Public Abstract
First Name:Craig
Middle Name:Ryan
Last Name:Weilbaecher
Adviser's First Name:Sheila
Adviser's Last Name:Grant
Co-Adviser's First Name:Shubhra
Co-Adviser's Last Name:Gangopadhyay
Graduation Term:SP 2010
Department:Biological Engineering
Degree:PhD
Title:Development of a Fluorescence-based Protease Biosensor using Nanoscale Platforms

The development of a protease biosensor utilizing nanomaterials is presented in this dissertation. Peptide substrates and nanomaterial platforms were investigated to increase the sensitivity and response time for the detection of protease analytes. Nano-sized platforms, including nanoparticles and nanofibers, offer the advantage of a higher surface area-to-volume ratio contributing to increased immobilization points and a capability of an enhance signal output due to a greater chance of analyte interaction with the sensing surface. Nanoparticles (Silica Nanoparticles, Quantum Dots, and Gold Nanoparticles) in solution and solid surface (Polymer) nanofibers were tested with immobilized peptide substrates that contained fluorophores to acquire fluorescence for signal transduction. We utilized FRET (Fluorescence Resonance Energy Transfer) and quenching techniques for our assays to generate a quantifiable signal to detect trypsin and thrombin. Thrombin, a blood coagulating enzyme, was the target analyte for the studies. A full characterization was accomplished through a variety of optical characterization techniques and an optimized protocol has been developed for each of the sensing systems. Limits of detection reached the picomolar range and response time was within minutes. The results from these studies are reported for each of the sensing platforms with response to protease analytes. Future applications for this technology include bed-side monitoring devices as well as environmental monitoring devices for other protease targets (i.e. biothreat agents).