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Diameter-dependent Guided Resonance of Dielectric Hole-array Membrane

Ou, Neil; Shyu, Jia-Hong; Lee, Huang-Ming; Wu, Jong-Ching

Abstract

Silicon nitride photonic crystal slabs having various submicron lattice constants and hole diameters have been investigated, in which optical transmission measurements were utilized in the characterization of the guided resonance. Samples were fabricated by using standard electron beam lithography in combination with KOH wet etching and reactive ion etching dry etching through a silicon substrate and silicon nitride membrane, respectively. The transmittance data reveal the asymmetrical shape of absorption dips associated with Fano resonance, and the positions of the resonance were found to be in accordance with the lattice constant. In addition, multiabsorption dips were evolved from the main absorption dip and became discernable when increasing the hole diameter. The plane wave expansion method was used to identify the mode splitting in the band structure that is caused by a finite size hole diameter, giving rise to the multiabsorption dips. Furthermore, the finite element method was used to calculate the transmission spectra. The simulated representations were in positive agreement with the experimental results.