Post-doctoral position
Fabrication and characterisation of 1D and 2D nanoheterostructures

Laboratories:
1) Laboratoire d'Etude des Microstructures (LEM), UMR104
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2) Groupe d'Etude de la Matière Condensée
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Project description

The emerging research field on 2D materials, such as graphene, boron nitride (hBN), transition metal dichalcogenides and Black Phosphorus (BP), is getting more and more rich as complex as progress is made in manipulating and assembling atomically thin layers to build heterostructures. One expects in that way to gain more degrees of freedom by combining intrinsic properties of 2D layers of different natures or to create new properties resulting from the coupling and the interaction between assembled layers. As a first example, encapsulating graphene layers into hBN layers has been proved to be the most efficient way for protecting graphene from its environment and to keep its intrinsic electronic properties in a device. A second example concerns BP, which is a highly reactive material when exposed to air and humidity - and thinner the material, higher its reactivity - , making mandatory its encapsulation by protecting layers. Nevertheless, mastering the manipulation of 2D layers and their assembling is a field still in its infancy as it has to face with several difficulties and is yet restricted to a few um lateral size flakes far from the requirements for large scale electronic or photonic devices.

The project is full part of this research dynamics on heterostructures of 2D materials. It aims at developing and studying the dry route to transfer and assemble 2D layers using an home made micromechanical stamping device and without using chemical and wet processes nor polymers. In a first step, research effort will first focus on mechanically exfoliated layers from bulk crystals in order to achieve reliable encapsulation of graphene and BP into hBN flakes with an accuracy of 1um in translation and 1° in rotation. In a second step, effort will focus on the use of CVD made hBN layers grown on large metal substrates using a dedicated CVD reactor implemented at LEM able to deliver large (up to 10 cm^2) thick and thin BN sheets. Specific problems inherent to the transfer of the BN sheets from the metal substrate and to the manipulation of large size layers will have to be solved. The structural, optical electronic properties of the obtained heterostructures will be characterized using a tool set available both at LEM and GEMaC such as: optical microscopy, AFM, photo and cathodoluminescence at cryogenic temperature, Raman spectroscopy, TEM and Electron energy loss spectroscopy. Best heterostructures will be integrated in electronic devices and their performances studied.

Framework : The candidate will join a consortium of two well equipped, highly motivated and long standing interacting teams involving 6 permanent researchers and several PhD and postdocs. The consortium is an important player for his work on BN material. The project is supported by an Internal Federative project at Onera on 2D materials, ANR projects GoBN and EPOS-BP coordinated by LEM and involving GEMaC, European Flagship Graphene

External cooperation: partners of the GoBN ANR project : MPQ (U. Paris 7), LPA (ENS Paris), and of european Flagship Graphene

Duration and Starting date : 18 months from 1st January 2018

Profile : Candidates must have a PhD in Physics, Chemistry or Nanoscience. Skills on 2D materials are highly desirable and a strong experience in either spectroscopy or structural study of individual nanostructures is compulsory. Self-motivation, taste for experimental work, analysis skills are key aspects.