Slow light, modal dispersion and mini stop bands in photonic crystal waveguides: experiment and modelling

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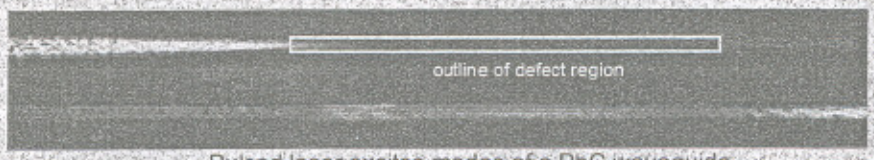
We have probed the modal dispersion of planar photonic crystal (PhC) waveguides fabricated on SOI. Experimentally, we have imaged the light above the surface of the waveguides using a pulsed laser source with a phase sensitive Near-field Scanning Optical Microscopy (NSOM). This has allowed us to show the real space observation of fast and slow pulses propagating inside a W3 PhC waveguide. Local phase and group velocities of modes are measured. For a specific optical frequency we observe a localized pattern associated with a flat band in the dispersion diagram. Movement of the field is hardly discernable in a 3ps time window: its group velocity would be at most c/1000 [1]. The huge trapping times without the use of a cavity should open new perspectives for dispersion and time control within PhCs.



Pulsed laser excites modes of a PhC waveguide.
The time elapsed between these two frames is 2.8ps

[1] H. Gersen, et al, *Phys. Rev. Lett.*, accepted for publication.

Woodpile-type photonic crystals composed of air columns

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Three-dimensional photonic crystals are ultimate light-confining structures. However, realizing these structures is difficult due to complicated fabrication techniques. We will describe woodpile-type PhCs composed of air columns, which can be fabricated using a simple technique, based on 45-deg-angled dry etching. This woodpile structure is composed of air columns (n=1) surrounded by Si (n=3.5). Band calculation based on the plane-wave method shows that the complete band gap is obtained for ℓ (width of column cross section) =0.4~0.6•(column period), when the column has a regular square cross section, even though the gap remains small. On the other hand, a large gap can be obtained for the rectangular cross section. The gap-midgap ratio exceeds 20% for the column cross section with a lateral- and vertical- width ratio of 2.4 (Fig. 1). We will also present a newly developed fabrication technique using an ICP deeply etching method [1].

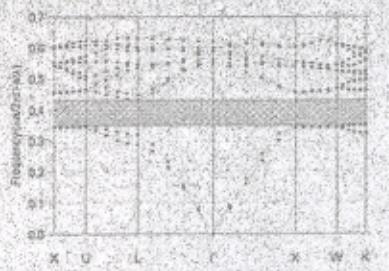

Fig. 1. Band structure for the column with a laterial- and vertical-width ratio of 2.4.

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[1] K. Hosomi et al., PECS-V, Mo-P1, p. 19 (2004).

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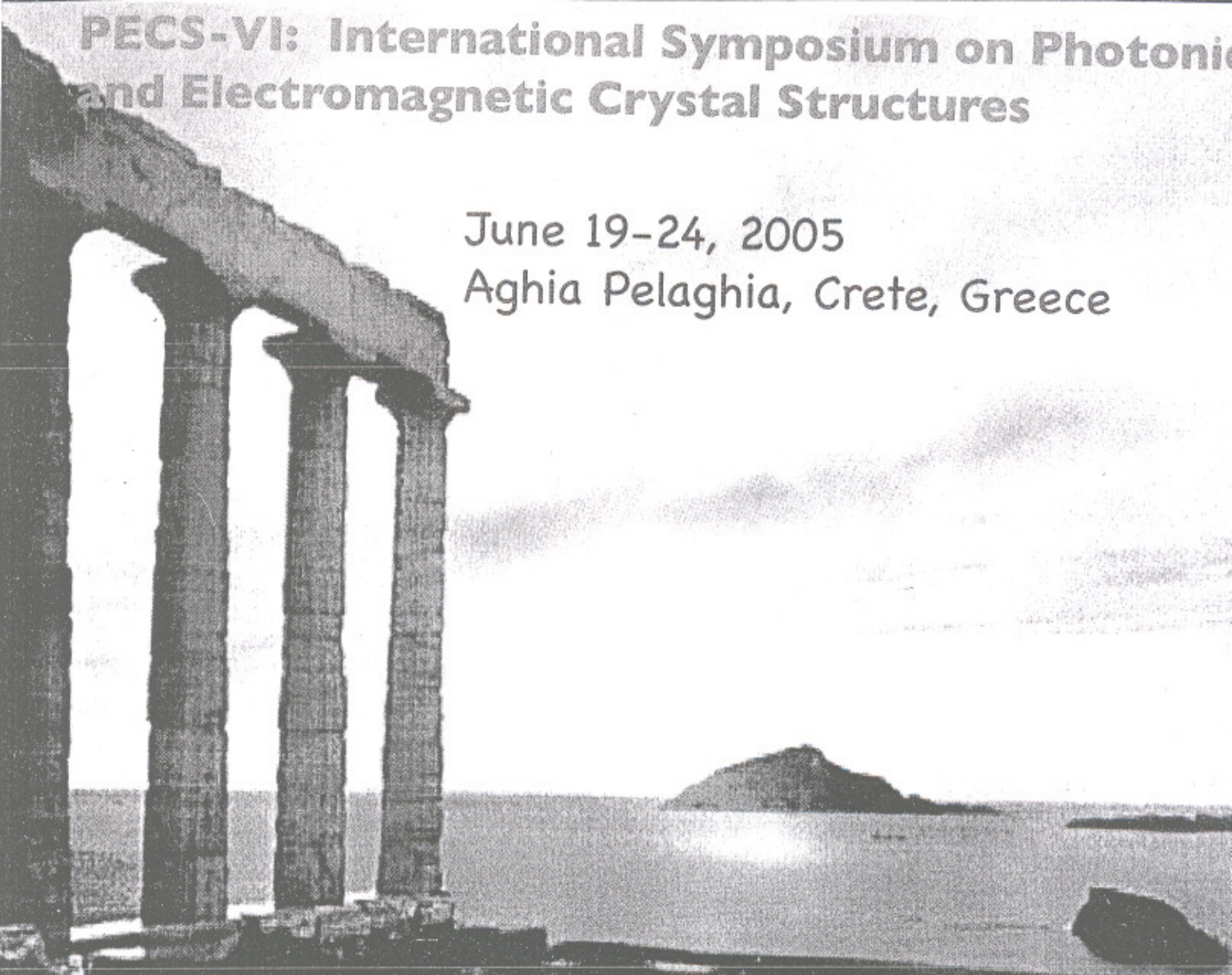

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