on electrode surfaces for enhanced biosensor performance. Jonathan was also the recipient of the ABE Outstanding PhD graduate student award this past school year.

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