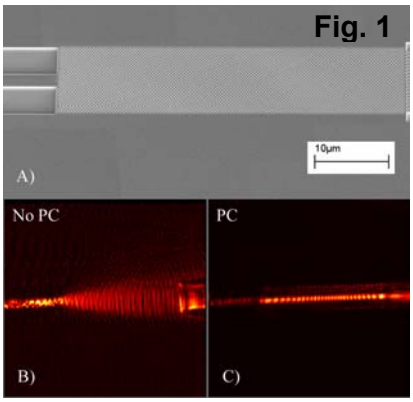
Self-Collimation in Si 2D Photonic Crystal Structures

W. Park, E. Schonbrun, M. Abashin, Y. Fainman, T. Yamashita and C. J. Summers
Department of Electrical & Computer Engineering, University of Colorado,
Boulder, CO, 80309-0425, U.S.A.



We have designed, fabricated and experimentally demonstrated the self-collimation effect in Si photonic crystal (PC) structure. Both far-field and near-field measurements directly revealed the self-collimated propagation. The initial 1.5 μm beam waist broadened only to 2.25 μm after traveling 50 μm inside the PC, in sharp contrast to the 16 μm beam waist measured in unpatterned Si slab of the same length (Fig. 1).

Heterodyne near-field measurements were used to obtain both amplitude and phase information. Flat and evenly spaced phase fronts were clearly resolved. We were also able to reconstruct Fourier space from the experimental data, which was in excellent agreement with the theoretically predicted equi-frequency surface.

Using the self-collimating PC structure, we constructed a polarization beam splitter based on a PC heterostructure. In this device, one polarization is strongly reflected at the hetero-interface and routed to the reflection port via self-collimation. The opposite polarization exhibits extremely low reflection at the hetero-interface and reaches the transmission port. We observed extinction ratio up to 19.7 dB.