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QUANTUM DOTS: PHYSICS AND APPLICATIONS

Arturo A. Ayon, Ph.D.

Physics and Astronomy Department. The University of Texas at San Antonio, Texas, USA.

Quantum Dots are frequently explored nanostructures because they exhibit the characteristic of capturing high energy photons and subsequently emitting lower energy photons. This photoluminescent effect is commonly referred to as down-shifting or Stokes shift. The photoluminescent wavelength peak is a function of the chemical composition of the QDs involved as well as their size, with longer wavelengths associated with larger QDs. Additionally, QDs are known to exhibit several favorable characteristics comprising (1) significant interactions between the nano crystals and wavelengths near the ultraviolet range of the solar spectrum, (2) an extraordinary photo stability, (3) a strong relationship of the size and shape of the nanoparticle with its emission and absorption spectrum and (4) having electrical properties that are intermediate between bulk semiconductor and discrete molecules and, therefore, making them attractive for a variety of applications. In this presentation we discuss the physics of the length parameters involved in the classification of nanocrystals including the crystal lattice constant aL, the exciton Bohr radius aB^*, and the wavelength, λ, associated with the lowest optical transition of the semiconductor, the relevance of the confinement regimes determined by the inequalities $R<aB^*$ and $R>aB^*$, the nucleation or growth mechanism and the utilization of quantum dots for tailoring fermionic properties, white-light generation, photovoltaic structures and biomedical applications.