Internship subject

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2D-materials for electro-optics modulation

Optical communications are at the core of the Internet today, enabling the development of the interconnected society. However, in order to meet the requirements of the future communication system applications, optical circuits have to deliver ever-growing data rates, being faster, cheaper, smaller and less power hungry. Silicon photonics, due to its compatibility with large volume CMOS fabrication processes has a unique potential to implement ultra-compact optoelectronic chips meeting these requirements. In recent years, significant progresses have been achieved in the development of silicon photonics and hybrid silicon III-V nanophotonic devices. However, for the future generation of circuits, the developed approaches are not scalable, mainly due to power consumption.

In this context, two-dimensional (2D) materials have attracted extensive interest as potential candidates for next generation electrical and optoelectronic applications. In particular, large optical second harmonic generation (SHG) has been recently discovered in a number of 2D materials, which allows them to have valuable applications in electro-optic modulators and switches, frequency conversion, and so forth. For instance InSe has been estimated of having one order of magnitude higher second order nonlinear response than lithium niobate (LiNbO3), which is the unbeatable material for electro-optic effects. This kind of materials opens the door to hybrid integration in the inexpensive silicon platform for modulation or even light generation and detection in different wavelength ranges, which promise to revolutionize on-chip functionalities.

The internship will be in close collaboration with the group of materials for photonics (PMAT) at the Department of Material Sciences and Engineering at MIT (USA).

The research activities will include:

- **Theoretical study and optical simulations** of nonlinear effects in hybrid Chalcogenide silicon photonic waveguides
- **Nonlinear characterizations** to demonstrate the Frequency Kerr Comb generation

During the internship, the student will be actively involved in the current research activity of the group, collaborating with PhD students, postdocs and researchers of different research backgrounds and nationalities.

VALUED QUALITIES IN THE STUDENT

- Curiosity for novel research experiences and fields.

- Creativity and pro-activity in the search for innovative solutions and approaches.

- Attractivity in experiments and simulations.

- Capability to communicate and share results in a multidisciplinary and multi-nationality environment.

This project can be continued and expanded within the frame of a PhD.