Time-domain analysis of bandgap characteristics of two-dimensional periodic structures by use of a source-model technique

Alon Ludwig* **and Yehuda Leviatan**

Department of Electrical Engineering, Technion–Israel Institute of Technology, Haifa 32000, Israel
**Corresponding author: ludwig@techunix.technion.ac.il*

Received June 4, 2007; revised November 21, 2007; accepted November 25, 2007;
posted November 27, 2007 (Doc. ID 83730); published January 28, 2008

We introduce a time-domain source-model technique for analysis of two-dimensional, transverse-magnetic, plane-wave scattering by a photonic crystal slab composed of a finite number of identical layers, each comprising a linear periodic array of dielectric cylinders. The proposed technique takes advantage of the periodicity of the slab by solving the problem within a unit cell of the periodic structure. A spectral analysis of the temporal behavior of the fields scattered by the slab shows a clear agreement between frequency bands where the spectral density of the transmitted energy is low and the bandgaps of the corresponding two-dimensionally infinite periodic structure. The effect of the bandwidth of the incident pulse and its center frequency on the manner it is transmitted through and reflected by the slab is studied via numerical examples.

OCIS codes: 050.1950, 260.2110, 000.4430, 230.1480, 290.0290, 320.5550.