IOWA STATE UNIVERSITY
Department of Chemical and Biological Engineering

Graduate Seminar Series 2018-2019

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Iowa State University

Nano-based Materials and Sensors for Pathogen Monitoring Applications: A Biomimetic Approach

The global supply of safe and abundant food is pressured by the increase demand from a growing population and by limitations in supply due to increases in biofuel production and urbanization, and by climate change. These pressures are further exacerbated by the fact that over 30% of food produced is currently wasted, due to poor quality, spoilage, and contamination, which not only impacts the quantity, but also the safety of food. To make matters worse, foodborne pathogens have further threatened human health and food recalls are increasingly common and economically costly. Thus, rapid and inexpensive sensor technologies with on-site measurement capabilities are sorely needed to ensure that food products are not wasted and remain safe at the nexus of global food security and safety across the food supply chain. The two major challenges for these biosensors are selective capture of the target pathogen, and determination of pathogen viability without requiring reagents and complex equipment. The current standard pathogen sensing technologies (e.g., ELISA and PCR) require expensive laboratory equipment, highly trained personnel, and are time consuming tests (24 to 72 h). Hence, current pathogen sensing technologies are not suited for rapid on-site detection. This seminar will discuss emerging biomimetic biosensor technologies for creating low-cost, disposable biosensors for rapid detection of pathogens in food products. The first part of the presentation will focus on biomimetic strategies for creating polymers structured with small nanoscale brushes that respond to stimuli (e.g., pH and temperature) and help selectively capture pathogens based on a natural symbiotic system – an association between the Hawaiian bobtail squid and the marine bacteria Vibrio fischeri. The second part will focus on a new strategy for viability determination and for concentrating cells at the sensor surface using a combination of dielectrophoresis and impedance spectroscopy analysis. Several prototype systems designed for food safety monitoring will be discussed, with examples of applications. As nanotechnology makes its way into food and agriculture, a multidisciplinary approach is absolutely critical for the development of sensing systems that can be applied throughout the food supply chain to ensure food security and safety for current and future generations.

Dr. Gomes is an associate professor in the Department of Mechanical Engineering at Iowa State University where she is leading a successful research program on the design of novel nanoscale materials using biopolymers for biotechnology and food applications. The study of stimuli-responsive biopolymer nanostructures is of particular interest to both basic and applied sciences to mimic the dynamic properties of biological systems. This research area is playing an increasingly important part in a diverse range of applications as these polymers can be accurately tuned via external stimuli to achieve functionalities that mimics processes found in nature (i.e., release, entrapment, detection, selective capture, etc.) resembling living systems. Projects pursued in her laboratory range from fabrication of polymeric nanomaterials and nanostructured devices for biosensors to bioactive delivery systems. Such stimuli-responsiveness are important to a wide variety of scientists and engineers who are interested in in-vivo cell monitoring, rapid analyte detection, drug delivery, and tissue engineering. She collaborates with scientists and engineers from diverse fields including biological and agricultural, electrical, mechanical, and civil engineers, physicists, food scientists, microbiologists, and plant pathologists to pursue these projects.

Thursday,

January 31, 2019

11:00 a.m.

171 Durham Center

Iowa State University