Sonderforschungsbereich 631

Festkörperbasierte Quanteninformationsverarbeitung

TECHNISCHE UNIVERSITÄT MÜNCHEN

SONDERSEMINAR

Freitag, 26. Juni 2009

13:00 Uhr

WSI, Seminarraum S 101

"Deterministically positioned quantum dot subject to electric fields in any crystal orientation"

Recent advances in nanofabrication technology have made it possible to develop novel quantum opto-electronic devices at the nanometre scale. In the work presented here, we demonstrate the ability to precisely position electrostatic gates around the periphery of a single, deterministically positioned InAs/InP quantum dot. This unique device geometry allows an application of an electric field along the growth direction or in any in-plane field direction across the same, single quantum dot. The InAs/InP quantum dots presented here have the added benefit in that they emit close to the telecommunications band around 1550 nm.

Experiments showing single electron charging by an applied vertical electric field and entangled photon generation via an in-plane electric field on the same quantum dot will be discussed. The single electron charging experiments are shown to provide information on the dot morphology which imply that the InAs dot composition is uniform. By comparison of the in-plane electric field dependence of exciton and biexciton to model calculations, the underlying quantum dot confining potential can be determined. SEM images of uncapped samples are presented that corroborate this observed electric field dependence. Of particular significance to entangled photon generation is that independent of the in-plane confinement potential, the exciton and biexciton optical transitions are expected to cross at finite field, and thus produce entangled photon pairs. The scalable gating technology presented here to electrically contact individual dots promises arrays of single spins, single photon or entangled photon sources that can be used for fiber-based quantum information based applications.

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