Analysis of arbitrary defects in photonic crystals by use of the source-model technique

Alon Ludwig and Yehuda Leviatan

Department of Electrical Engineering, Technion–Israel Institute of Technology, Haifa 32000, Israel

Received November 24, 2003; revised manuscript received March 1, 2004; accepted March 4, 2004

A novel method derived from the source-model technique is presented to solve the problem of scattering of an electromagnetic plane wave by a two-dimensional photonic crystal slab that contains an arbitrary defect (perturbation). In this method, the electromagnetic fields in the perturbed problem are expressed in terms of the field due to the periodic currents obtained from a solution of the corresponding unperturbed problem plus the field due to yet-to-be-determined correction current sources placed in the vicinity of the perturbation. Appropriate error measures are suggested, and a few representative structures are presented and analyzed to demonstrate the versatility of the proposed method and to provide physical insight into waveguiding and defect coupling mechanisms typical of finite-thickness photonic crystal slabs.

OCIS codes: 000.4430, 250.5300, 050.1950, 130.2790, 230.5750.