Classical and Quantum Light Generation from GaN-based Semiconductor Nanostructures

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GaN-based semiconductor materials and their micro- and nano-structures provide unique platform for versatile classical and quantum photonic applications. Here, we present broad-band and white light generation, effective single photon generation, and exciton-polariton formation at room temperature by using GaN-based quantum structures grown on various three-dimensional GaN templates First, we present phosphor-free broad-band and white-color light emission using three-dimensional GaN-based structures [1-2]. Second, we demonstrated effective single photon generation from site-controlled singe quantum dots (QDs) formed on the apex of pyramidal GaN structures and the self-aligned deterministic coupling of single QDs to nanofocused plasmonic modes, leading to strong spontaneous emission enhancement of QDs over a wide spectral range even at near room temperature. Moreover, we found that the majority of the extracted light from single QD could be guided toward the bottom of the pyramid with high directionality [3-6]. Finally, we observed room-temperature exciton-polariton condensates and photonic lasing from single hexagonal GaN core and GaN/InGaN core-shell microrod structures [7]. These approaches overcome the major hurdles in the implementation of practical solid-state classical and quantum photonic devices.

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