International Doctoral Program in Science Position

Time-resolved optical microscopy techniques to characterize 2D transition metal dichalcogenides

Background and motivation

2D transition metal dichalcogenides (TMDs) hold great potential for application in different fields, in particular in nanoelectronics and photonics. In nanoelectronics, large energy dissipation due to heating in chips is unsustainable in terms of both costs and performance drop and 2D TMDs hold great potential to alleviate these problems. In photonics, the integration of 2D TMDs is predicted to enhance the energy harvesting. Towards such applications, it is crucial to develop a controlled, engineered, synthesis at large scale of such materials with high uniformity and to investigate their electronic/optical/thermal dynamics. Among the TMDs, MoS_2, $MoTe_2$, WS_2 and WTe_2 and are the most attractive materials to be investigated. **The aim of this project is to synthetize and characterize the 2D TMDs materials and develop ultrafast temporally and spectrally resolved high resolution optical microscopy methods to investigate the electronic and thermo-mechanical aspects of 2D TMDs deposited on a bulk substrate.**

The main aspects of the project are:

1. Synthesis of the 2D TMDs and characterization with spectroscopic ellipsometry.
2. Fast optical surface mapping in various environments (i.e. air and liquids) by microsphere assisted optical microscopy to get sensitivity to the few atomic layers constituting the surface termination;
3. Investigation of hot spots and dielectric spacers;
4. Use of neural networks and machine learning techniques to analyze experimental data.

Profile

- Diploma: Master's degree or comparable qualification in Physics, Materials Science, Materials Engineering, Electronic Engineering or adjacent fields. The title must be obtained before OCTOBER 31ST 2022.
- A strong interest for multidisciplinary research is required.
- Previous experience in the growth of 2D transition metal dichalcogenides by chemical vapor deposition and their characterization using Raman spectroscopy, scanning electron microscopy and electrical methods (C-V, I-V, Internal photoemission) and/or in microscopy and/or ultrafast optics will be considered as an additional advantage.
- Candidates should have a solid background in optics and/or materials science.
- Good knowledge of the English language, both spoken and written, is essential.
- Strong commitment, ability to work in a team, and eagerness for international mobility is desired.

Opportunities

- Participating to an international collaboration among Università Cattolica del Sacro Cuore, Institute of Microelectronics and Microsystems (IMM-CNR) and KU-Leuven (Belgium).
- Double degree opportunity.

Supervisors

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