Abstract:

Nanophononics is a research field addressing the control and the manipulation of high frequency mechanical vibrations at the nanoscale. Current fabrication techniques enable the realization of nanophononic systems where acoustic phonons interact with confined optical fields, with exciting perspectives for example in the context of high frequency cavity optomechanics. The work carried out in this thesis addresses the conception and the experimental characterization of novel opto-phononic resonators. We will first present a novel confinement method for high frequency mechanical vibrations, based on the adiabatic localization of longitudinal acoustic phonons. We will then present the three-dimensional confinement of light and hypersound in micropillar optomechanical platforms operating at unprecedentedly high mechanical frequencies (20 GHz). This theoretical study was carried out through finite element simulations and demonstrates the potential of these systems for future high frequency cavity optomechanics experiments. Finally, we will present our experimental work on the measurement of confined high frequency phonons in micropillar systems through Raman scattering spectroscopy. Based on these results I will discuss some future perspectives.

Keywords: Nanophononics, Raman scattering spectroscopy, Optomechanics, superlattices, adiabatic cavity, micropillars.