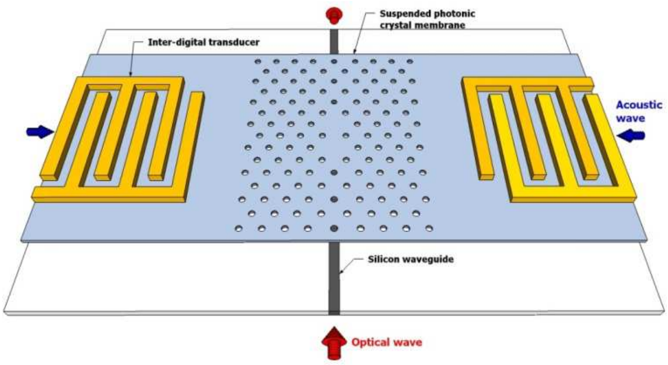
Axe 5: Capteurs, MEMS

Thesis title:
Integrated actuation of photonic crystal membranes for optomechanics

Subject:
Optomechanics deals with the interactions between light and a mechanical oscillator. It uses this coupling (via optical forces) to read or control the mechanical behavior of this resonator. Within a timeframe of the last decade, the field of optomechanics has moved from exploring and establishing optomechanical phenomena to establishing *optomechanical technologies*. These new prospective technologies are based on disruptive concepts exploiting photon-photon interaction for a broad range of applications including quantum technologies, microwave photonics, sensing...
All these applications would strongly benefit of the scalability and integrability of nano-ptomehcanical resonators, opening the way to optomechanical circuits interfacing various functionalities. The building block here is an optomechanical platform integrating simultaneously actuation and detection tools on single planar setting. The development of such platform will be at the core of the PhD work.

The platform will consist in suspended photonic crystal slabs, sustaining mechanical modes in the GHz frequency range and optical modes around 1.5 µm; such resonator will be coupled to integrated silicon waveguides insuring optical actuation and detection and interfaced with integrated surface acoustic wave transducers allowing for on-chip acoustic actuation. The feasibility of such acoustic transduction mainly relies on the use of piezo-electric materials such as GaN, AlN.



The PhD work will involve nanofabrication and advanced optomechanical characterization. The challenge here lies in the combination of two technologies: integration of SAW transducers and etching of AlN/GaN photonic crystal membranes with high optical confinement. Such combination will allow to achieve novel scalable nano-optomechanical resonators integrating efficient acoustic and optical functionalities on the same chip; on platform will be used to build an on-chip ultra-stable optomechanically-driven microwave oscillators with high spectral purity for microwave photonics.

Laboratories: Thesis will mainly be done at L.P.N. for nanofabrication and opto-mechanical measurements. Some stays are planned at CRHEA to support epitaxy and material characterization effort.

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