The Fall 2006 Condensed Matter Seminar series presents:


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# "Advanced Transmission Electron Microscopy: Towards Single Atom Detection"

Today, almost any cutting-edge nanoscience effort includes extensive atomic resolution electron microscopy. Recent technological advances in the field of transmission electron microscopy (such as aberration correction) have increased the spatial resolution into the sub-Ångstrom range, the energy resolution into the sub-eV range, and the sensitivity to resolve single atoms. Atomic-scale analysis plays a unique role in discovering how structures function on the nanoscale.

Virginia Tech is addressing this fundamental characterization need by the establishment of a new user facility with its core facility – a 'FEI Titan' scanning / transmission electron microscope (S/TEM), a dedicated aberration corrector system with state-of-the-art imaging (HRTEM phase contrast, exit-wave reconstruction, HAADF-STEM 'Z-contrast', tomography, …) and spectroscopic capabilities (EDX, EELS, EFTEM). The application of these techniques will provide critical information to understand phenomena on the nanoscale. I will briefly discuss the exciting new electron microscopy research opportunities that exist now at Virginia Tech. The 'strategic plan' includes attaching a spherical aberration (CS) corrector for the image plane and the application of new state-of-the-art experimental methodologies.

As an example, I will show how advanced TEM has been used to describe a comprehensive picture of the general light emitting mechanism of commercially available high-brightness InGaN/GaN based green light emitting diodes (LED). For the first time, the local indium stoichiometry has been linked to the local electronic structure inside the quantum well (QW) structure. This challenge was addressed by application of high-resolution TEM (HRTEM), reconstruction of the exit wave (EWR), annular dark field (ADF) TEM, and Z-contrast imaging (HAADF-STEM) to characterize the atom distribution. Furthermore, valence electron energy loss spectroscopy (VEELS) has determined local band gap fluctuations.

Finally, I briefly would like to focus on how we will achieve atomic resolution in 3-D electron microscopy (electron tomography) in the near future.

**Wed., Nov. 1 | 4:00 P.M. | 304 Robeson**