Electrooptically Tunable Photonic Crystal

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A long standing challenge in photonics is the implementation of a nanophotonic circuit into a noncentrosymmetric medium which exhibits a second order nonlinear optical susceptibility based on electronic displacement polarization [1]. The inherent quasi instantaneous response of the nonlinear polarization in such media generates the potential of ultrafast electrooptical submicrometer photonic devices with switching bandwidths well beyond 100 GHz. Such functionalities will play a vital role in next generation computer technologies.

We report on electrooptical modulation with a sub 1 Volt sensititivity in a photonic crystal slab waveguide resonator which contains a nanostructured second-order-nonlinear optical polymer. The electrooptical susceptibility in the core was induced by high-electric-field poling. A square lattice of holes carrying a linear defect was transferred into the slab by electron-beam-lithography and reactive-ion-etching [2], creating a photonic crystal slab based resonator. Applying an external electric modulation voltage to electrodes leads to a linear electrooptical shift of the resonance spectrum and thus to a modulation of the transmission at a fixed wavelength based on the electronic displacement polarization in a noncentrosymmetric medium (Pockels-effect). This effect is therefore inherently faster than other reported electrooptic modulation effects in nanophotonics [3].

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