

Centre National de la Recherche Scientifique (CNRS)

University of sciences and technologies of Lille, BP 60069, avenue Poincaré,
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**PostDoc position opening on the following topic:
Elaboration and study of physical properties of graphene-based nanostructures**

Host laboratory: Institut d'Electronique, de Microélectronique et de Nanotechnologies (IEMN) , Lille, France

Research group: Nanostructures, nanoComponents & Molecules (NCM)

Starting date: October 2023

Contract duration: 12 months

Keywords: surface science, physical chemistry, scanning probe microscopy (STM/nc-AFM/STS/c-AFM/KPFM...)

Context of the research project

The discovery of new 2D materials with original electronic band structures has initiated a tremendous interest for studying how further modification of their morphology can affect these physical properties. One of the main objectives has been to find alternatives to conventional *top-down* manufacturing of *tailored graphene-based structures* originally demonstrating semimetal electronic properties. The *bottom-up* approach using **on-surface reaction** of molecular precursor's proved to be an efficient method for growth of one- and two-dimensional graphenic architectures on metal surfaces (e.g., via Ullmann coupling and cyclo-dehydrogenation). Following this strategy, different tailored graphene nanostructures like graphene nanoribbons (GNRs) can be elaborated that permit tuning their electronic properties from semimetal to semiconducting. This holds great promises for future integration of these graphenic materials into vertical van der Waals heterostructures assembling together isolating, semimetal, and semiconducting 2D materials.

Inspired by these studies, the project proposed in our group will be focused on the investigation of atomic structure, electronic and electrical properties of tailored graphene-based materials that will be grown on surfaces of different nature followed by their transfer on targeted substrates.

Candidate profile

The candidate should have a strong interest in experimental work. Knowledge of surface science, ultra-high vacuum (UHV) techniques and Scanning Probe Microscopy (SPM) would be clear advantages for this project.

The study will be mainly conducted in UHV condition:

- ✓ Substrate's preparation and deposition of molecules on these surfaces by molecular beam epitaxy (MBE)
- ✓ Synthesis of graphene-based nanostructures via *on-surface reaction*
- ✓ Investigation of their structures at atomic scale and electronic properties with scanning tunneling microscopy (STM), atomic force microscopy (AFM), scanning tunneling spectroscopy (STS)

The candidate will also be involved in studies at ambient conditions:

- ✓ Electrical measurement with contact AFM (c-AFM), Kelvin probe force microscopy (KPFM), and electrostatic force microscopy (EFM);
- ✓ Transfer of GNRs from the growth to the targeted substrate;
- ✓ Fabrication of vertical vdW heterostructures.

The candidate should be able to work both independently and in a collaborative environment (i.e. interact with physicists, chemists and theoreticians). Good communication skills and knowledge of English are required since the candidate will participate in the dissemination of his/her research to the international community: publications in scientific journals, conferences, general public communication, etc.

Working environment

The project will take place at the Institut d'Electronique, de Microélectronique et de Nanotechnologies (IEMN, <https://www.iemn.fr/en/>) which is a French major player in the field of micro/nanotechnologies and their

applications. The IEMN is part of the INSIS institute of CNRS (<http://www.cnrs.fr/index.php>) and the Université de Lille (<https://www.univ-lille.fr/>), and located in the metropolitan area of Lille (110,000 students).

The project will involve several research groups of the Nanostructured Materials and Components Department at IEMN. The main part of the project will be carried out in the Nanostructures, nanoComponents & Molecules (NCM, <https://www.iemn.fr/la-recherche/les-groupes/groupe-ncm>) group working in the physics of nanostructures and micro/nano-devices made of organic materials, self-assembled monolayers, oxide or iono-electronic materials. In addition, the project will benefit from the facilities available at IEMN such as (i) a multi-physics characterization platform (PCMP) and (ii) a clean room (ISO6 1600 m²). In particular, the candidate will work in the Pôle Microscopie en Champ Proche (PCP) which is one of the hubs of the PCMP platform. PCP brings together the means dedicated to the topographic, physical, and electrical analysis of surfaces from 100µm to the atomic scale such as STM, AFM, KPFM, etc. In summary, the facilities of IEMN cover all areas of micro and nanoelectronics from the elaboration and characterization of nanomaterials to their implementation into advanced nanodevices.

To apply

Interested candidates are invited to send a CV, motivation letter and contact details of two referees to

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