Offre de stage/thèse 2019-2020

Laboratory: Laboratoire de Physique de l'ENS

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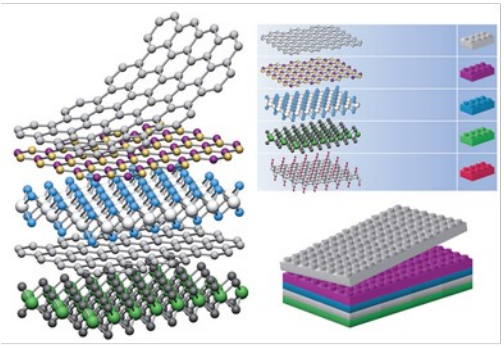
Title

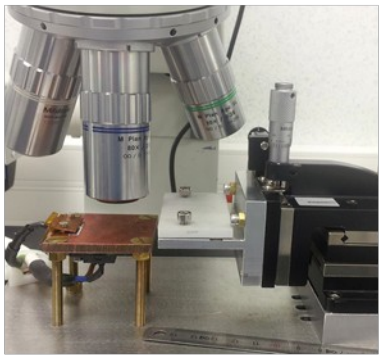
Opto-electronics of 2D materials : Optical characterization of $PtSe_2$

Scientific project:

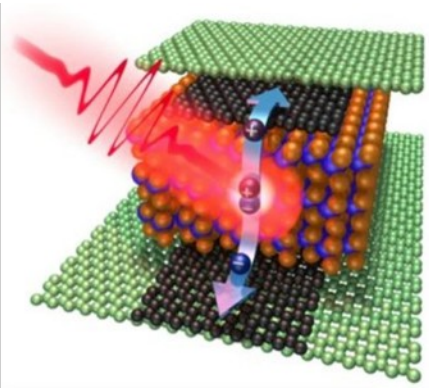


2D materials can be stacked as legos

Credit : MacMillian publishers



The 2D material transfer setup at ENS clean room



State of the art stack used as a photodiode

Credit : Fabien Vialla, ICFO

Following the isolation of a single layer of graphene from a graphite crystal by mechanical exfoliation in the 2000's, a large class of similar crystals with equivalent mechanical properties have been discovered. This field of research around the so-called "2D materials" has been growing rapidely because those materials can be combined by stacking of monolayers alternatively metallic, semi-conducting or insulating, which allows to forsee new opto-electronic devices with extreme properties in photo-detection, energy harvesting or emission of light. .

At Laboratoire Pierre Aigrain (ENS), we are currently focusing our effort on a promising novel 2D material PtSe2 which is an indirect bandgap semiconductor (ANR 2018 BIRD). The reason for our interest in this material is two-fold : it has a tunable bandgap depending on the number of stacked layer, and its electronic mobility compares favorably to the best 2D materials available today. We aim in particular at exploring this material's potential for photodetection in the telecom wavalengths (1,26-1,63µm). The exploration of carrier generation mechanism, in-plane and out-of-plane electronic transport will be of major importance to determine if this device can be used as an ultrafast photodetector or photomixer (up to 50 GHz).

The first goal of the PhD project will be to use our in-house microspectrocopy setup to characterize various PtSe2 sources with unknown optical properties. It will be necessary to introduce a holographic filter on the supercontinuum laser beam path to allow the PL-E measurements.

The candidate will have solid bases in physics of condensed matter and a real taste for nano-fabrication and testing combining optical spectroscopy techniques and radio-frequency electronics.

Methods and techniques: Exfoliation, Van der Waals stacking, photo/electro-lithography, Optical spectroscopy (absorption&PL), cryogenics, electronics, RF electronic and optoelectronic characterization.