Purdue University

School of Materials Engineering MSE 690 Seminar Series Presents

Date: Monday, September 30, 2013

Time: 3:30 Refreshments
3:45 Seminar

Place: ARMS 1010

PURDUE MATERIALS ENGINEERING

Infinite Possibilities

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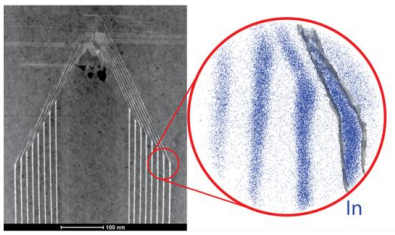
ABSTRACT

Design, Synthesis and Characterization of Nanostructures

Bottom up synthesis of nanostructures has gained much attention in the past decade due to the unique characteristics of the synthesis method, which involves mild experimental conditions and less precise control of process variables. This method leads to the creation of size controlled nanostructures that show promising potential in nanoelectronics, optoelectronics and sensing. These structures are essentially metal/semiconducting nanoparticles decorating a nanoscale template such as proteins, cellulose etc. This part of the talk will highlight the significance of this synthesis technique with a brief emphasis on the structure and properties of these structures.

Decorations of nanowires with plasmonic nanoparticles to form a hybrid, which have some similarities to the above nanostructures, are of great interest in energy related applications especially in catalysis and energy storage. These hybrid structures are fast emerging as a viable alternative to the commercially available thick film solar cells. Here, design, synthesis and characterization of Si nanowire-Au nanoparticle hybrid structures will be discussed. Finite difference time domain (FDTD) simulations, Raman spectroscopy and a tomographic technique using scanning transmission electron microscopy (STEM) were used to explore these hybrids. The main focus of this work was to study the enhanced *light absorption* in Si nanowires in the presence of plasmonic Au nanoparticles. This enhanced light absorption generates additional charge carriers in the Si nanowires, which are essential for improving the efficiency of devices that would integrate these hybrid structures.



HAADF-STEM image of a GaN-InGaN heterostructure.
APT reconstruction showing Indium in the heterostructure.

The next part of the talk discusses the characterization of GaN-InGaN core-shell heterostructures, which are predominantly used for *light emission*. Here, Atom Probe tomography (APT) was utilized for the characterization purposes. The recent commercial development of APT has enabled the composition of conventional inorganic semiconductors and devices to be explored at the nanoscale in three dimensions with part-per-million sensitivity. The samples, for this characterization, were prepared by focused ion beam (FIB) technique followed by precise annular milling. Various regions of the core-shell heterostructure were characterized to study the Indium content in the structure. Correlated cathodoluminescent (CL) measurements were also performed on these heterostructures. The figure shown here is a high angle annular dark field (HAADF) STEM image of a GaN-InGaN core-shell heterostructure. The highlighted region in the image is representative of a region where APT was performed. The image to the right is a reconstruction from an APT data showing Indium atoms in a GaN-InGaN heterostructure.

SHORT BIO

Sonal was born and brought up in India. She completed her Bachelors in Engineering with Metallurgy as her major, from Government College of Engineering, Pune University. She then obtained a Masters in Physical Metallurgy, from Pune University. Sonal has been a graduate student in the School of Materials Engineering at Purdue University. She completed her Ph.D. under the guidance of Prof. Lia Stanciu in 2010. Presently, Sonal is a post-doctoral fellow in the Department of Materials Science and Engineering at Northwestern University. She is supervised by Prof. Lincoln Lauhon.