Demonstration of Optically Modulated Photonic Bandgap Crystal Optical Intersections

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This paper reports demonstration of free carriers' effects by optical pumping in 2D slab-type rods configuration photonic bandgap crystal (PhC). In the sub-wavelength ultrasmall optical intersection resonator structures, reduced radii defect PhC rods of less than 100 nm in critical dimensions were realized by a laser source with much longer wavelength at 248 nm. Ultra smooth reactive ion etching side-walls were obtained despite the low aspect ratio and especially the time multiplexed etch and passivation actions.

The realized PhC devices were sensitive to the canonical optical communication wavelengths centered at 1550 nm, which was used as the signal probe beam. Upon inducement of highly localized excited carriers' plasma, instantaneous modulation of 3 dB was obtained for optical pumping power of only 0.318 MW/cm^2 without optimization. These PhC intersections were designed to have quality-factors (Q) two orders of magnitude larger than previous demonstrations [1, 2], and were verified to be sensitive to modulations in sizes of the center resonant cavity rod, corresponding well with finite-difference-time-domain first principle simulations.

Hence, all optical modulations of high Q photonic crystal optical intersections were achieved in both static and dynamic resonator modulation demonstrations. These results therefore provides indication for the potential use of ultra small size photonic crystal optical intersections that could be used extensively in next generation active photonic integration for light speed active optical circuits.

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[2] Selin H. G. Teo, A. Q. Liu, J. B. Zhang, and M. H. Hong, *Appl. Phys. Lett* **89**, 091910 (2006).