MICRO-801

Summer School on Optoelectronics on 2D materials (2018)

Kis Andras

Cursus	Sem.	Type
Microsystems and Microelectronics		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Written
Workload	60h
Hours	**42**
Courses	29
Exercises	10
TP	3
Number of positions	

Frequency

Only this year

Remark

From 19 to 25 August 2018 - Davos Wiesen (Switzerland)

Summary

The summer school will give the participants an overview on the research being done on 2D materialâ##based optics and optoelectronics, starting from a general introduction to finally address the most recent results and future challenges of the field.

Content

Summer school will begin with a strong introduction on 2D layered materials and their use in optoelectronics, followed by invited talks in three major directions the school will focus on.

Exciton physics in 2D:
While excitons are well#studied quasi#particles in conventional semiconductors and InGaAs/GaAs heterostructures at low temperature, the natural quantum confinement of 2D materials results in a dramatically increased binding energy of excitons, which allows their observation even at room temperature. Moreover, by combining different materials in Van der Waals heterostructures, long#lived indirect excitons can be produced and manipulated. Such structures hold promises for novel photonic devices and fundamental experiments. Such strongly bound excitons can also enhance light#matter interaction, leading to the formation of polaritons, hybrid light#matter quasiparticles arising from the coupling between dipolar oscillations of excitons and photons. For low dimensional systems, the strength of light#matter interaction is large enough to make polaritons stable at room temperature. Experimental evidence of light-matter interaction in TMDCs will be presented, together with the possibility of room temperature valley polarization of polaritons.

Two#dimensional optoelectronics:
Semiconducting TMDCs having a direct bandgap are optically active even in the monolayer limit. They can absorbup to 15% of light in the vertical direction and show quantum efficiency as high as unity. Light absorption can drastically modify the electrical response of devices, which hold promise for many applications in optoelectronics, including solar cells for energy generation, tunable light emitting diodes and ultrasensitive photodetectors. Moreover, 2D crystals proved to be fascinating platform for single photon emission, an important building block for quantum information processing.

Spin- and valley-tronics:
The presence of broken inversion symmetry in the crystalline structure of monolayer TMDCs, combined with a strong spin#orbit interaction, reveals an additional degree of freedom beyond the conventional charge and spin, which is often referred to as valley index or pseudospin. Specific optical selection rules make optics the easiest way to manipulate pseudospin. Thus valley state could be probed or populated optically via circular polarized light, providing access to both spin and pseudospin via spin#valley locked physics, making them suitable for data processing, transfer and storage.

Workshops:
Summer school program also includes three workshops provided by Comsol Multiphysics "Numerical simulations of 2D materials", Oxford Instrumets "Practical cryogenics" and Nature Publishing Group "Scientific Publishing".

Keywords

2D materials, optics, electronics, optoelectronics, spintronics, excitonics, valleytronics, plasmonics, van der Waals heterostructures

Resources

Websites

- http://2doptoelectronics2018.epfl.ch