

Optical properties of epitaxial InAs/GaAs quantum dots overgrown under different V/III flux ratios

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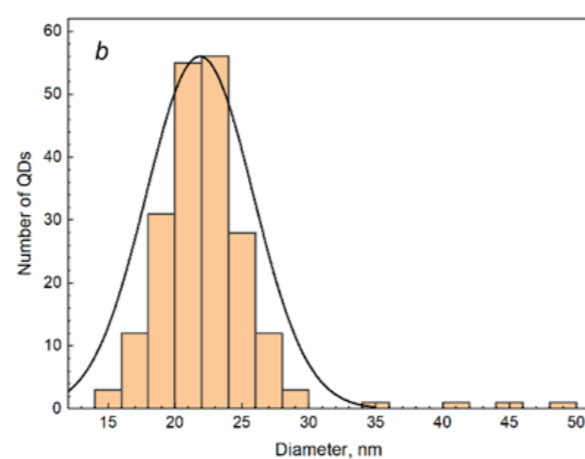
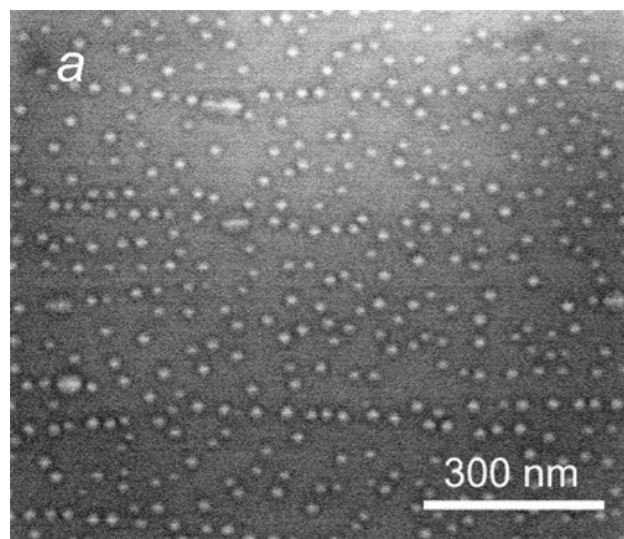
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Experiment

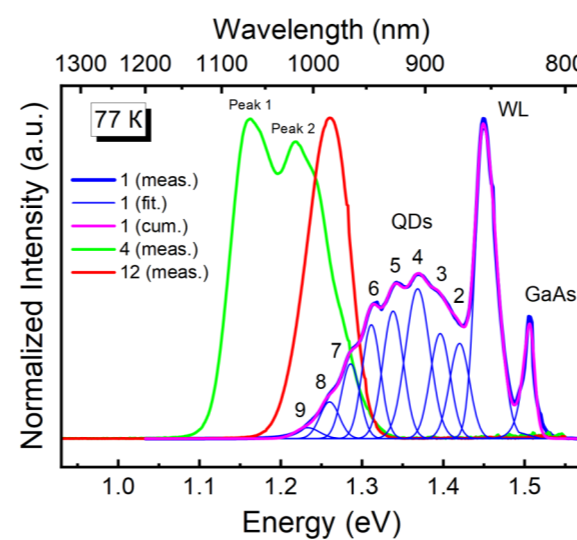
- QD growth temperature: 500°C
- QD growth rate: 0.05 ML/s
- QD overgrowth rate: 0.05-1.5 ML/s
- LT-GaAs layer thickness: 10 nm
- V/III flux ratios: 1-20
- As pressures: $2.5 \cdot 10^{-6}$ - $6 \cdot 10^{-5}$ Pa

