

Luminescent quantum dots and upconversion nanocrystals: Synthesis and biomedical applications

Amiya Priyam

Birla Institute of Technology, India

Amongst various types of luminescent nanomaterials, the two that have attracted attention worldwide are: 1. Semiconductor nanocrystals or quantum dots (QDs) and 2. Lanthanide based upconversion nanocrystals (UCNs). In semiconductor nanoparticles, unique optical properties such as size dependent luminescence arise due to spatial confinement of the charge carriers. In this talk, I would discuss the aqueous routes to obtain biocompatible, highly monodisperse and luminescent nanocrystals. In the synthetic methodology developed by us, the nanoparticles were capped with amino acids, thiols and dendrimers which impart stability, functionality and determine the solubility of these particles. The temporal evolution of these surface-functionalized nanocrystals has been thoroughly studied and key parameters affecting the luminescence efficiency and size distribution has been identified. Subsequently, the interaction of bio-functionalized nanoparticles with some biomolecules such as enzymes and bio-oxidants was investigated and new protocols for nanoparticle-based biosensors have been developed. These QDs exhibit very good optical properties and did overcome several limitations of the organic dyes that were conventionally used for biomedical applications. However, 'blinking' effects, tissue auto-fluorescence and cytotoxicity concerns limit their use in bio-imaging. The exciting UV/Vis light cannot penetrate tissues beyond 1 cm and therefore these materials are not suitable for deep tissue imaging. Upconversion luminescent nanomaterials (UCN) circumvent all these problems involved in bio-imaging. They can be excited by near-IR (NIR) light where biological components do not absorb and the upconverted multicolor fluorescence can be observed with zero background and without causing photodamage to the cells. The second part of my talk would focus on such nanomaterials, specifically, Yb, Er co-doped NaYF₄ nanocrystals which show unique property of NIR-to-vis photon upconversion. The synthesis of these nanocrystals and their use in fluorescence imaging of cancerous cells would be discussed.

Biography

Amiya Priyam (<http://www.researcherid.com/rid/B-4164-2010>) obtained his B.Sc. and M.Sc. degree in chemistry from University of Delhi, India. He completed his PhD from Jadavpur University in 2008. Subsequently, he worked as post-doctoral research fellow at Florida State University, USA and National University of Singapore. Currently, he is assistant professor in the department of applied chemistry at Birla Institute of Technology, Mesra, India. He is a life member of CRSI (Chemical Research Society of India) and MRSI (Materials Research Society of India). He also serves as reviewer for prestigious RSC journals.

amiya.priyam@gmail.com