Epitaxial growth of low surface density InAs/GaAs quantum dots emitting near 1.5 µm.

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The InAs quantum dots with increased lateral dimensions resulting in a photoluminescence spectrum shift to the telecom C-band have been grown directly on GaAs. We demonstrate that it is necessary to use $Ga_{0.8}In_{0.2}As$ cap layer grown at reduced temperatures to achieve intensive emission in this spectral region. It was shown experimentally that higher growth temperatures promoted increased dot size while simultaneously reducing surface density. High single-photon emission purity was achieved at room temperature, demonstrating the effectiveness of the combined growth and capping strategy. Detailed modelling calibrated by TEM studies explains experimental observations.

Low-density sample was studied at room temperature using a confocal setup with an excitation laser wavelength of 458 nm and 1 mW excitation power. Well-separated emitters (density ~1 dot/µm^2) were observed (Fig. 1a). Very high purity of the single photon emission at room temperature was demonstrated by the measured experimental value of the second-order autocorrelation function at zero delay: $g^{(2)}(0) = 0.08$ was observed (Fig. 1b). The typical measured room temperature µPL spectrum is shown in Fig. 1c. We also integrated the GaInAs-capped QDs layer into a vertical microcavity formed by two $GaAs/Al_{0.9}Ga_{0.1}As$ distributed Bragg reflectors (DBRs). The DBR stopband with a well-defined λ-cavity resonance was observed and the PL spectrum matched the cavity resonance in telecom band.

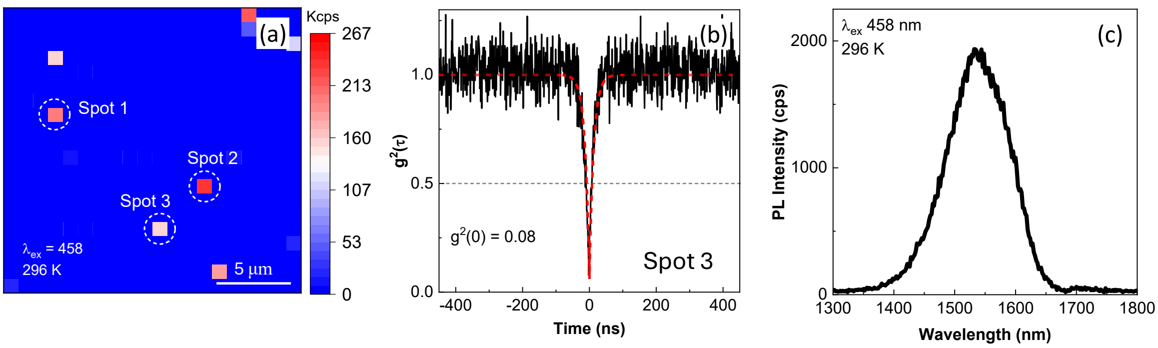

Fig. 1: *(a) Confocal PL intensity map of the capped QD sample, (b) the second-order autocorrelation function $g^{(2)}(\tau)$ of a selected QD, and (c) single QD µPL spectrum - all measured at room temperature.*

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