iemn
Institut d'Electronique, de Microélectronique et de Nanotechnologie
UMR CNRS 8520

PhD Project in nanomaterials science

Job title: **Doctoral Research Fellowship (PhD)**
Title: Germanene
Location: Institut d'Electronique, de Microélectronique et de Nanotechnologies (IEMN-CNRS), Lille, France
Duration: 3 years
Closing date: January 2018
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Gross living allowance: 1768 € per month

Context

Nature usually forces two-dimensional (2D) crystallites consisting of group IV elements other than carbon to morph into stable three-dimensional forms as their lateral size increases. Only an epitaxial growth on top of a substrate can suppress the deleterious thermal vibrations that are responsible for such transformations. This concept turned out to be successful for the growth of silicene and germanene, the promising graphene analogues. So far both materials have been synthesized on metals. But the use of metallic substrates prevents the characterization of their intrinsic properties and their subsequent integration in devices. As a result, this project wants to address the growth of germanene on semiconducting and insulating substrates to get a comprehensive understanding of the physics of Dirac Fermions in a 2D atomic crystal with a buckled atomic structure and a significant spin orbit coupling. It has recently received the financial support of the French National Research Agency and involves four French research institutes, IS2M (Mulhouse), IEMN (Lille), INSP Paris and the synchrotron facilities of SOLEIL.

PhD Research project

The bottleneck of growing large size sheet has to be resolved for the future exploitation of germanene in a wide range of applications. As a result, the candidate will study the growth of germanene on Al-terminated Si(111) surfaces, the Si wafers being the substrate of choice for mass scale fabrication of integrated devices. As the production of high-quality germanene in a reproducible manner should take along with a continuous improvement of in-situ, and non-invasive characterization methods, the second goal of this project will focus on Raman spectroscopy that is quite useful for fingerprinting 2D crystal material in air and that will be expanded to ultrahigh vacuum (UHV) within a collaboration with Horiba. Finally, UHV-compatible

transfer methods to protect germanene with inert 2D layered materials will be experimented and should lead to the precise determination of germanene fundamental properties with multi-physical characterization technique.

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) The ability to work independently, and as a member of a research team.
(4) Excellent interpersonal and communication skills.
(5) A good command of English language.

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

- A past record of experimental work with scanning probe microscopies.
- 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: http://physique.iemn.univ-lille1.fr/en/physics-of-nanostructures-quantum-devices/