GaAs quantum dots under external perturbations: Experiment and theory

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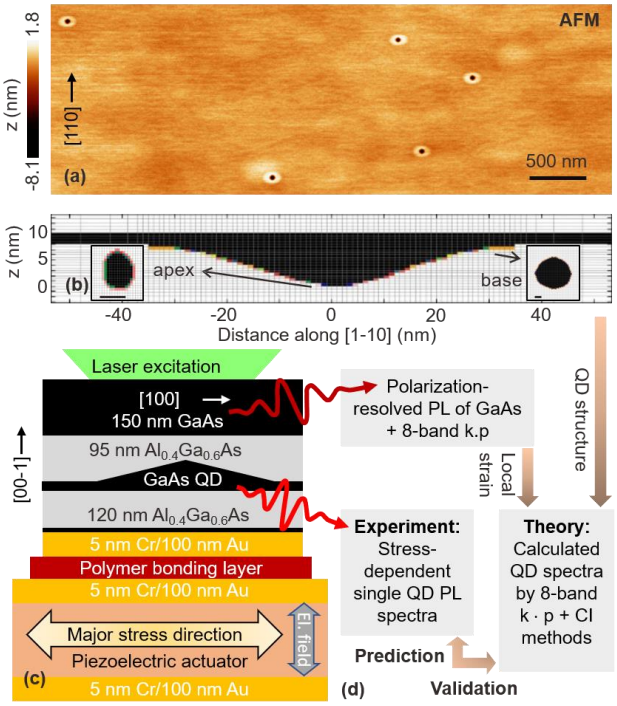
The electronic structure of excitons confined in initially unstrained GaAs/AlGaAs quantum dots are studied as a function of a variable quasiuniaxial stress [1], electric [2], and magnetic fields. We calculate the excitonic emission energy, degree of linear polarization, and fine-structure splitting using a combination of eight-band k · p or empirical tight-binding [3] formalism with correlated multiparticle corrections using the full configuration interaction method. [4] To allow the validation of our computational tools for describing the optical properties of nanostructures, we determine the quantum dot morphology and the in-plane components of externally induced strain tensor, electric, and magnetic fields at the quantum dot positions. These experimental parameters are then used as an input for our theory without any further tuning. The experimental observations are quantitatively well reproduced by our calculations.



[1] X. Yuan, *et al.*, Phys. Rev. B **107**, 235412 (2023).
[2] H. Huang, *et al.*, Phys. Rev. B **104**, 165401 (2021).
[3] A. Mittelstädt, A. Schliwa, P. Klenovský, Light Sci. Appl. **11**, 17 (2022).
[4] P. Klenovský, P. Steindl, D. Geffroy, Sci Rep **7**, 45568 (2017).