Stage de recherche (4 mois minimum, à partir de Mars-Avril 2019)

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*: C2N

Code d'identification :UMR9001 — Organisme : CNRS/UPSud

Site Internet / *web site*: http://www.qdgroup.u-psud.fr/

Adresse / *address:* Avenue de la Vauve 91120 Palaiseau

Lieu du stage / *internship place*: C2N Avenue de la Vauve 91120 Palaiseau

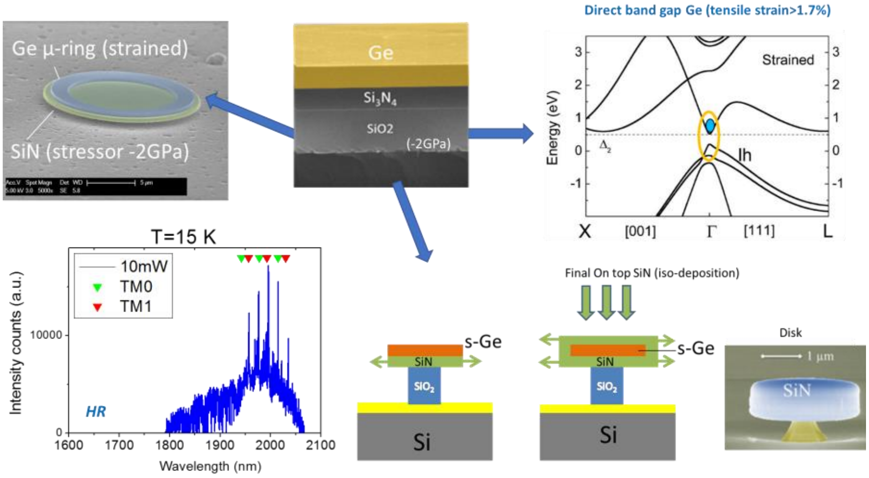
Titre du stage / *internship title*: **Direct band gap Ge-based micro-cavities emitters**

Résumé / *summary*

The objective of the project is to explore the potential of merging direct band gap Ge-based material for developing new electro-optical application with group IV elements such as optical sources in the NIR and the MIR. During the training, the candidate will be involved in optical analysis of light emission from Ge-based micro-cavities. Depending on his motivation and on the lab schedules, the candidate will be also introduced to the clean room facilities of C2N to contribute to device processing using the micro-nano fabrication tools.

<u>Research context :</u>

One of the major challenges of photonics is to meet a full-CMOS compatible technology. The main missing element that would allow to fully exploit the technology of silicon photonics is the laser source. Unfortunately silicon and germanium, which are the main group-IV elements used in the microelectronics industry, are penalized for the emission of light because of the indirect nature of their electronic band structure. Currently the semiconductor laser sources are mainly made from III-V elements whose integration on silicon turns out to be complex, for reasons of chemical incompatibilities between III-V and IV-IV, and also of manufacturing cost. C2N research group have succeed to turn the band structure of germanium into direct band gap through the application of tensile mechanical stress or by alloying Ge with tin. This has led to recent demonstration of laser effect in Ge at low temperature. It is also possible to combine both strain and alloying to obtain direct band gap materials. It has been recently shown a laser emission regime in the GeSn operating at low temperature as well. It turns out that the alloy of Ge with tin and the application of tensile stress reduces the band gap of the materials and the operating wavelengths can extend from 2 µm to 5 µm in depending on the tin composition and the stress applied. At these wavelength CO_2 and CH_4 exhibit a high absorbtion signature. Applications for labs-on-chip spectroscopy for biosensing, gas detection and air monitoring are envisioned with the opportunity to integrate the full group IV photonic circuits in interconnected objects.



Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : OUI**

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