Centre DE Nanosciences & DE Nanotechnologies

C2N General Seminar

Friday November 15th 2019 - 10h 00

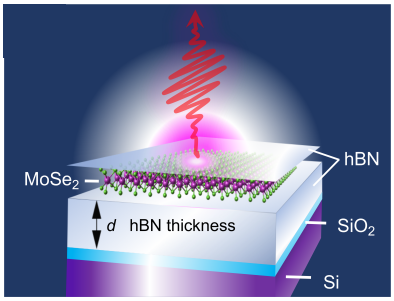
Amphitheater of C2N

"Optical Properties of 2D Semiconductors in van der Waals Heterostructures"

Xavier MARIE

Université de Toulouse, INSA-CNRS-UPS, Laboratoire de Physique et Chimie des Nano-Objets, Toulouse, France

marie@insa-toulouse.fr



The spectacular progress in controlling the electronic properties of graphene has triggered research in alternative atomically thin two-dimensional crystals. Monolayers (ML) of transition-metal dichalcogenides (TMD) such as MoS2 have emerged as very promising nanostructures for optical and electronic applications.

In this talk I will review the exciton and optical properties of TMD monolayers [1]. I will show that encapsulation of MoS2 ML in hexagonal boron nitride (hBN) can efficiently reduce the inhomogeneous contribution to the exciton linewidth, as we measure in photoluminescence and reflectivity a FWHM down to 1 meV [2]. Similar results are obtained with encapsulated MoSe2, MoTe2, WSe2 and WS2 MLs [3].

Among the new possibilities offered by the well-defined optical transitions we evidence the optical selection rules for in-plane propagation of light. These studies yield a direct determination of the bright-dark exciton splitting [4]. We also uncover new information on exciton-exciton interactions [5] and exciton-photon weak coupling regime in these Van der Waals heterostructures. The exciton spontaneous emission time can be tuned by one order of magnitude depending on the thickness of the surrounding hBN layers as a result of the Purcell effect [6].

[1] Wang *et al*, Rev. Mod. Phys. **90**, 21001 (2018)
[2] Cadiz *et al*, PRX **7**, 21026 (2017)
[3] Manca *et al*, Nature Com. **8**, 14927 (2017)
[4] Wang *et al*, PRL **119**, 47401 (2017)
[5] Han *et al*, PRX **8**, 31073 (2018)
[6] Fang *et al*, PRL **123**, 067401 (2019)

***Xavier Marie** is Professor at the National Institute of Applied Sciences (INSA Toulouse). He has joined the Institut Universitaire de France in 2005 as a Junior member and in 2015 as a Senior member. He is currently the director of the Labex NEXT (Nano, EXtreme measurements and Theory).*
He has worked for about 30 years on electronic and optical properties of low dimensional semiconductor structures (quantum wells, quantum dots, 2D materials). His main present interest is the optical, valley and spin coherence in semiconductor nanostructures and band structure engineering of semiconductors for optical telecommunication devices and solar cells.

External visitors should be register beforehand in the following link