Quantum dots on GaAs substrates as integration-ready high-performance single-photon sources at telecommunication wavelengths

Bianca Scaparra [1,5], Beatrice Costa [1,2], Hubert Riedl [3], Gregor Koblmüller [2,3,4], Eugenio Zallo [2,3], Jonathan Finley [2,3], Lukas Hanschke [1,2] and Kai Müller [1,2]

1 Department of Electrical and Computer Engineering, TUM School of Computation, Information and Technology, Technical University of Munich, Munich, Germany
2 Munich Center for Quantum Science and Technology (MCQST)
3 Walter Schottky Institute, TUM School of Natural Sciences, Technical University of Munich, Munich, Germany
4 Institute of Physics and Astronomy, Technical University Berlin
5 Quandela GmbH, Munich, Germany

The development of deterministic single-photon sources emitting in the telecommunication bands is a key challenge for photonic quantum computing and quantum communication. To tackle this, we present the optical properties and single-photon emission of molecular beam epitaxy–grown semiconductor quantum dots (QDs) emitting in the telecom O- and C-bands.

The QDs are embedded in an InGaAs matrix with fixed indium content, grown on a compositionally graded InGaAs buffer with a tailored final lattice constant [1,2]. To improve the photon extraction efficiency, we implemented high refractive-index-contrast distributed Bragg reflectors achieved by growth on GaAs substrates [3]. This structure enables the future implementation of electrically contacted nanocavities to achieve high-quality and bright QD emission.

Using photoluminescence excitation (PLE), we identify resonances for optical excitation of QDs emitting in the telecom O- and C-bands. With this excitation method, we observe linewidths of single charged excitons up to the resolution limit of the spectrometer and demonstrate coherent control of their ground- and excited-state populations via Rabi rotations. Finally, through phonon-assisted excitation, we measure $g^2(0)$ values as low as 0.02 ± 0.01 [4].

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