Virginia Tech
Wake Forest University
School of **Biomedical Engineering and Sciences**

Distinguished Lecturer Series:
Thursday, February 2nd, 10am – 11am
VT: 310 ICTAS/WFU: Radiology Lecture Hall, 1st floor MRI Bldg.

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In situ Optical Sensing with Plasmonic Nanostructures: From Biotechnology to Energy Systems

Plasmonic nanostructures have long been known to manipulate light to yield unique optical properties. In this essence, my talk will discuss how optical properties of plasmonic nanostructures can be harnessed to understand fundamental physical processes directly relevant for biomedical and energy applications. First I will demonstrate the theranostic potential of metal nanoshells, plasmonic nanostructures consisting of a silica core wrapped in a gold shell, enabling tumor targeting, diagnosis and therapeutics all within a single nanoscale complex. The theranostic nanoshells were designed by coupling FDA-approved near-infrared fluorophores, iron oxide nanoparticles, and targeting moieties for multi-modal MRI and near-infrared fluorescence imaging, and targeted photothermal therapy of cancer cells both *in vitro* and *in vivo*. I will show *in situ* tracking of these theranostic nanoshells *in vivo* providing detailed information regarding the distribution and fate of complex nanoparticles designed for specific diagnostic and therapeutic functions.

In the next part of my talk I will discuss the use of plasmonic nanostructures as probes for the design of next-generation hydrogen storage systems. Currently, experimental understanding of how nanoparticle size controls the kinetics and thermodynamics of metal-hydride formation and decomposition is limited, due to challenges both in directly probing these events at the nanoscale and preparing uniform samples over a series of sizes. By developing a sensitive optical technique to monitor the luminescence of metal nanocrystals *in-situ*, I will present experimental results detailing the thermodynamics and kinetics of hydride phase transformations within a size-series of monodisperse palladium nanocrystals. The *in situ* optical approach enables a detailed understanding of how nanocrystal surfaces control nucleation of metal hydride phase which directly impacts the design of practical high-performance hydrogen storage materials. This *in situ* optical technique provides a general platform to measure and understand optical response of a range of nanomaterials enabling applications from energy storage and energy conversion to cellular and molecular imaging.