Quantum dot solids with tunable optical properties on glass substrates

B. Pejova

Institute of Chemistry, Faculty of Natural Sciences and Mathematics,

Ss. Cyril and Methodius University, Skopje, N. Macedonia

*biljana@pmf.ukim.mk

The focus of nanoscience and nanotechnology is gradually shifting from individual nanostructures to their assemblies in which these nanostructures mutually interact and organize into nanostructured materials with new collective properties and remarkable applications in a wide range of fields (such as medical diagnostics, drug delivery, sensors, electronic devices etc.). Currently, in this context, self-assembly of nanoparticles is a hot topic in nanotechnology and a key tool in construction of novel nanodevices.

In this talk, tunable optical properties of several QD solids will be of primary focus, including materials built up by core-shell nanostructures. Band gap energy of QD solids was size-tuned using a bottom-up approach, based on the ultrasound-assisted colloidal mechanism. Coupled with sonoluminescence, this approach provides fine control of the QD size. Along with this, optical properties were additionally modified implementing doping procedure which led to creation of doped QDs and core-shell nanostructures. Since self-assembly of QDs is driven by interactions between them, depending on the experimental conditions under which the synthesis has been taken, QD solids with different degree of ordering have been created. Their optical properties, including sub-band gap absorption and photoluminescence, were considered as a complex interplay of the structural disorder on an individual QD level and on a superlattice scale. Structural inferences have been derived from advanced analysis of X-ray diffraction patterns of the synthesized QD solids, as well as from electron diffraction technique, while superlattice-scale morphology has been studied by SEM and AFM in conjunction with image-analysis techniques.

Keywords: quantum dots (QDs), QD solid, self-assembly, tunable optical properties, band gap energy, sub-band gap absorption, photoluminescence properties, ultrasound-assisted synthesis, bottom-up approach, sonoluminescence.