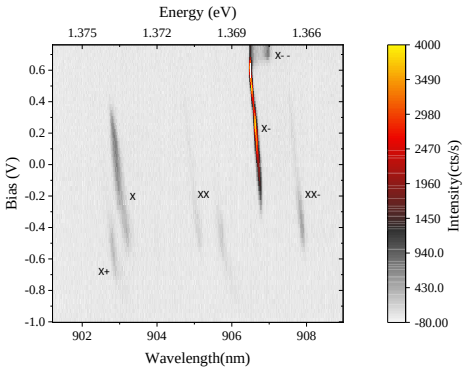
Droplet GaAs quantum dots for optical readout of spin qubits

Advertising institute: PGI-9 Semiconductor Nanoelectronics

Project description:



Example of effect of photoluminescence spectra of a quantum dot with applied electric field (bias). Neutral electron-hole complexes (X, XX) as well as ones with extra hole (X+) and extra electrons (X-, X--) are visible at different biases due to the charge transfer to / from a 2DEG.

Addressing scalable, electrically controlled quantum processors by photons is an outstanding challenge in the development of quantum computers and of quantum communication. Epitaxial quantum dots have been shown to convert optical photons to spins and also to microwave photons, promising to address optically either spin-based or superconducting quantum processors. Epitaxial quantum dots are small inclusions of semiconductors with the size of tens of nanometers inside a larger bandgap semiconductor crystal, which have been shown to be excellent, efficient and fast single-photon emitters that can be incorporated in electronic devices using nanoelectronic fabrication techniques. The most recently developed GaAs epitaxial quantum dots in AlGaAs can be incorporated in the same heterostructure as two-dimensional electron gas (2DEG) that hosts spin-qubits and so they can act as spin-photon interfaces to the spin-qubits, defined in the 2DEG with electrostatic gates. In this project, we want to optimise the energy of photons emitted by the epitaxial quantum dots to avoid decoherence of the spin-qubits by adjusting their elemental composition and other epitaxial growth parameters. The emphasis of the project will be on the characterisation of optical transitions in the quantum dots with different compositions and in the vicinity of the two-dimensional electron gas in different electric fields. Several optical techniques using state–of–the–art techniques and instrumentation will be used to this end. Preparation of devices for the experiments will take place in the clean room of the Helmholtz Nanoelectronics Facility. Finally, measurements of electron tunelling between the optimise quantum dots and the 2DEG will be performed.

Your profile:

- Have bachelor degree in Physics
- Be able to work independently as well as in a small team
- Enjoy working in a laboratory
- Be familiar with Python scripting
- Be able to get to the heart of the problem and solve it quickly and efficiently
- Have good communication and documentation skills in English

What we offer:

- Experienced and friendly research team
- State-of-the-art characterisation equipment
- Motivating research environment

Please send your application (including CV and course transcript) by email to Prof. B. Kardynal (b.kardynal@fz-juelich.de)