LMGP
Laboratoire des matériaux et du génie physique
une vision des matériaux

2020-2021

Internship proposal (Master 2 or final internship) at the LMGP

# Percolation study based on silicon nanonet transistor

## Context:

Very promising at the time of their discovery, after more than a decade of intensive research, 1D and 2D nanostructures have proved disappointing for transfers to the application domain because of the difficulty of fabricating them reproducibly and on a large scale. Thus, in the context of the More than Moore roadmap, a major challenge lies in developing systems that are inexpensive, reproducible, effective in exploiting nanometric properties, easily manipulatable and compatible with large-scale integration. With the aim to remain beneficial for the environment, this development requires breakthrough technologies compatible with a sustainable development: (1) manufacturing with low carbon emission and abundant materials, (2) low energy consumption, (3) possibility of circular economy with reuse and recyclability in agreement with the guidelines of the EC's "Green Deal".

In our group, we developed all the technological bricks, including thermal treatments, to fabricate field effect transistors using single SiNW as well as SiNW percolating network on rigid or flexible substrates. We also reported that a proper alumina passivation drastically enhance the SiNW/oxide interface quality and thereby the transistor performances. These devices also displayed high mechanical flexibility, transparency and air stability over months.

The "Semiconductor Nanonets" project, currently being developed at LMGP, in collaboration with LTM and IMEP-LaHC, aims to meet this challenge and go beyond the current limits of nanomaterial integration by studying percolating devices based on randomly oriented networks of semiconductor nanowires, so called semiconductor nanonets. These nanonets benefit from advantageous nanoscale properties as well as an easy connection to macroscopic objects thanks to their thin film structure. We have shown and successfully fabricated transistors with really promising properties and equivalent to those of the best single nanowire devices.

## Position Instructions

The successful candidate will immediately join to PhD fellows in our group to study percolation in silicon nanonets. The experimental part of the work will be dedicated to the electrical characterization of the devices fabricated by the PhD fellow before the start of the interhship. In parallel to this work and in order to ensure the sustainability of the work, an interface for data treatment will be developed under Matlab by the applicant. Then based on the experimental results and by comparing them with numerical simulation which has already been developed in our group, impact of nanowire density and channel length will be studied in the frame of the percolation theory.

In summary, the tasks will involve data collection, electrical characterisations, data processing interface and the conduct of the analyses described above. They will lead and contribute to academic and scientific articles resulting from the project.

The successful candidate will be part of a small team at LMGP and will spend most of the time with assigned PhD fellow.

## Qualifications

Applicants must have a Master 1 not older than 3 years at the application deadline in a related field of materials science, microelectronics technologies, and semiconductor physics. Please address these skills directly in your application.

This position requires an ability to work in a team, excellent academic records, candidates should be fluent in written and spoken academic English**.**

## Application instructions

## A complete application consists of:

**Cover page:** Short motivation of the applicant and connection with the position, including how this position serves future career goals. Include name and contact information of applicant (1 page max)

**CV:** Academic and professional background, detailing relevant experience, particularly research. Any publications (separate peer-reviewed, technical reports, and popular science or outreach). Any teaching experience. Include names and contact information for two academic or professional references who can speak to your professional and teamwork abilities. At least one should be a former or current research supervisor.

**Relevance for Application:** The applicant should include a clear description of how his or her scholarly background and expertise is applicable, and might add value, to the project set out above. The applicant should also outline the kind of methods and theories that he or she would propose to draw on when conducting the fieldwork.

Our team welcomes applicants with diverse backgrounds and experiences. We regard gender equality and diversity as strength and an asset.

Depending on the student's motivation, the internship may lead to a doctoral project.

**Laboratory: LMGP collaboration with LTM and IMEP-LaHC**
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**http://www.grenoble-inp.fr/annuaire/celine-ternon-703939.kjsp**
**Deadline for application: end of December, Start internship: from early February or March**
**Documents to provide:** ***CV, results M1 and M2 with ranking if possible, letters of recommendation***