성균관대학교 에너지과학과
DEPARTMENT OF ENERGY SCIENCE

[Energy Distinguished Lecture Series]

Nov. 11 Wed. 2026, 4:00pm

Structural Engineering Strategies for Semiconductor Heterostructures in Optoelectronic Applications

N Center #86120, Sungkyunkwan University, Suwon

Prof. Byeong Guk Jeong

Pusan National University

Abstract

Colloidal semiconductor nanocrystals (NCs), commonly known as quantum dots, have emerged as transformative material platforms for next-generation optoelectronic energy applications. Their unique quantum confinement effects enable size- and composition-tunable bandgaps, near-unity photoluminescence quantum yields (PLQYs), and high spectral purity—attributes critical for high-efficiency color conversion and electroluminescent devices. Moreover, their solution processability holds substantial promise for scalable, energy-efficient manufacturing of large-area optoelectronic platforms.

However, realizing their theoretical efficiency limits and ensuring long-term operational durability under rigorous electrical/thermal stress remain central challenges. In this lecture, I present rational structural engineering strategies designed to optimize exciton dynamics. Specifically, we discuss precision synthesis methodologies for advanced radial and compositional heterostructures engineered to suppress non-radiative recombination pathways.

Furthermore, we address interfacial and surface engineering paradigms aimed at establishing balanced charge injection and transport dynamics. By tailoring the electronic band alignments, we demonstrate quantum dot light-emitting diodes (QD-LEDs) with significantly enhanced external quantum efficiencies (EQEs) alongside prolonged operational stability. Finally, we highlight how these sophisticated heterostructure design principles can be generalized across broader optoelectronic and clean-energy technologies, offering a robust blueprint for high-efficiency, sustainable photonic devices.

Brief Bio



Byeong Guk Jeong received his Ph.D. in Chemical and Biomolecular Engineering from KAIST in 2019. Following postdoctoral and visiting research appointments at Sungkyunkwan University, Hanyang University, Purdue University, and Los Alamos National Laboratory, he joined Pusan National University in 2022, where he is currently an Associate Professor in the School of Chemical and Biomolecular Engineering. His research interests center on colloidal semiconductor heterostructures, spectroscopic analysis of nanocrystals, and the development of high-efficiency optoelectronic devices such as next-generation displays and photodetectors.

Department of Energy Science, SKKU

Center for fostering renewable energy integrated system researcher, SKKU