The superprism effect in lithium niobate photonic crystal for ultrafast, ultracompact electro-optical switching

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An interesting potential application of photonic crystals, based on the superprism phenomena first shown by Kosaka et al [1], would be the realisation of ultracompact optical components for beam-steering and beam-switching. We have been studying photonic crystals in an electro-optical material ($LiNbO_3$) in order to fabricate an ultrafast, ultracompact electro-optic superprism device.

Previously, we have studied the superprism effect in lithium niobate with both the Plane Wave Expansion Method (PWE) and 2D Finite Difference Time Domain (FDTD) [2]. These numerical simulations, for a triangular lattice of air holes in lithium niobate substrate (r=105nm, a=525nm) at λ=1550nm, have shown an angular sensitivity of 0.8°/nm and 10.8° for a refractive index variation of 1%. A first generation of experimental devices, based on the configuration identified by our simulations, has been fabricated by Focused Ion Beam (FIB) milling of Annealed Proton Exchange (APE) lithium niobate waveguides. The experimental setup, and both far-field and near-field characterization results will be presented.

Finally, in a related project we have observed a slow light effect in nano-periodic structures that can greatly enhance the Pockels effect [3]. Thus we will also propose an efficient electro-optic superprism photonic crystal device in lithium niobate, in which the electro-optical tuning of the superprism effect can be optimized by this same slow light effect.

[1] H. Kosaka, T. Kawashima, A. Tomita, M. Notomi, T. Tamamura, T. Sato and S. Kawakami, *Phys. Rev. B,* **58**, R10096 (1998).

[2] J. Amet, M.-P. Bernal and D. Van Labeke, submitted to *Journal of Microscopy* (2006).

[3] M. Roussey, M.-P. Bernal, N. Courjal, R. Salut, D. Van Labeke, and F.I. Baida *Appl. Phys. Lett*, **89**, 241110 (2006).