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Advances in GaN quantum dots for coherent control

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To date, the majority of quantum dot coherent control experiments have been performed on QDs formed in the III-As semiconductor system, with which a 2-qubit CROT logic gate has also been realized using exciton and biexciton states. However, there have been no reports on the successful coherent optical manipulation of III-Nitride QDs, which emit in the UV to visible regions. The III-Nitride system is promising as it can sustain room-temperature stable excitons in single GaN QDs; a property which enabled the realization of a single photon emitter operating at 200K [1].

Recently, in order to control the site of such QDs, we have developed the selective area growth of nanowires containing single QDs [2] by metal organic chemical vapor deposition (MOCVD). Our high-quality GaN QDs exhibit a very large biexciton binding-energy [3], fine structure splitting [4], and a strong phonon interaction [5]. Moreover, the presence of the excited states in single GaN QDs was evidenced by means of photoluminescence excitation (PLE) measurements [6].

In this presentation, we discuss recent progress in the growth and optical properties of site-controlled GaN quantum dots in GaN/AlGaN nanowires, including the experimental observation of excited state Rabi rotation, where damped oscillation has been observed in the power dependent spectra of the quantum dot ground state upon resonant pumping of an excited state [7].

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