単一 InGaN 量子ドットにおける スペクトル拡散の励起強度依存性の測定

Measurement of the power dependence of spectral diffusion from a single InGaN quantum dot.

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Single photon emitters based on quantum dots (QDs) are of particular interest due to their narrow emission linewidths, good thermal stability, rapid radiative recombination rates, high single photon purities, and the ability to be integrated in photonic crystal or optical cavities. Over recent years, III-Nitride QDs have displayed many advantages for use as single photon emitters, such as their widely tunable emission wavelength range, and the possibility to operate at relatively high temperatures (room temperature and above). However, III-Nitrides suffer from spectral diffusion caused by strong Coulomb interactions between QD-confined charges and fluctuating charges in the surrounding environment.

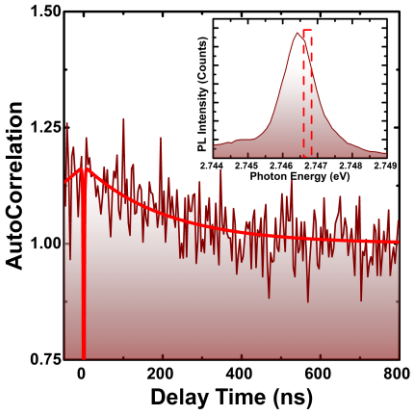

Fig. 1. Spectrally filtered autocorrelation measurement. Figure inset, spectra of an InGaN QD and the spectral filter (red dashed box).

In this work, we investigate the excitation power dependence of spectral diffusion time scales in a single self-assembled MOCVD grown InGaN QD. [1] Optical characterization is performed under CW laser excitation at a wavelength of 375nm (allowing excitation of the QD below the GaN bandgap). The temporal scale of the spectral diffusion is measured using spectrally filtered photon autocorrelation measurements [2]. Fig. 1 shows the 2nd order autocorrelation of a filtered emission profile from a single InGaN QD under an excitation power of 3μW (~70W/cm^2). In addition to an anti-bunching dip at time delay 0, bunching arises due to spectral diffusion of the emission line in and out of the measurement window during data acquisition.

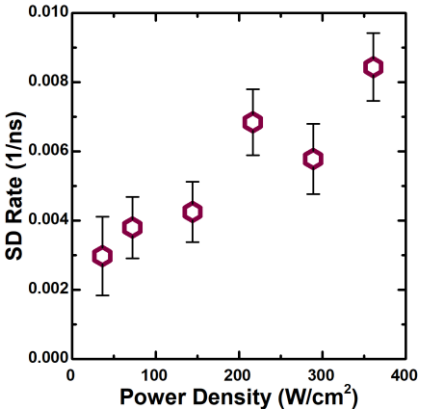

Fig. 2. Power dependent spectral diffusion rate of the single InGaN QD.

Fig. 2 shows the extracted spectral diffusion characteristic time as a function of excitation power density. A linear increase in the inverse spectral diffusion time with increasing power can be observed, with diffusion times as long as ~300ns achieved at low excitation powers. These values are much longer than have been reported from GaN QDs, making these structures of interest for indistinguishable photon generation.

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Reference: [1] H. Springbett *et al.*, Appl. Phys. Lett., 113 101107 (2018). [2] K. Gao *et al.*, AIP Adv., 7 125216 (2017).

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