Engineering micromagnets for spin qubits in silicon quantum dots

Julien Camirand Lemyre*[1]

[1]Institut quantique et département de physique, Université de Sherbrooke – 2500 boul. de lÚniversité, Sherbrooke, QC J1K 2R1, Canada

Résumé

Micro-magnets proved to be powerful tools for single spin rotations in quantum dots. By providing large magnetic field gradients micro-magnets allow for rapid electrical control of single spins with high fidelity. In this work, the integration of cobalt micro-magnets on a silicon metal-oxide-semiconductor (MOS) quantum dot platform has been investigated.
The MOS quantum dots are fabricated with a foundry-compatible etched poly-silicon gate stack. A minimalist gate layout consisting of two independent accumulation gates allows the tunnel coupling between the quantum dot and the reservoirs to be controlled over four orders of magnitude.

The micro-magnets are deposited directly on top the etched poly-silicon gate stack with e-beam lithography and lift-off. The fabrication process is found to be compatible with our MOS specific materials (Si and SiO2). Transport measurement indicates electrostatic stability of our devices and magneto-spectroscopy reveals the influence of the magnet on the energy levels of the quantum dot.
Also, we propose robust micro-magnet geometries for high fidelity single spin-operations.

*Intervenant