ETH zürich

Master / Semester Thesis

Impact of strain in double quantum dot formation in split-gate FinFET architecture

The Big Picture

The motivation behind this project is to apply technology computer aided design (TCAD) to the simulation of p-type nanoscale FinFET-like devices for prospect applications in quantum computing. To this end, theorical quantum physical models capturing the hole properties must be implemented in an already available simulation framework.

Description

Quantum Dots (QD) are spatially confined structures in all three directions that show atom-like behaviour. The physical implementation of QDs in silicon nanowire is performed via split metallic gates that ensure the formation of the dots in the device's upper corners. When the device is brought to cryogenic temperature, the spin of the confined electronic charges can be used to encode information. However, at low temperature the strain in the Si channel increases and lead to renormalization of the the different bands consituting the dots (mostly light- and heavy-hole bands).

Your work would be to:

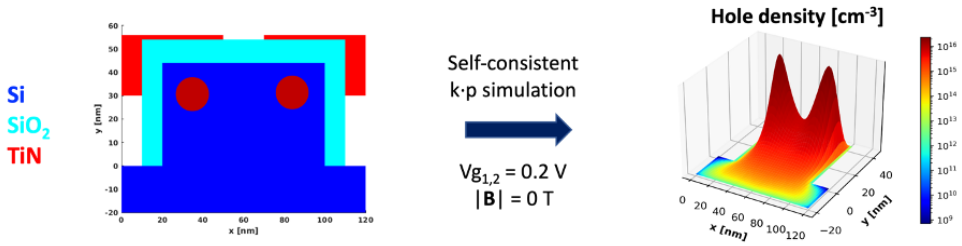
- Calculate the strain/deformation map of the device using the multiphysics simulation software COMSOL.
- Simulate the device electrostatic under strain using a home-made quantum transport solver (QTSolver).
- Compare the results and conclude on the importance of strain in the device description.

Type of Work

Theory (20-30%), model development (10-20%), simulation & analysis (60%).

Prerequisites

You have (1) an interest in nanoelectronics and device physics, (2) some experience with Python/MATLAB or similar, and (3) a familiarity with Linux-based operating systems.



Left: cross section of the split-gate architeture device.
Right: kp simulation at zero magnetic field.

Status: Available

Looking for 1 Master/Semester student
Interested candidates please contact: Ilan Bouquet → bouqueti@iis.ee.ethz.ch
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