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Two-dimensional numerical analysis on mid-infrared emission from IV-VI lead salt photonic crystal microcavity

Shaibal Mukherjee, Gang Bi, Jyoti P. Kar, Zhisheng Shi

Keywords

lead salts, plane wave expansion (PWE), finite difference (FD) perturbation method, finite difference time domain (FDTD), mid-infrared emission

Abstract

An optimal design of two dimensional (2D) hexagonal photonic bandgap (PBG) resonating micro-optical defect cavity on IV-VI lead salt material has been carried out. The nature of both the transverse electric (TE) and transverse magnetic (TM) band structure for the electromagnetic waves in the periodic triangular lattice pattern is formulated by the well-established plane wave expansion (PWE) method. The defect cavity is engineered to resonate at ~4.17 μm in TM bandgap. The field distribution in the defect cavity has been analyzed based on two very efficient and popular schemes – perturbation correction finite difference (FD) method and finite difference time domain (FDTD) mechanism which is truncated by uniaxial perfectly matched layer (UPML) absorbing boundary condition (ABC). FD method efficiently solves Helmholtz equations to evaluate the field distribution in the semiconducting waveguide for any single spectral wavelength. The numerical results by FD method are re-established by the FDTD scheme that incorporates a precise numerical analysis within a specified wavelength range.

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