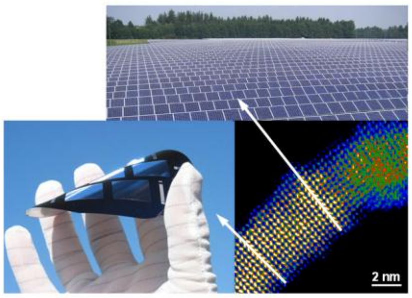
NANOHOUR

Wednesday, October 13, 2010 3:00 pm
Beckman Institute - Room 3269

CdSe/CdTe Nanocrystal Heterostructure Based Photovoltaics

Hunter McDaniel, Materials Science and Engineering
Graduate Student with Professor Moonsub Shim

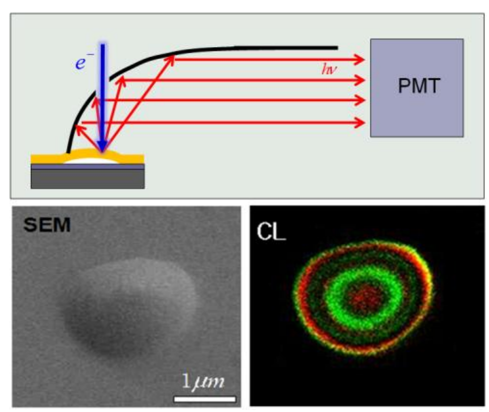


In the pursuit of lower costs and increasing efficiency, many researchers have looked at incorporating nanocrystals (NC) in photovoltaics. Our new approach is to sandwich type II nanocrystal heterostructures between wide gap electron and hole transport layers of appropriate band energies.

Type II nanocrystal heterostructures (NCHs), CdSe/CdTe for example, exhibit tunable photo-induced charge separation, long carrier lifetimes and broad red-shifted absorption compared with their single phase counterparts. Due to properties that are strongly dependent on size and shape, and furthermore, due to the necessity for physically and chemically accessing both components of the heterostructure, the key step towards functional multi-component systems is the ability to control not only the size and shape but also spatial orientation of each component with respect to each other. In order to better understand growth mechanism leading to enhanced anisotropy and charge separation in NCHs synthesized from monodisperse nanorod seeds, we have examined various factors that contribute to and the effects of structural diversification in the type II CdSe/CdTe system. Highly Stokes-shifted emission arises from heterointerfacial recombination and can be enhanced or suppressed via controlled positioning of CdTe on CdSe nanorod seeds. A careful examination of these NCHs using high resolution TEM and STEM techniques allow for a spatial mapping of the composition which is then correlated with electronic and optical features yielding information about how the interfacial strain (6.6% mismatch) is relieved in such systems and how it might be engineered to promote charge separation for photovoltaic applications.

Light confinement in nano-bubble cavity probed by cathodoluminescence

Hyungjin Ma, Physics
Graduate Student with Professor Nicholas Fang (MechSE)



Optical modes in metallic nanostructures have been widely studied for various applications such as surface enhanced Raman spectroscopy, sensors and metamaterials. Metal-Dielectric-Semiconductor (MDS) composite structure has brought a new attention as a promising candidate for nanoscale confinement of light with relatively low loss and high confinement, especially for potential applications in optoelectronic devices. However, typical mode volume of such structure is very small and far below the diffraction limit of conventional optical microscope. Here we have employed cathodoluminescence (CL), which is light emission under electron beam bombardment, to investigate local optical modes of air cavity trapped in between semiconductor and metal layers. It is observed that spectral and spatial characteristics of light emission are highly dependent on the gap size, which is well explained by theoretical modeling of radiation using multiple image charges.

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