INSTITUT NEEL Grenoble

Post doc position in Si spin qubits– Academic year 2021-2022

Interfacing spin qubit with magnetic materials

Context : In quantum nanoelectronics, one of the major goals is the use of quantum mechanics for the development of nanoprocessors that are more and more efficient. This requires the ability to control quantum phenomena at the single electron scale within nanostructures. In this context, the degree of freedom of the electron spin has been identified as a potential candidate for the support of quantum information. We can define the elementary block of the nanoprocessor by capturing a single electron (and therefore its spin) inside a quantum dot. The development of a quantum circuit will follow the same methods of microelectronic circuits conception, by connecting the elementary bricks, while respecting the constraints of controlling the individual spins. Nowadays, in quantum dots systems, all the elementary operations required for the functioning of a quantum processor have been demonstrated in trapped spins of AsGa heterostructures. The effort of the spin qubits community turns to the transposition of these demonstrations for trapped spins in silicon structures, whose fabrication is compatible with CMOS industrial processes.

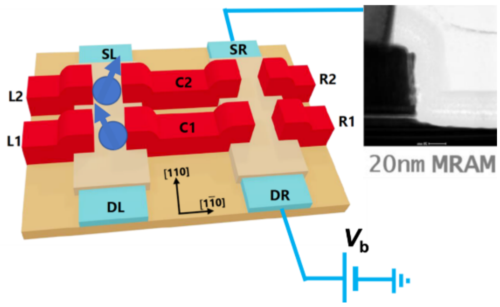

Illustration of a co-integrated device. It comprises three section. i) qubit part on the left nanowire contains two qubit (depicted with blue balls) and which are controlled using the gate L1 and L2. ii) the detector on the right nanowire, which is capacitively coupled to the qubits through C1 and C2. iii) The MRAM is serially connected with the detector. Therefore, the detector current output is sent to the MRAM to write the information.

Objectives and means available: The candidate will develop research on the readout and coherent control of single electron quantum dot to form spin qubit. In particular, the candidate will investigate the interfacing of spin qubits with magnetic materials. She/he will be in charge of measurement of hybrid devices comprising a CMOS spin qubit and a spintronic unit (MRAM) that will be operated to achieve fast and high-fidelity readout. She/he will also develop new methods for the coherent drive of the spin qubits through EDSR based on integrated nanomagnets and ferromagnetic resonance.

Most of the work will consist in doing experiments at cryogenic temperatures (<1K) to evaluate and benchmark the different strategies for reading and controlling spin qubits. The candidate will have the opportunity to work with devices made at the CEA LETI's foundry in an industrial CMOS process line. The candidate will also work in close collaboration with SPINTEC researchers, where she/he will benefit from their expertise as one of the leading spintronics research laboratories worldwide.

Interactions and collaborations: This work is part of a large collaborative effort between the CEA-INAC, CEA-LETI and CNRS-Institut Néel to develop and push the technology of spin qubit in silicon and investigate its potential scalability. Moreover, the applicant will benefit from the collaboration with Spintec on the integration and operation of magnetic components in the CMOS device.

Skills and training: It is mandatory to have presented a PhD thesis defense in the following topics: condensed matter, micro–nanotechnologies or quantum physics. It is essential to have good knowledge of semiconductor devices, in particular on the physics of quantum dot and spin qubits or in spintronic devices. Knowledge in the operation of cryogenic apparatus and expertise in microwave and radiofrequency techniques is highly desirable. A candidate familiar with electron spin or ferromagnetic resonance is a plus. Good written and spoken English skills are required, on the same way as communication, ability of writing reports/articles, and team work.

Foreseen start for the position: immediate
Salary : from 2050 to 2850 euros after tax, depending on experience
Duration : 24 months

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