The Waterloo Institute for Nanotechnology

Presents

From "Giant" Nanocrystal Quantum Dots to Controlled Colloidal Synthesis of Semiconductor Nanowires

Dr. J.A. Hollingsworth

Scientist, Center for Integrated Nanotechnologies
Los Alamos National Laboratory

Part 1: Nanocrystal quantum dots (NQDs) are nearly ideal candidates for light-emission applications due to high quantum efficiencies, and narrow-band and particle-size-tunable photoluminescence. However, they suffer from important deficiencies, including intermittency in fluorescence intensity, or "blinking", at the single NQD level and chemical-environment-dependent photo-instability at the ensemble level. We recently reported the first demonstration of an inorganic shell approach to address these outstanding issues; namely, the suppression of blinking and ensemble-level instabilities. Here, I will review these results, as well as key findings establishing the "giant" NQDs (g-NQDs) as a functionally new class of colloidal quantum dot: significant suppression of nonradiative Auger recombination, highly emissive multiexcitons and near-unity biexciton emission. Beyond a summary of these fundamental studies, I will describe the integration of g-NQDs into light emitting devices as (1) robust, "passive" phosphors and (2) active layers in electrically pumped light emitting diodes, where, the thick-shell NQDs provide significant advantages compared to their thin-shell counterparts in terms of device efficiencies, self-reabsorption, and/or stabilities.

Part 2: Semiconductor nanowires (SC-NWs) constitute "next-generation" nanoscale building blocks for a range of applications from nanoelectronics and photonics to energy harvesting. SC-NWs can be fabricated using either vapor- or solution-phase methods, where solution-phase approaches offer advantages in simplified processing and scale-up, ultra-small diameters for enhanced quantum-confinement effects, and an almost unlimited choice of materials systems. Despite these advantages in terms of composition and size control, there is currently no clear way to use the solution-phase methods to grow complex axial heterostructures. Here, I describe our efforts to develop new fabrication strategies that afford unprecedented control over SC-NW growth in the solution phase, including semiconductor-semiconductor and semiconductor-metal heterostructures.

WATERLOO INSTITUTE FOR nanotechnology

Thursday, September 22nd, 2011
3:30 pm - 4:30 pm
Davis Centre 1304