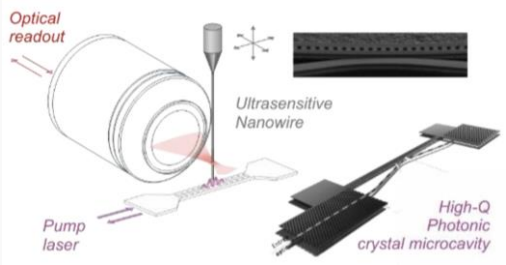
Centre DE Nanosciences & DE Nanotechnologies

PhD proposal:
Scanning Near-field OptoMechanical Microscopy

After being able to control and read displacements of a single optomechanical resonator, one of the next challenges is to extent these capabilities to several optomechanical elements. By combining ultrasensitive nanomechanical resonator, featuring large zero-point position fluctuations, namely a SiC nanowire to high-Q and small volume photonic crystal microcavity (see fig below), it allows performing metrological sensing experiments.

By inserting the vibrating extremity of a suspended nanowire in the evanescent optical field of high-Q and small mode volume microcavities will cause frequency shifts of the cavity resonance, thus providing a parametric coupling between the oscillator position and the intracavity field. In turn, the intracavity photon field will apply an optical force on the resonator, which can be used to mechanically probe the intracavity field, through scattering like and force measurements, thus providing novel, local, analysis tool for both systems. By scanning it above the sample while recording the cavity responses, nanomechanical exploration of the photonic crystals will be done by mapping the optical and mechanical fields embedded within the cavity [1].



Accurate probing of the optical mode in these crystals and also mapping of the mechanical modes of such crystal will permit the separation between the mechanical and optical components of the optomechanical system. This will help to significantly enhance the interaction strength and could potentially make possible quantum applications. A second objective will consist in mapping the optomechanical force applied on the nanowire via pump-probe experiments. Monitoring the induced nanowire driven displacement with the lateral readout beam, will permit to determine the local optical force.

PhD will be involved in the optical and mechanical simulations of the photonic crystal cavity as well as in the impact of the nanowire on both quantities. This task will be dedicated to the realization and optimization of the photonic crystal microcavities to maximize their interaction to the nanowire vibrations. Fabrication of such structures will be the next task of the PhD student for her/his project in C2N clean-room. Finally, she/he will be involved in the opto-mechanical experiments in order to perform scanning near-field optomechanical microscopy at room temperature. The PhD student will be funded by the ANR project “SinPhoCom”.

Please send the following application documents to: Rémy BRAIVE (remy.braive@c2n.upsaclay.fr)
- Cover letter expressing your motivation in the position
- CV