PhD Project in nanomaterials science

Job title: **Doctoral Research Fellowship (PhD)**
Title: Exploring the electronic structure of Dirac antidot superlattices based on III-V semiconductors
Location: Institut d'Electronique, de Microélectronique et de Nanotechnologies (IEMN-CNRS), Lille, France
Duration: 3 years
Closing date: March 2017
Contact: Dr. Bruno Grandidier, e-mail: bruno.grandidier@isen.fr; tel.: +33 3 20 30 40 14
Gross living allowance: 1684,93 € per month

Context

The discovery of the outstanding properties of graphene in which electrons behave like zero-mass relativistic particles has triggered a new field of research focusing on the so-called "Dirac matter". It aims at creating artificial honeycomb lattices with physical properties, such as multiple Dirac cones and topologically non-trivial flat bands, that are not accessible in graphene or in any other natural two-dimensional (2D) materials. While artificial honeycomb lattices have been obtained with phonons, cold atoms, molecules and polaritons, the French project Dirac III-V wants to demonstrate the existence of Dirac fermions in artificial honeycomb lattices that are produced by the regular perforation of 2D electron gases confined in epitaxially-grown III-V semiconductor heterostructures. It has recently received the financial support of the French National Research Agency and involves three French research institutes, IEMN (Lille), LCPO (Bordeaux) and Institut Néel (Grenoble), and the participation of the Debye Institute (Utrecht, The Netherlands).

PhD Research project

While the project includes advanced semiconductor growth, lithography and technological processes to reach lattice parameters down to 10 nm, it also strongly relies on unique characterization techniques to investigate the linear band dispersions in very limited energy windows (from one meV to tens of meVs). In order to tackle this issue, you will study the electronic structure of artificial honeycomb superlattices based on III-V semiconductor heterostructures using low temperature scanning tunneling microscopy and spectroscopy in ultra-high vacuum. To this end, you will interact with scientists in charge of the growth and the fabrication processes in order to design appropriate transfer methods of your samples that minimize disorder from surface-induced effects. You will also be able to work with a wide range of scanning probe equipment and additional analysis techniques to get insight into the surface properties of the nano perforated quantum wells and the dynamics of the charge carriers tunnelling into the superlattice. Finally, you will receive a theoretical support to guide you in the interpretation of your experimental results.

Responsibilities

(1) Perform high quality research in the bespoke research project under the guidance of the supervisory team.
(2) Meet the members of the supervisory team on a regular basis.
(3) Write up the results of the research activity and present research papers and publications at meetings and conferences, as advised by the supervisors.
(4) Widen the personal knowledge in the research area and undertake complementary training.
(5) Keep records of the activities.

Person Specification

The successful candidates ***must*** have:

(1) An excellent academic record in physics, Engineering, Material Sciences or related areas.
(2) Demonstrate a keen interest in pursuing experimental research in nanoscience.
(3) A past record of experimental work with scanning probe microscopies.
(4) The ability to work independently, and as a member of a research team.
(5) Excellent interpersonal and communication skills.
(6) A good command of English language, with excellent oral and written skills.

Any or combination of the following will be a clear advantage.

- A demonstrable ability or potential to produce research published in peer-reviewed journals.
- Knowledge and willingness to learn the language of the host institution.

Website of IEMN group of physics: http://physique.iemn.univ-lille1.fr/index.php?id=442&L=1