



发光学应用及交叉前沿

含复合缺陷层的光子晶体的光学特性

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摘要：运用传输矩阵法研究了在一维光子晶体中插入缺陷层的透光特性。在无缺陷层的一维光子晶体中能产生467~510 nm、1 279~1 715 nm两处明显的光子带隙。重点研究了插入缺陷层后，在1 279~1 715 nm的光子带隙中缺陷层厚度和入射角度大小分别与透射光谱变化的关系。研究发现：缺陷模的位置对入射角变化很敏感；出现缺陷模的数量和插入缺陷层的数量相同；一维光子晶体厚度的增大不会改变缺陷模的数量和位置，只改变透射峰的宽度和透射率。

关键词：光子晶体 光子带隙 一维光子晶体缺陷模 滤波器

Optical Characteristics of One-dimensional Photonic Crystals with Insertion of Compound Defect Layers

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Abstract: The characteristics of one-dimensional photonic crystals with insertion of defect layers were studied by using transfer matrix method. There are two PBG range of 467~510 nm and 1 279~1 715 nm in the PC without defect layers. The relationship of the transmission spectra between the defect layer thickness and the angle of incidence was studied. The location of the defect mode is very sensitive to the angle of incidence. The number of the defect mode is equal to that of the defect layers. The thickness of one-dimensional photonic crystal does not change the number of defect mode and the central location of transmission peaks, it just changes the width and transmittance of the transmission peak.

Keywords: photonic crystal photonic band gap one-dimensional photonic defect mode filter

收稿日期 2013-07-19 修回日期 2013-09-11 网络版发布日期

基金项目：

国家自然科学基金(60776062, 50730009)；国家自然科学基金仪器专项基金(61127015)资助项目

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参考文献：

- [1] Yablonovitch E. Inhibited spontaneous emission in solid-state physics and electronics[J]. *Phys. Rev. Lett.*, 1987, 58(20):2059-2062.
- [2] John S. Strong localization of photons in certain disordered dielectric superlattices[J]. *Phys. Rev. Lett.*, 1987, 58(23):2486-2489.
- [3] Liu H K, Luo C T, Chen T. Design considerations of multi-channel photonic crystal devices[J]. *J. Vacuum Sci. Technol.* (真空科学与技术学报), 2009, 29(z1):36-38 (in Chinese).
- [4] Zou H. One-dimensional Photonic Crystal All-optical Switches and Logic Gates[D]. Guangzhou: Sun Yat-sen University, 2008 (in Chinese).
- [5] Wang Y, Wu Y D, Li J G, et al. Fabrication of hybrid sol-gel SiO₂ optical waveguide devices by UV-light imprinting[J]. *Chin. J. Semicond.* (半导体学报), 2007, 28(7):1130-1133 (in Chinese).
- [6] Liu S, Liu Y G, Liu R Y, et al. All-fibre flat-top comb filter based on high-birefringence photonic crystal fibre loop mirror[J]. *Chin. Opt.* (中国光学), 2010, 3(1):64-69 (in Chinese).

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- [7] Luo Z M, Sun J G, Liu J. All-optical switch based on two-dimensional nonlinear photonic crystal waveguide [J]. *Semiconductor Optoelectronics (半导体光电)*, 2006, 27(6):683-685 (in Chinese).
- [8] Wang H, Ouyang Z B, Yan L, *et al.* Amplification of one-dimensional photonic crystals defect-mode laser [J]. *Acta Optica Sinica (光学学报)*, 2006, 26(11):1691-1697 (in Chinese).
- [9] Deng K F, Shi D F, Jiang M P, *et al.* Progress in the study of photonic crystal[J]. *Chin. J. Quant. Elect.(量子电子学报)*, 2004, 21(5):555-564 (in Chinese).
- [10] Chen S Y, Zhuang D X, Qiang Z X, *et al.* 1×4 optical multiplexer based on self-collimation effect in silicon photonic crystals[J]. *Opt. Precision Eng.(光学 精密工程)*, 2012, 20(12):2626-2632 (in Chinese).
- [11] Zheng H R, Zhou J, Xue C H, *et al.* Design of super narrow band and comb-shaped multi-channel photonic crystal filters[J]. *High Power Laser and Particle Beams (强激光与粒子束)*, 2006, 18(11):1917-1921 (in