Indium gallium nitride quantum dots for optical quantum technologies

Master 1 internship 2026

Semiconductor quantum dots are nanoscale structures in which charge carriers are confined in all three spatial dimensions, leading to discrete, atom-like energy levels. Because of this strong quantum confinement, quantum dots can act as highly efficient and stable sources of single photons and entangled photon pairs. These properties make them key building blocks for optical quantum information technologies, including quantum communication, quantum cryptography, and photonic quantum computing. The main drawback of these emitters is the lack of control of their position and emission wavelength.

The master thesis will take place in the GEMaC laboratory (UVSQ/CNRS) located in Versailles. We aim to investigate quantum dots based on a new fabrication technique, realized in CRHEA (Nice), allowing to determine both the position and emission wavelength of the quantum emitters (see preliminary results on Figure 1.

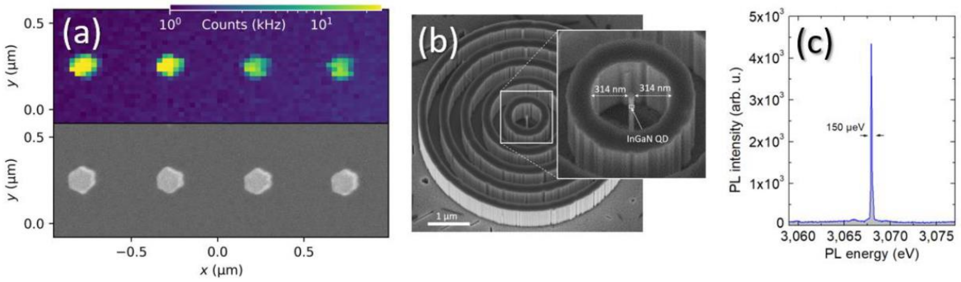

Fig. 1 (a) Room temperature cathodoluminescence (top) and scanning electron microscopy image (bottom) of site-controlled InGaN/GaN nanostructures. (b) Site-controlled InGaN quantum dot placed with nanometric precision at the center of a photonic structure. (c) Low-temperature photoluminescence spectrum of a site-controlled InGaN quantum dot, showing a resolution-limited emission peak.

In this context, the master thesis will consist of optical characterization of QD single-photon sources These experimental studies will be based on photoluminescence (non-resonant laser excitation), associated with photon counting techniques (Hanbury Brown and Twiss), as well as spectroscopy. The results will establish the relevant figures of merit such as emission wavelength, linewidth and brightness, and will be used at a later stage to improve the device design and fabrication. The experiments will be performed at both room temperature and cryogenic temperature. The candidate will also perform simulations using a FDTD (finite differences time domain) software. The project will take place in the QNP team (web link), in collaboration with the project partners at CRHEA (Nice).

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