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A Comparative Study of Linearly Graded and without Graded Photonic Crystal Structure

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Abstract : Photonic crystals (PCs) have attracted much attention due to its electromagnetic properties and potential applications. In PCs, there is certain range of wavelength where electromagnetic waves are not allowed to pass are called photonic band gap (PBG). A localized defect mode will appear within PBG, due to change in the interference behavior of light, when we create a defect in the periodic structure. We can also create different types of defect structures by inserting or removing a layer from the periodic layered structure in two and three-dimensional PCs. We can design microcavity, waveguide, and perfect mirror by creating a point defect, line defect, and palanar defect in two and three- dimensional PC structure. One-dimensional and two-dimensional PCs with defects were reported theoretically and experimentally by Smith et al.. in conventional photonic band gap structure. In the present paper, we have presented the defect mode tunability in tilted non-graded photonic crystal (NGPC) and linearly graded photonic crystal (LGPC) using lead sulphide (PbS) and titanium dioxide (TiO2) in the infrared region. A birefringent defect layer is created in NGPC and LGPC using potassium titany phosphate (KTP). With the help of transfer matrix method, the transmission properties of proposed structure is investigated for transverse electric (TE) and transverse magnetic (TM) polarization. NGPC and LGPC without defect layer is also investigated. We have found that a photonic band gap (PBG) arises in the infrared region. An additional defect layer of KTP is created in NGPC and LGPC structure. We have seen that an additional transmission mode appers in PBG region. It is due to the addition of defect layer. We have also seen the effect, linear gradation in thickness, angle of incidence, tilt angle, and thickness of defect layer, on PBG and additional transmission mode. We have observed that the additional transmission mode and PBG can be tuned by changing the above parameters. The proposed structure may be used as channeled filter, optical switches, monochromator, and broadband optical reflector.

Keywords : defect modes, graded photonic crystal, photonic crystal, tilt angle
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