Abstracts

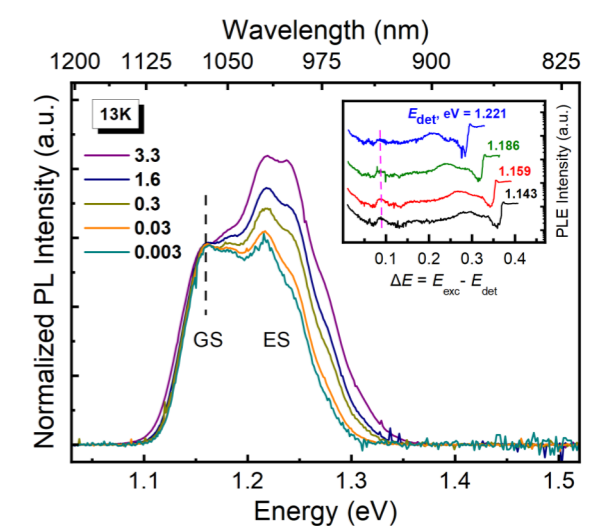
We study optical properties of epitaxial InAs/GaAs(001) quantum dots (QDs) overgrown under different V/III flux ratios using photoluminescence (PL) and PL excitation spectroscopy. If the V/III flux ratio during overgrowth is low, a series of pronounced QD-related peaks is observed in the 77-K PL spectrum over a 200-meV broad spectral interval with the brightest one located at 1.37 eV. With increasing V/III ratio, the PL spectrum becomes smoother and is red-shifted up to 1.16 eV. We explain this behavior in terms of enhanced QD decomposition, the mechanism of which is strongly dependent on the arsenic deficiency or excess during the overgrowth process, determined by the arsenic pressure. This study reveals an essential role of the arsenic pressure in the overgrowth of InAs QDs.



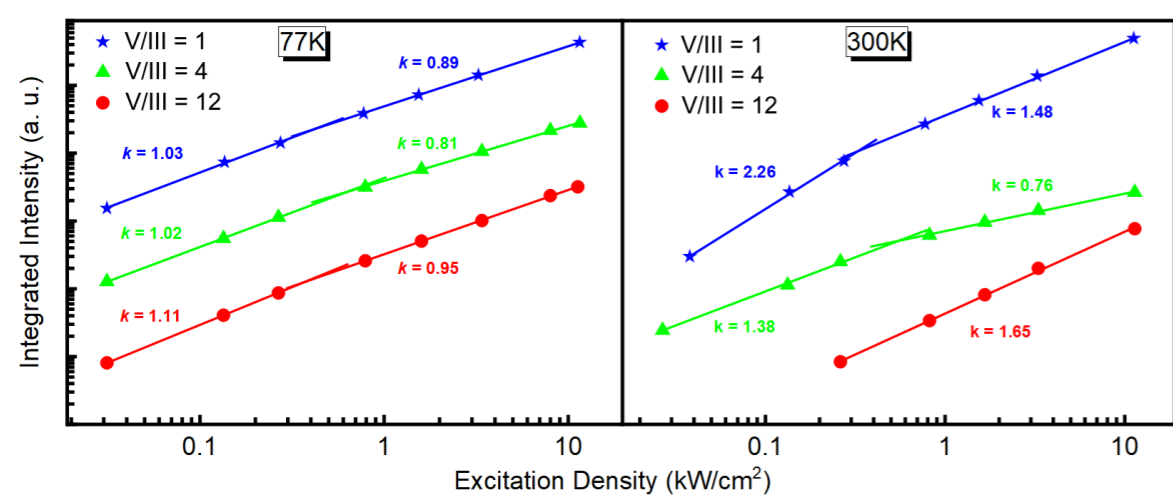
SEM image (a) and size distribution (b) of an array of uncapped InAs/GaAs QDs



