Nanosensors for measuring pathogens in food products – a biomimetic approach

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Seminar host: Eliot Winer

Abstract
The global supply of abundant and safe food is pressured by increased demand from a growing population, by limitations in supply due to increases in urbanization and biofuel production, and by climate change. Furthermore, over 30% of food is currently wasted, due to poor quality, spoilage, and contamination. Moreover, additional threats to our food supply include mislabeled or misbranded food entering the supply chain. 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 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. 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.

Bio
Dr. **Carmen Gomes** is currently an Associate Professor in the Biological and Agricultural Engineering Department at Texas A&M 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 breakthrough 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. These nanomaterial-based biosensors are functionalized with biorecognition agents such as aptamers, antibodies, and lectins for the selective and rapid detection of pathogens. The combination of stimuli-responsive polymers actuation with selective capture of bacteria by biorecognition agents immobilized on the polymer surface increases selective capture and detection of target pathogens. Moreover, controlled release can be achieved by precisely tailoring nanostructure properties to respond to external stimuli and ultimately control bioactive delivery. Such stimuli-responsiveness are important to a wide variety of scientists and engineers, especially mechanical engineers, who are interested in in-vivo cell monitoring, rapid analyte detection, drug delivery, and tissue engineering.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.