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Method SWE for calculation of finite 2D photonic crystal resonators

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The photonic crystal resonators (PCR) are of interest for all-optical signal processing as elements of logic devices with extremely high quality factor which may be reached at modern state of technology. Nevertheless, the existing calculation methods actually are valid only for infinite structures. The proposed Standing Wave Expansion Method (SWE) as a continuation of the proposed in [1] theory was developed especially to calculate the electromagnetic spectrum and field distribution inside the PCR of finite sizes. A general feature of the solutions corresponding to modes trapped inside the resonator is that all its energy are concentrate inside the resonator whereas outside the resonator we have only falling tails of states. A finite 1D problem serves in SWE method as a generator of analytically determined functions describing X or Y part of the total 2D basis with close periods in both directions. The 2D basis generator works to cover the $N_1 \bullet N_2$ periodic resonator with 1D functions found for N_1-period resonator in X direction and N_2-period resonator for Y direction. It is easy to understand that the predominant density of field energy is concentrated inside the $N_1 \bullet N_2$ resonator unlike to other approaches based on plane waves. The set of basis' functions {|s,g>} found for p-polarised waves may be described with the help of magnetic field. We have calculated by the SWE method several types of PCR differing by intrinsic contrastivity and beginning with weak contrastive SiO_2/SiO_2 PCR, intermediate Si/SiO_2 PCR and strongly contrastive Si/air resonators. Possible applications of the method are discussed.

1. *Glushko, E.,Ya, Glushko, O, E., Evteev, V. N. Stepanyuk, A. N.* Electromagnetic eigenwaves in metastructures: perturbation theory method//

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