Nanophononics, nanoacoustics, and nanomechanics

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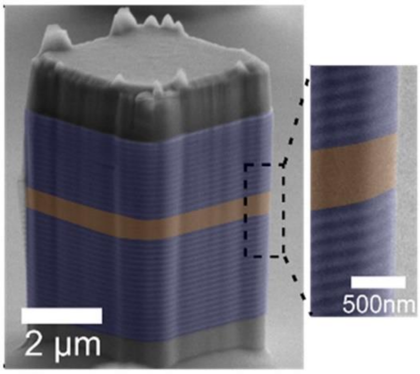
Acoustic-phonons in the GHz-THz range (i.e. acoustic waves with wavelengths in the 1-100 nm range) appear as a suitable platform to study complex wave phenomena, motivating the development of nanophononic devices. The strong interactions with other excitations in solids extend the range of applications to other fields such as nanoelectronics, photonics, communications, NDT, optomechanics, and quantum optics [1]. Contrary to what happens in standard opto-acoustics, at these scales, the wavelength of the photons is comparable to or much larger than the wavelength of the acoustic waves. Advances in material science and fabrication techniques enabled a new generation of samples with nanometric dimensions where it is possible to confine photons and acoustic phonons in a single resonant cavity.

In this presentation, I will describe the behavior of a plethora of devices able to control the interactions between light, sound, and charge at the nanoscale. I will introduce some strategies to generate, manipulate, and detect ultra-high frequency acoustic phonons both in the time and spectral domains. The presented results open a new playground in the control of acoustic vibrations in solids and constitute a new platform to study topological effects, quantum phenomena, and thermal transport properties [2-6].



Semiconductor micropillar resonator where acoustic phonons and visible photons can be simultaneously confined.

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