Lithium niobate electro-photonic devices

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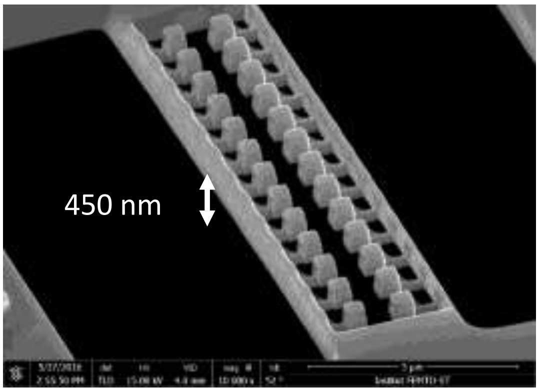
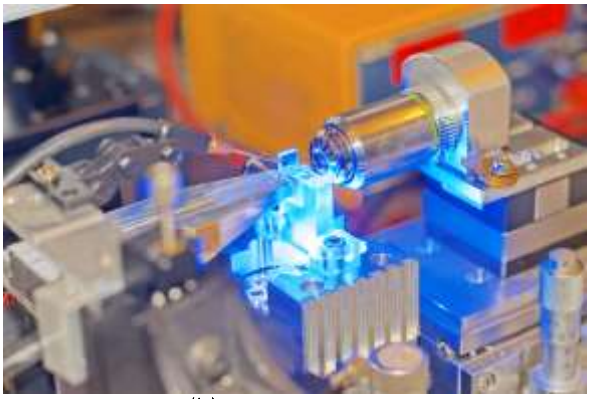
The advent of LiNbO3 thin films (LNTF) has paved the way for new integrated photonic components, from ultra-high bit rate modulators with low drive voltage [1], to polarization scramblers [2] or broadband frequency combs [3]. LiNbO3 acousto-optic, electro-optic, and nonlinear properties are widely appreciated in applications ranging from quantum circuits to ultra-high-bit-rate telecommunications systems. LiNbO3 thin-film-based waveguides promote dense integration and enhance electro-optical interactions. Usually, LNTF components are made of photonic microguides. Their footprint is a few millimeters, and the electro-optical enhancement is due to the small distance between the electrodes surrounding the guide.

By writing nanostructures in thin LiNbO3 membranes, we show how to gain two orders of magnitude in miniaturization and in electro-photonic interactions. Figure 1(a) gives an overview of such nanostructures, and Figure 1(b) shows the electro-optical characterization bench.

As an example, we will show two types of freestanding micrometer-sized modulators. The first one is a 200 µm long Fabry-Perot realized between two short Bragg gratings [4]. The resonance spectral shift under external voltage is 40 pm/V, which is twice as efficient as the LNTF state-of-the-art. We also show photonic crystals based on Fano resonance inscribed in a 700 nm layer and transferred onto a PM fiber, generating giant electro-photonic interactions through slow light effects [5]. These developments lead to the shortest electric field sensor reported to date and pave the way for a new generation of micrometer-sized photonic integrated circuits.



(a)



(b)

Figure 1: (a) SEM view of a 450 nm-thick $LiNbO_3$ freestanding nanostructure. (b) Picture of the electro-optic characterization setup

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