Master / PhD Thesis Project

P-N junction nanowires for solar cells

Context: Semiconductor nanowires (NWs) with controlled composition and dimensions can be fabricated using optimized growth conditions (bottom-up method) or by lithography and etching of a suitably designed substrate (top-down method). Moreover, it is possible to tune the electrical properties by doping, so that p-n junctions can be implemented within the NWs. These structures are interesting, for example, for application as solar cells or high-speed photodetectors. NWs present a major advantage for such applications: they act as antennae and therefore can absorb the light more efficiently using less material. However, challenges remain to control and measure the doping levels in such nano-objects with nm precision. Furthermore, the role of the NW surface on their electrical properties requires further investigation.

Objectives and available means: The aim of this internship is to contribute to the study of p-n junction semiconducting NWs regarding their opto-electrical properties. The student will integrate a multi-institute, multi-disciplinary research group. His/her role will be to fabricate electrical contacts to p-n junction NWs of different materials, including GaN and InP. The NWs will be electrically contacted on membrane chips compatible with transmission electron microscopy (TEM) measurements, and the student will be in charge of their electrical and electro-optical characterization (responsivity, linearity, spectral selectivity, time response). These results will be correlated to detailed characterization by transmission electron microscopy, performed on exactly the same single NW, to improve our understanding of NW doping, which will aid device fabrication, for instance for NW solar cells.

The student's work will involve:
– Nanowire contacting in a cleanroom environment. It implies training in nanowire dispersion, mapping using scanning electron microscopy, surface passivation, metalization and assisting electron beam lithography.
– Current-voltage measurements and electro-optical characterization as a photodetector.
– The student will be involved in the correlation of electro-optical and 4D STEM results.

The team: The student will work under the supervision of Martien DEN HERTOG at Institut Néel and Eva MONROY at PHELIQS.

For more information on our work, read our recent publications (available on demand):
[1] M. Spies, A. Ajay, E. Monroy, B. Gayral, and M.I. Den Hertog, Nano Lett. 20, 314 (2020)
[2] S. Cuesta, et al., Nano Lett. 19 55506 (2019)

We are seeking for students with a background on semiconductor physics and optoelectronics, and highly motivated for experimental laboratory work.

APPLY NOW!

To apply for this position, send your application (including CV) by e-mail to: martien.den-hertog@neel.cnrs.fr and eva.monroy@cea.fr

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