Quantum Photonics with Wide-Bandgap Semiconductor Nanostructures

Yong-Hoon Cho
Department of Physics and KI for Nanocentury,
Korea Advanced Institute of Science and Technology (KAIST), Daejeon 34141, Korea

Low-dimensional semiconductor nanostructures have attracted a lot of attention due to their rich and unique optical properties and their versatile photonic and quantum photonic applications. Especially, control of interaction between light and single quantum emitters are an important issue for cavity quantum electrodynamics studies and quantum information science. Here, we present various kinds of nitride-based quantum nanostructures and their intriguing photonic and quantum photonic phenomena including multi-color/broadband visible light emission, unidirectional light propagation, single photon generation, and exciton-polariton formation. Moreover, we demonstrated deterministic coupling between single quantum dots (QDs) and three-dimensionally nanofocused plasmonic modes. Large enhancement of the QD spontaneous emission rate is measured for all processed QDs emitting over a wide spectral range. We also developed a novel polariton system with large Rabi splitting energy resulting from strong coupling between a two-dimensional exciton and whispering gallery mode photon using a core−shell hexagonal wire with multiple quantum wells.