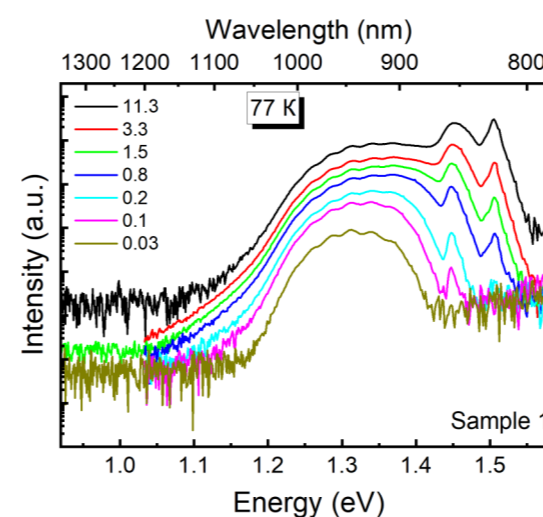
PL spectra at various V/III ratios. Digits denote a QD height in MLs



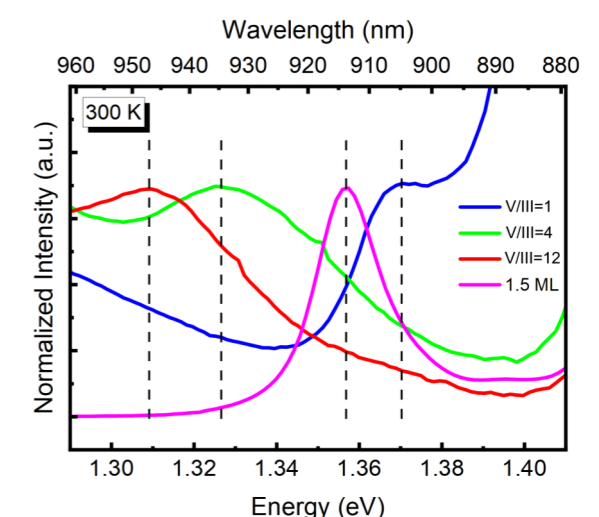
PL and PLE spectra of QD samples at a V/III flux ratio of 4



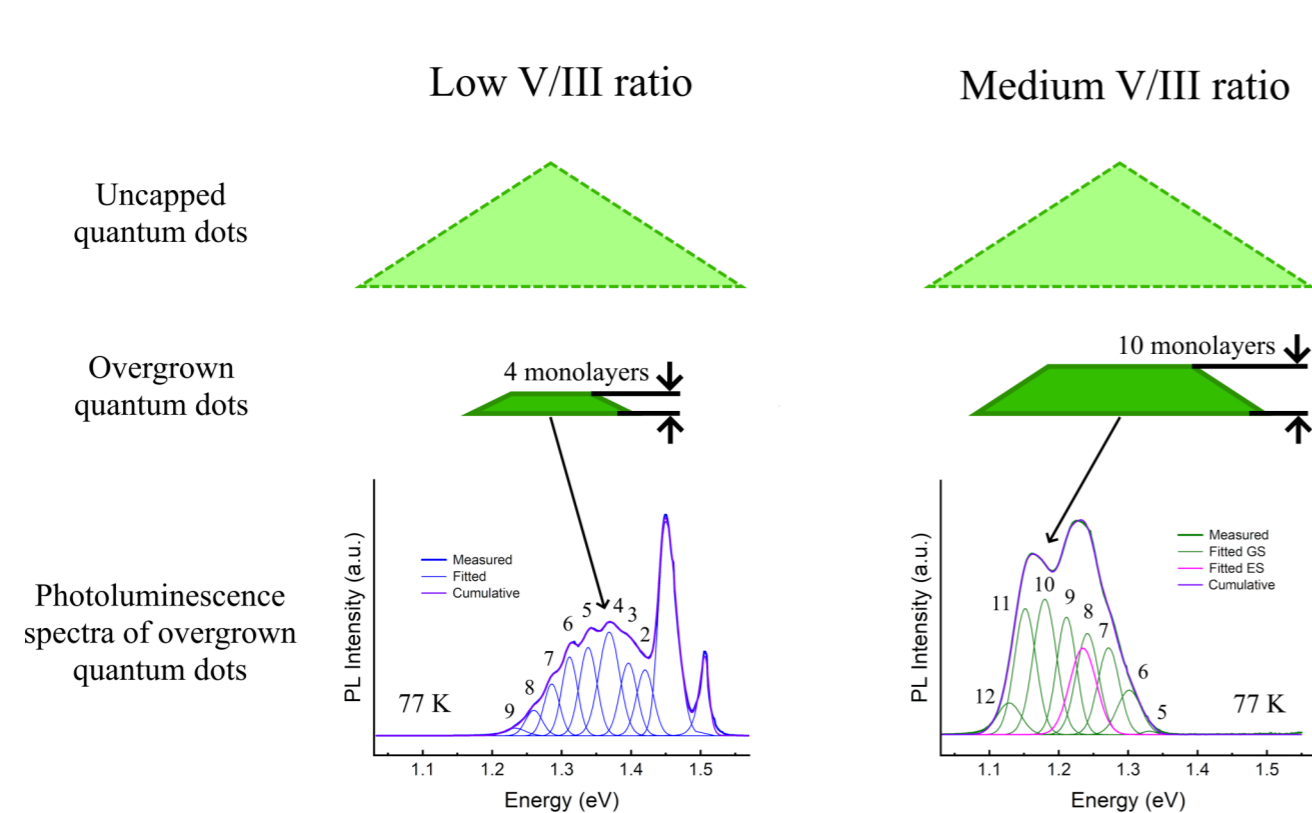
PL intensity dependences on the excitation power density at various V/III flux ratios



