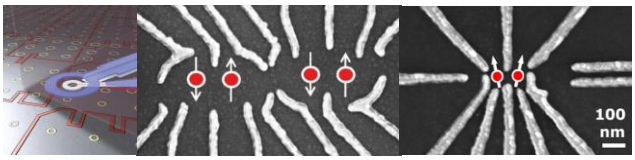
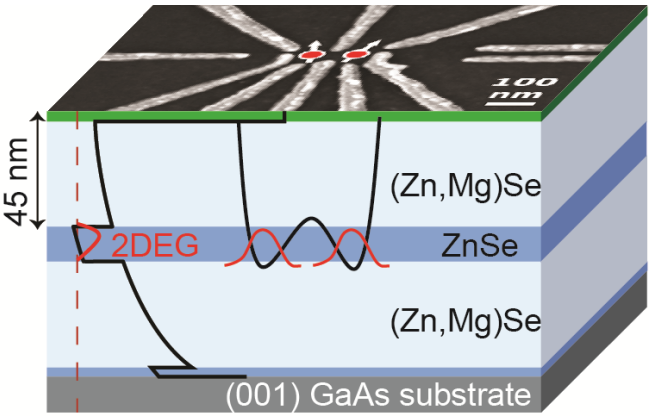


Qu Tech Quantum Technology Group | RWTH AACHEN UNIVERSITY

Towards electron spin quantum bits in ZnSe

Master's project starting WS 2017/18

Scientific background (Zn,Mg)Se is a II/VI semiconductor system that exhibits decisive advantages as a host material for electron spin qubits. (I) It can be used to grow high qualitative quantum wells confining a 2D electron gas. (II) It can be made nuclear spin free by isotopical purification. Thus, the electron spin coupling to an uncontrolled bath of nuclear spins is not an issue. (III) It is also a direct semiconductor without valley degeneracy in the conduction band. Thus uncontrolled valley excitation is absent and spin-to-photon conversion is possible in the future, in order to transport qubit information across a large distance.



Research goal Despite its ideal properties, not much is known about electrical contacts from outside to the 2DEG operating at 10 mK. These are a prerequisite for electrical manipulation and detection of qubits. As a first step, we explore electrical contacts by implanting different donors and evaporating different contact materials. The goal is to find a linear contact IU characteristic with low contact resistance down to 1 K and high transport mobility within the 2DEG.

Your task You will learn the fabrication of (Zn,Mg)Se by optical lithography, reactive ion etching and electron beam evaporation. Halls bars are fabricated in order to characterize the electrical properties of the contacts and the 2DEG in a 1K electrical transport system.

- Material properties of (Zn,Mg)Se
- Clean room fabrication and equipment
- Cryogenic temperature physics
- Low-noise electrical measurement techniques

Furthermore, you will attend group seminars and journal clubs to learn about new developments in quantum computing.

Top: Layer structure of the (Zn,Mg)Se sample forming a ZnSe quantum well filled by a 2D sheet of electrons.
Bottom: 1 K cryostat set-up for transport experiments.

Cooperation partners: Helmholtz Nano Facility in Jülich, Dr. Alex Pawlis (IBN-9)

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