UE Physics of 2D materials: from elaboration to properties

Niveau d'étude
Bac +4

ECTS
3 crédits

Composante
UFR Physique, Ingénierie, Terre, Environnement, Mécanique (PhITEM)

Période de l'année
Printemps (janv. à avril/mai)

Diplômes intégrant cet élément

- Master Nanosciences et nanotechnologies

Langue(s) d'enseignement: Anglais

Ouvert aux étudiants en échange: Oui

Code d'export Apogée: PAX8NAAJ

Présentation

Description

In the context of intensive research on post-CMOS electronics, a new families of nano-materials has opened new avenues in different fields, including optoelectronics and quantum information. These low-dimensional systems are a new playground to understand the interactions between elementary excitations, electron-phonon and phonon-phonon, which play a major role in the behavior of electron transport and heat at this nanoscale. For example, the reduction of dimensionality in the case of graphene has made the adiabatic approximation obsolete. Thus, the electron-phonon coupling is so strong that the optical phonons can be modulated by an external electric field but also as has been recently shown by an optical grid.

The important advances in the control of graphene electronic properties, open the way to new two-dimensional materials. Thus, monolayers of Dichalcogenides of Transition Metals such as MoS_2 ($MoSe_2$, WS_2, WSe_2, …etc.) have appeared very recently as promising nanostructures for applications in both the field of optics and electronics. We will discuss the growth of such materials including the fabrication of heterostructures based on graphene (semi-metal), boron nitride (insulator) and MoS_2 (semiconductor)

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and their physical properties. Indeed marrying different 2D systems can take advantage of the properties of each part and more since the resulting hybrid is more than the sum of its parts.

This lecture will give an overview of the physical properties of graphene on the one hand, new 2D semiconductors like MoS_2 on the other hand and will open on the heterostructures. We will discuss their growth, band structure, phonons, electron-phonon coupling, excitons in MoS_2, the spin / valley polarization but also the prototype components (transistor, photodiode, LED ...) based on this new class of materials.

Heures d'enseignement

CMTD	Cours magistral - Travaux dirigés	24h

Période : Semestre 8

Infos pratiques

Campus

Grenoble - Domaine universitaire

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