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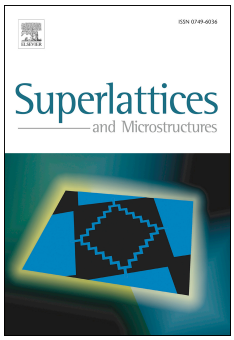

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Complex waveguide based on a magneto-optic layer and a dielectric photonic crystal

N. N. Dadoenkova[1,2,*], I. S. Panyaev[1], D. G. Sannikov[1], Yu. S. Dadoenkova[1,2,3], I. A. Rozhleys[4], M. Krawczyk[5], I. L. Lyubchanskii[2]

[1]*Ulyanovsk State University, Ulyanovsk, Russian Federation*
[2]*Donetsk Physical and Technical Institute of the NAS of Ukraine, Donetsk, Ukraine*
[3]*Novgorod State University, Veliky Novgorod, Russian Federation*
[4]*National Research Nuclear University MEPhI, Moscow, Russian Federation*
[5]*Faculty of Physics, Adam Mickiewicz University in Poznań, Poznań, Poland*

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ABSTRACT

We theoretically investigate the dispersion and polarization properties of the electromagnetic waves in a multi-layered structure composed of a magneto-optic waveguide on dielectric substrate covered by one-dimensional dielectric photonic crystal. The numerical analysis of such a complex structure shows polarization filtration of TE- and TM-modes depending on geometrical parameters of the waveguide and photonic crystal. We consider different regimes of the modes propagation inside such a structure: when guiding modes propagate inside the magnetic film and decay in the photonic crystal; when they propagate in both magnetic film and photonic crystal.

1. Introduction

The optic waveguides based on the multilayered photonic structures have been in the focus of intense investigations during last decades. The theory of Bragg reflection waveguides has been proposed in [1, 2] in 1976. It has been shown that waveguides utilizing Bragg reflection at the boundaries can support confined and lossless propagating modes in regions of low refractive index. The waveguide propagation of the electromagnetic waves (EMWs) in nonmagnetic multilayered systems of different geometries, including photonic crystals (PCs) [3], has been reported by many authors [4–6]. The mode selection mechanism is realized by using an asymmetric quasi-one-dimensional Bragg reflection waveguide and shown to be effective to achieve high side-mode suppression ratio [7]. The guided modes of a slab waveguide which consists of a low-index layer sandwiched between two PCs are analyzed theoretically using a ray-optics model in [4, 5]. It has been shown that the guided modes of the waveguide operate inside the overlapped photonic band gaps of two Bragg reflectors and each guided mode in such a waveguide has two cutoff points, and the dispersion curves of the guided modes are fragmentary and, as a result, the waveguide can be designed to support only the high-order modes instead of the low-order modes. The theoretical investigations of the quarter-wave Bragg reflection waveguide are presented in [6]. An analytical solution to the mode dispersion equation is derived, and it is shown that such a waveguide is polarization degenerate, although the TE- and TM-mode profiles differ significantly as the external Brewster's angle condition in the cladding is approached. The aperiodic Bragg reflection waveguides have been also studied in [8].

*Corresponding author.
E-mail address: dadoenkova@yahoo.com (N. N. Dadoenkova).