Proposition de SUJET DE STAGE M2R/Ingénieur-3A

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Strained silicon photonics for nonlinear optics

The performance evolution of telecommunication networks, computing systems and integrated circuits requires increasing communication bandwidth at all interconnect levels. Also, the power efficiency, i.e. the energy required to transfer data, must be considerably improved. The use of silicon photonics has been well identified as a means to overcome electrical interconnects bandwidth and power efficiency limitations. This research domain has exhibited a remarkable rate of development, with current advances, which were inconceivable few years ago. This evolution is largely based on the vision that silicon as a mature integration platform can bring photonic integrated circuits closest to its electronics.

Despite the demonstration of high performance silicon modulators, germanium photodetectors, and III-V lasers on silicon, there are still some challenges to solve including their integration in a common chip and the reduction of the power consumption of optical modulators. Furthermore, as silicon is a centrosymmetric material, it does not exhibit second order optical nonlinearities, i.e. there is no Pockels effects and no possible wavelength conversions using such processes. However, straining silicon can break its centrosymmetry, leading to exhibit such second order nonlinearities. Recent proofs of concept have been demonstrated based on the use of silicon nitride stress layers on top of silicon.

The objective of the internship is to design and characterize a new type of strained silicon photonics waveguides based on subwavelength structures and to propose new approach to strongly increase the strained induce in waveguides. The student will also performed characterization in close collaboration with PhD students on high-speed electro-optics effect.

The candidate will be fully involved in the optical and electrical simulations and in the characterization using integrated optical benches and Raman spectrometers.

The research activity will include:

- **Theoretical study and electro/optical simulations** (using commercial software) to evaluate the key metrics for tuning the optical properties of the waveguide modes

- DC and high-speed **experimental characterizations** of optoelectronic devices based on second-order nonlinearities (i.e. Pockels effect)

The work is done in the framework of the ERC POPSTAR project.

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.

This project can be continued and expanded within the frame of a PhD (European Research Council projects or Doctoral school funding).

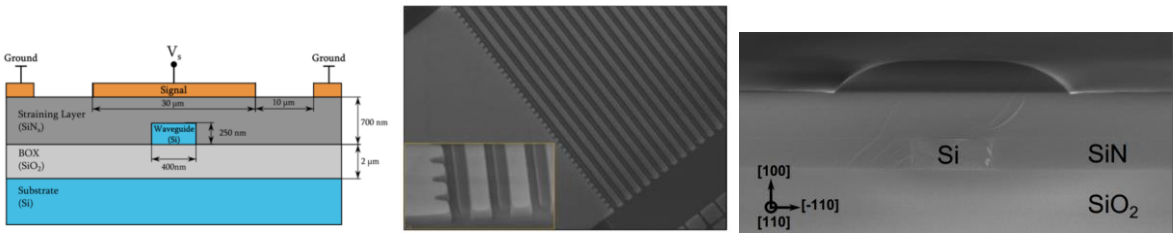

Fig. 1*: left: schematic view of a strained silicon waveguide. Middle: Grating coupler based on subwavelength structures. Right: SEM image of strained waveguide fabricated at C2N.*

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.

BIBLIOGRAPHY RELATED TO THE TOPIC

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