Sonderforschungsbereich 631

Festkörperbasierte Quanteninformationsverarbeitung

TECHNISCHE UNIVERSITÄT MÜNCHEN

Seminar Announcement

Coherent Light-Matter Interaction in Semiconductor Quantum Dots

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An overview over different aspects of coherent light matter interaction in InGaAs quantum dots (QDs) is given. The coherence decay of the ground-state excitonic transition in InGaAs quantum dots is investigated using four-wave mixing spectroscopy in the temperature range from 5 to 300 K. At low temperature, a long dephasing time in the nanosecond range is observed, approaching the natural line width given by the radiative lifetime. Between 5 and 100 K the polarization decay shows two distinct components, resulting in a non-Lorentzian homogeneous line shape with a narrow zero-phonon line of ~ μeV width and a broader band of ~ meV width. Such a line-shape is characteristic for strongly localized excitons, and is due acoustic-phonon assisted transitions. At even larger temperatures, the homogeneous line width is in the meV range, increasing linearly with temperature. A strong tunability of the exciton dephasing, the exciton fine-structure splitting and the biexciton binding energy on the confinement energy is demonstrated in a series of InGaAs QDs that were subjected to rapid thermal annealing at different temperatures. The dephasing of coupled states in vertically stacked double QD structures, important for their application in quantum computing, is investigated as function of coupling strength. Furthermore, the possibility of coherent manipulation is shown by the observation of optical Rabi oscillations in the excitonic ground-state transition of an InGaAs quantum dot. As an outlook, coherent spectroscopy and manipulation of single localized exciton states will be discussed.

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