NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2021-2022

Integration of a semiconductor quantum dot single photon emitter to a quantum photonic circuit

General Scope:

Single-photons as flying quantum bits (qubits) are required for ultimately secure communication or quantum computing. Integration of quantum sources with photonic waveguides is crucial for the development of "plug and play" sources for secure quantum communication as well as for experiments requiring complex photonic circuits such as linear optics quantum computing. Single-photon sources based on semiconductor quantum dots (QDs) are particularly interesting because of their possibility of integration into conventional optoelectronics devices.

Research topic and facilities available:

Our group develops the growth of CdSe QDs inserted in ZnSe nanowires (NWs), covered by a thick ZnMgSe shell acting as a photonic wire helping to guide photons emitted by the QD. These NW-QDs emit single-photons in the visible domain and have shown the possibility of single-photon emission up to room temperature. The NW-QD geometry offers several advantages, such as the control of the optical dipole orientation and nano-maniplulation of single emitters. In this internship, we propose to explore the integration of a NW-QD single-photon emitter to a waveguide and a photonic circuit. The goal of the internship will be: (i) to optically characterize the NW-QDs grown in our group, (ii) to design, fabricate and characterize waveguides for the optimal guiding of single photons, (iii) to study the coupling of the NW-QD to the waveguide.

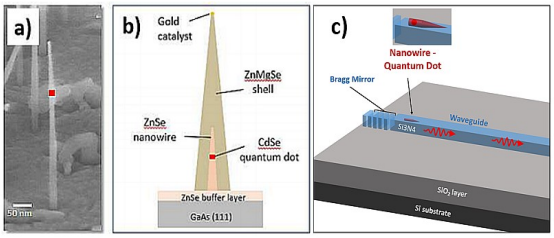

Figure: a) a ZnSe/CdSe NW-QD on the as-grown sample; b) a similar NW-QD in a photonic wire ; c) Evanescent coupling of a NW-QD to a wave guide.

Possible collaboration and networking:

Our group "NanoPhysics and Semiconductors" is a joint CEA/CNRS team and the internship will take place both in CEA-IRIG and CNRS-NEEL, with collaboration with LETI-DOPT. This internship will allow tackling different topics in nanociences and optics: NW-QD grown by Molecular Beam Epitaxy, nano-fabrication in clean room, spectroscopic (micro-photoluminescence) studies, light-matter interaction at the nanometer scale studies supported by numerical simulations.

Possible extension as a PhD: Yes

Required skills: Semiconductor physics, optics, photonics, nanotechnology, with strong interest for experiment.

Starting date: February 2022

Contact:

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