UNIVERSITY OF RHODE ISLAND
Department of Chemistry
SEMINAR

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Ph. D Seminar
Chemistry Department
URI

"Nanostructured Platforms for Single Molecule Sensing and Molecular Fingerprinting"

HOST

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Nanostructured Platforms for Single Molecule Sensing and Molecular Fingerprinting

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Nanoscale platforms can have a profound influence on sensor performance, arising from the increased surface-area-to-volume ratio on length scales <100 nm, and often on the emergence of new phenomena on this length scale and even enhancement of existing phenomena. These platforms can be used to form sensing devices capable of molecular sensing and fingerprinting. We are interested in building sensitive, selective, low-cost and reliable sensing platforms to sense molecules with the long-term goal of building point-of-care diagnostics. Our work extends in two directions, (1) development and characterization of a low-overhead route for surface enhanced Raman spectroscopy (SERS) substrate fabrication; (2) solid-state nanopore sensing of polysaccharides—a new direction in the field of single molecule polysaccharide profiling.

Surface enhanced Raman Spectroscopy is a powerful technique for molecular vibrational fingerprinting that senses molecules proximal to a coinage metal surface. Enhancement depends on the structure of the metal film, and consequently the technique relies on both the metal film deposition characteristics and the underlying physical support structure. We used electroless gold plating as a general approach to fabricate a series of gold film structures on a variety of supports that resulted in apparent structural differences in the gold film, thus augmenting nanoporous filters, chromatography platforms, and nanofabrication building blocks with SERS capability.

Polysaccharides are a complex class of biomolecules that play a vital role in energy storage, structure, cellular communication, and even as drugs, e.g. heparin. Compared to other biomolecules like DNA or proteins, polysaccharide analysis is significantly complicated with over 100 naturally occurring monomer units that build polysaccharides with a wide variety of linkages, chain lengths, isomeric forms and branching. Nanopore single molecule sensors have shown immense promise for DNA and protein analysis and have promise to do the same for polysaccharides. So far, nanopores have been limited to monosaccharide and oligosaccharide analysis. Solid-state nanopores with the capability to tailor-make the pore sizes, hold promise for polysaccharide analysis. For the first time, we demonstrate the ability of silicon nitride nanopores to detect polysaccharides and enzyme-digested products and ability to differentiate them by a fingerprint profile. Moreover, we demonstrate the nanopore fingerprint capability in detecting contaminants in polysaccharide-based drugs by analyzing a heparin sample deliberately contaminated with over-sulfated chondroitin sulfate.