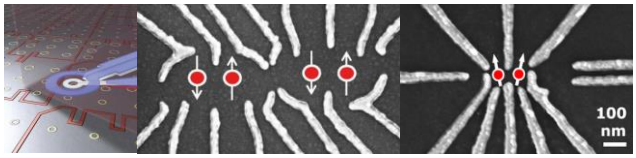


Quantum Technology Group

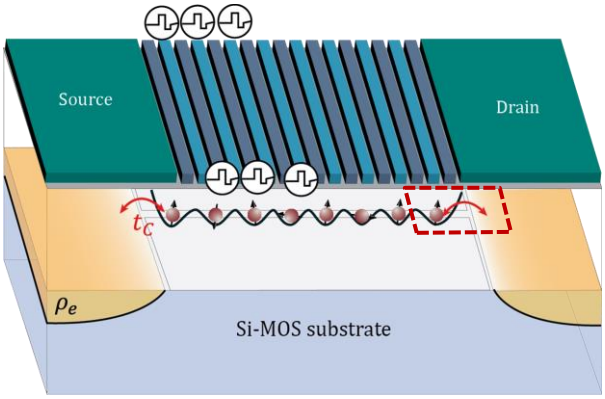
RWTH AACHEN UNIVERSITY

Multi qubit Si quantum devices fabricated by industrial processes

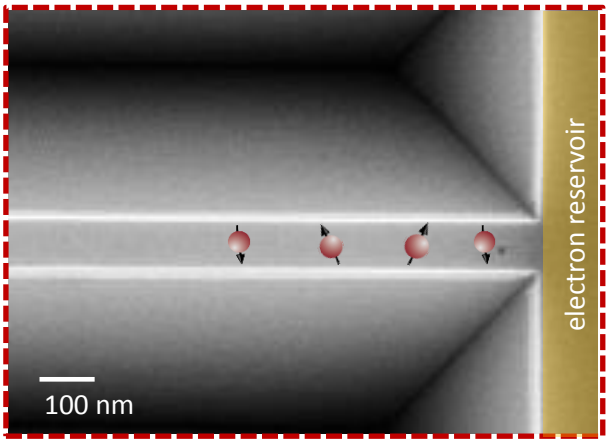
Fabrication and Characterization of Silicon MOS quantum devices using CMOS technology
Master's Project starting summer semester 2019

Scientific Background

The electron spin confined to a gated silicon MOS (metal-oxide-semiconductor) structure is an ideal platform for the implementation of a long-lived and precisely controlled quantum bit as a building block of the quantum computer. These computers are operated at ~10 mK and require a large number of spin qubits. Single spin localization in devices fabricated by high-yield industrial process are an important milestone.



Top: Gate layout with two reservoir structures (green) connected via a linear array of gates (blue). By applying voltages to all gates, electrostatic potentials are induced resulting in two dimensional electron reservoirs (Source, Drain) and quantum dots (QDs) in a one-dimensional configuration. **Bottom**: Scanning electron micrograph of the atomically flat silicon ridge for lateral electron confinement.



Research Goal

In cooperation with the Institute for Semiconductor technology (IHT) at RWTH, we use CMOS-compatible technology and low temperature measurement setups. Project milestones are ohmic contacts operated at cryogenic temperatures in silicon and observation of enhanced electron mobility due to improved interface properties by Quantum-Hall-effect measurements. Finally, the fabrication of metallic finger gates (30 nm width) using electron beam lithography, Damascene and spacer processes leads to quantum dot devices with a linear array of spin qubits in Si-MOS.

Your Role

Your task will be to fabricate and characterize the Si-MOS quantum device with state-of-the art equipment at IHT and our group. This explicitly includes the hands-on improvement and use of industrial fabrication processes in multiple research cleanroom facilities in Aachen and electrical measurements in our low temperature setups and cryostats. This project will allow you to extend your knowledge in

- Working with state-of-the-art semiconductor fabrication technologies in cleanroom research facilities
- Gaining deeper understanding in low temperature measurement setups and fundamental quantum physics of electronic bandstructures and quantum devices
- Conducting and analyzing measurements capturing quantum effects of atomistic origin.

Our group provides journal clubs and group seminars to encourage interchange and education in the field of quantum technologies.

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