Center for Molecular Spectroscopy and Dynamics, IBS-Korea University

IBS Center for Molecular Spectroscopy and Dynamics

Seminar

- **SPEAKER**
  Dr. Young-Shin Park (Department of Chemical & Biomolecular Engineering, KAIST)

- **TITLE**
  Compositionally graded CdSe/CdxZn1-xSe colloidal quantum dots

- **ABSTRACT**
  Semiconductor colloidal quantum dots (QDs) have been explored as promising nanomaterials for light-emission application such as light-emitting diodes (LEDs) and display due to their favorable properties at room temperature: size-tunable emission colors based on quantum confinement effect, very high brightness (quantum yield up to ~ 100%), and inexpensive solution-based processability. One of long-standing issues that remain unresolved in QD studies is the control of nonradiative Auger recombination of multicarrier states, where the electron-hole recombination energy is not converted to a photon, but instead transferred to a third carrier. Due to Auger process, biexciton lifetime is very fast (typically, < 100ps) and makes biexciton state nearly non-emissive (quantum yield ~ a few % only). Thus, Auger recombination is normally known to be responsible for, for example, efficiency roll-off in LEDs and photoluminescence (PL) intermittency in single-dot level. Among trials to suppress Auger process in heterostructured QDs, an effective way is to make the core-shell potential transition 'soft', instead of 'sharp′ core-shell interface, as widely reported in various publications.

  In this talk, I will discuss the newly developed CdSe/CdxZn1-xSe QDs, wherein the CdSe core is surrounded by a compositionally graded shell, leading to 'soft' interface along the radial direction. We demonstrated that biexciton quantum yield of CdSe/CdxZn1-xSe QDs is as high as ~ 45% along with an extended biexciton lifetime (tBX > 1 ns). When these QDs are applied in devices, we achieved nearly roll-off-free behavior in LEDs and theoretical-limit thresholds in QD lasers. Interestingly, in single-level studies, these structures exhibit a highly stable emission energy (s.d. < 1 meV) along with non-blinking emission. In addition, a very narrow, subthermal roomtemperature linewidth (~20 meV) is observed, which is attributed to strong suppression of excitonphonon interaction. These remarkable spectral characteristics make these compositionally graded QDs well suited for practical realization of single-photon sources.

- **DATE AND VENUE**
  December 13, 2021 (Monday, 16:00 - 17:00)
  Seminar Room B (119), KU R&D Center

- **LANGUAGE**
  Korean

- **INVITED BY**
  Professor Kwang Seob Jeong