BAND STRUCTURE ANALYSIS OF 2D PHOTONIC CRYSTALS BY COUPLED-WAVE METHOD: A ROBUST *R*-ALGORITHM

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S u m m a r y

The coupled-wave method (CWM), which is used for the analysis of electromagnetic wave diffraction at planar 1D gratings, has been demonstrated to be able to quickly determine whether the propagation of an electromagnetic wave with an intended frequency is allowed in a 2D photonic crystal, provided that periodic boundary conditions are imposed. The problem is reduced to the solution of the equation $\mathbf{W_1 X} = \rho \mathbf{W_2 X}$ and the verification of whether $|\rho| = 1$. If so, the propagation of the intended frequency is allowed. The dimension of the vector $\mathbf{X}$ is equal to $2N$ – two times the number of the coupled waves used at calculations – and is determined by an accuracy needed for analysis. Since the dielectric constants of typical photonic crystals are characterized by a symmetric spatial dependence, the symmetry considerations allow the dimension of the vector $\mathbf{X}$ to be reduced to $N \pm 1$ or N, depending on the symmetry type. In so doing, the calculation time becomes about 8 times shorter, without any loss of resulting accuracy. A modified, robust *R*-algorithm has been used for the numerical analysis.