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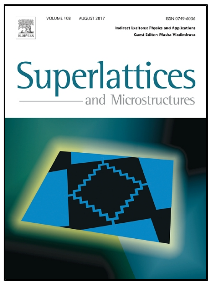

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Double-negative multilayer containing an extrinsic random layer thickness magnetized cold plasma photonic quantum-well defect

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Abstract: Theoretically, the transmission properties of a symmetric double-negative metamaterial one-dimensional photonic crystal containing an extrinsic random layer thickness magnetized cold plasma photonic quantum-well defect structure have been investigated. From the numerical results performed by characteristics matrix method, it is found that, such type of structure possesses a transmission peak within the zero-$\overline{n}$ gap. To design a tunable microwave filter, the effects of many parameters such as randomness of layer thickness of the multilayer defect in terms of standard deviation (σ), strength of external magnetic field ($\boldsymbol{B}$) and electron density of magnetized cold plasma (n_e) on transmission peak is discussed. Our findings show that the histogram for the central frequency of the transmission peaks becomes wider with respect to smaller values of σ. In addition, in the case of $\boldsymbol{B}$, our investigations also reveal that the histogram shifts to the higher frequency range and vice versa while considering the case of n_e. These findings help to design a tunable filter for different microwave applications.

Keywords: Metamaterial; Magnetized cold plasma; Extrinsic disordered defect; Structure-property relationship; Photonic quantum-well defect.

1. Introduction

Control and manipulation of the propagation of electromagnetic radiation in a dielectric medium can be effectively implemented by altering the dielectric constant of the medium. Periodic profile of alteration of dielectric constant generally considered as photonic crystal (PC) was first numerically and experimentally demonstrated by Yablonovitch [1] and John [2], respectively. The periodic variation in the dielectric constant forms a photonic bandgap (PBG). However, the position and width of PBGs are determined by the dielectric constant and the physical thickness of each individual layers. Using these PBG structures, various technological applications such as sensors for chemical, physical, and biological stimuli's, photovoltaic's, lasers, LEDs etc. were predicted and demonstrated experimentally [3–13]. However, most of the applications of PC are eventually related with the filtering action i.e. localized electromagnetic state of PC within the PBG. To create such localized electromagnetic state or popularly known defect mode has become a kin interest of one-dimensional (1D) PC. Intrusion of a defect mode in the 1DPC is done by customizing some

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