Optomechanical coupling in 1D corrugated structures with complete dual photonic and phononic band gap.

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Simultaneous confinement of photons and phonons in a tailored structure leads to a strong interaction between light and mechanical motion, allowing optomechanical effects, i.e., transduction of motion through optical signals and even direct actuation through energy transfer from light to phonons (heating, regenerative oscillations) or vice versa (cooling). The observation of such effects is limited to high quality factor photonic structures, and in photonic crystal cavities requires a careful design of the defect. We present the design and experimental characterization of suspended silicon one-dimensional corrugated nanobeams. We start from a unit cell that has simultaneously large and complete photonic and phononic band gaps[1] and we chose parabolic variation of the period, the wing width and the hole radius to obtain high-quality-factor cavities. By means of the evanescent field out of tapered fibre, we coupled light into the proposed cavities and identify several photonic resonances with Q factors in the range of 10^4. Performing RF spectroscopy, spectral analysis of the time domain transmitted and re-coupled light, we identified several phononic modes ranging from tenths of MHz (clamping modes) to 7 GHz (confined modes).

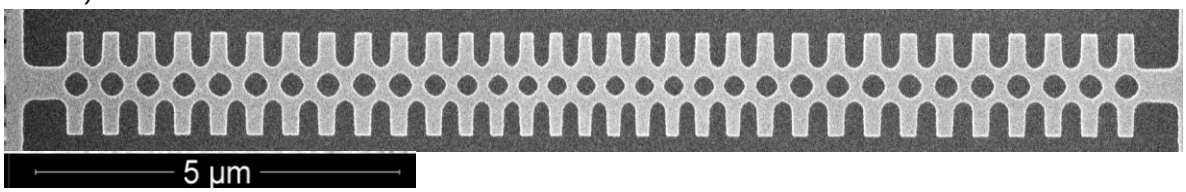

Figure 1 SEM image of a fabricated structure.

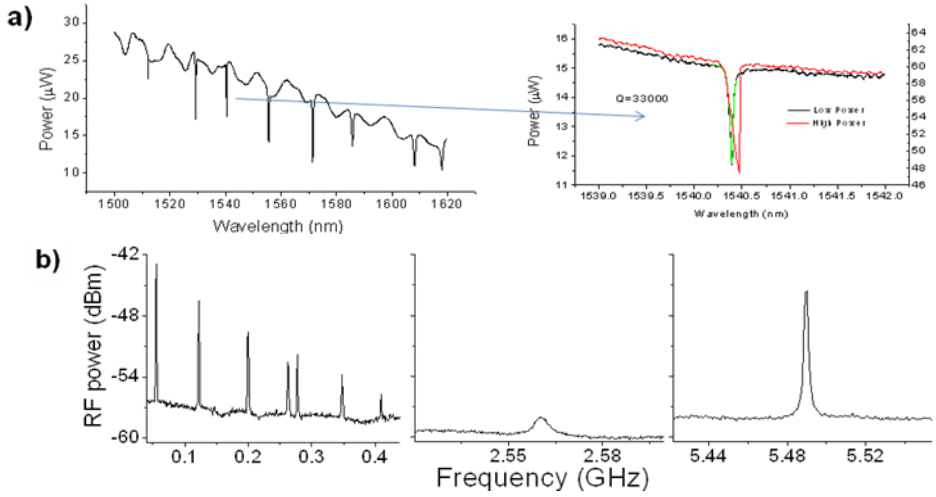

Figure 2 a) Photonic characterization of the structure b) RF spectroscopy of the different phononic modes.

1. Pennec, Y. *et al.* Band gaps and cavity modes in dual phononic and photonic strip waveguides. *AIP Advances* **1**, 041901 (2011).