Optical characterization of 1D and 2D Silicon PhoXonic crystals with an evanescent light coupling technique

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Phononic and photonic crystals have been subject of an extensive investigation during the last decades. Structures with the existence of both photonic and phononic gaps (also called PhoXonic crystals) enable the simultaneous localization of acoustical and optical modes, thus enhancing acousto-optical and opto-mechanical interactions.

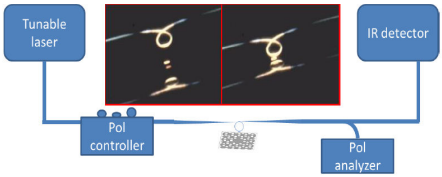

Figure 1: Experimental setup for optical transmission measurements. The two photos show a lateral view of the real fiber away from the sample (left) and close to the sample (right). The mirror image of the fibre can be seen reflected in the sample.

In this work, we will present the optical characterization of 1D and 2D PhoXonic (PX) crystal Silicon membranes fabricated with standard CMOS compatible techniques by means of an optical transmission technique.

The 1D structures are strip waveguides in which each unit cell contains one hole in the middle and two stubs on the sides. [1] The 2D structures are honey-comb lattices with just one type of holes. [2] Both PX crystal geometries have been fabricated without and with single defects, the latter case to provide PX mode localization within the gaps and the defect region.

The experimental setup exploits the evanescent light coupling from a microlooped tapered fiber into the PX structures. The relatively high spatial resolution provided by the loop shape (~1µm) allows the local excitation of the supported optical modes within the gap.

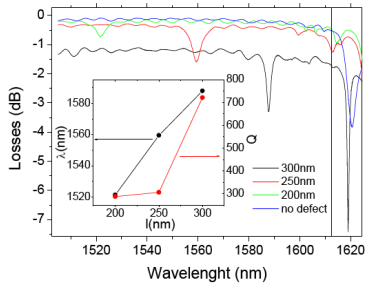

Figure 2: TE polarized transmission curves for different defect lengths for the 1D structures. Spectral position of the resonance for different defect lengths (inset, left) and the corresponding quality factor (inset, right).

On the 1D structures, we will present a study of the effect of the defect length on the spectral position of the resonant localized mode within the gap, while on the 2D structures we will show the effect of changing the pitch and diameter of the holes.
We will discuss on the expected opto-mechanical interaction in these structures on the basis of the experimental results.

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References

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