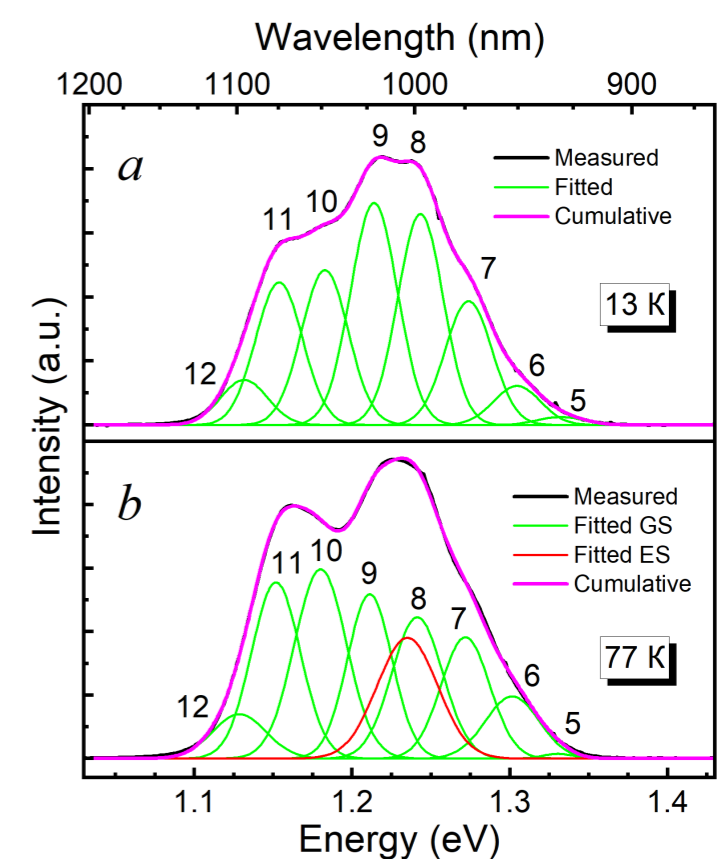
PL spectra of sample with V/III = 1 at various excitation densities



PL spectra of the wetting layer at various V/III flux ratios at 300 K



Schematic illustration of the transformation of the most representative QD from an array at various V/III flux ratios and corresponding PL spectra of the QD structure at 77 K



PL spectra deconvolution of sample with V/III = 4 at 13 and 77 K

Acknowledgements

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