光子学报 2011, 40(7) 1076-1081 DOI: 10.3788/gzxb20114007.1076 ISSN: 1004-4213 CN: 61-1235/O4

论文

一维电-磁介质互联的光子晶体偏振带通滤波器

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摘要:

传统一维纯电介质光子晶体较难实现TE偏振带通滤波,而且每种偏振滤波器的禁带很窄.本文基于不同电磁参量占主导地位控制不同偏振波禁带较宽的特性,利用一维光子晶体禁带带边交叉的方法设计了TE偏振滤波器、TM偏振滤波器和双偏振滤波器.每种滤波结构均为包含电介质和磁性材料的异质结,因此实现各种滤波的同时也展宽了禁带范围.由于电-磁介质互联,所设计的滤波器结构简单,均具备宽禁带、窄带通滤波特性.此外,利用已报道的磁性材料,分析了磁性材料色散对偏振滤波器性能的影响.

关键词: 一维磁介质光子晶体 偏振滤波 异质结

Polarization Band-pass Filters Based on One-dimensional Dielectric and Magnetic Photonic Crystals

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Abstract:

One-dimensional traditional pure dielectric photonic crystals have disadvantages that the design of TE-polarization band-pass filters is difficult,and the bandgaps of TE- and TM-polarization band-pass filters are narrow.Based on the fact that a greater permittivity (permeability) than permeability (permittivity) makes wider TE (TM) bands than TM (TE) bands,three kinds of filters,(TE-polarization band-pass filter,TM-polarization band-pass filter and double-polarization band-pass filter),were designed by stop-band superposition of one-dimensional photonic crystals.Each of them was a heterostructure constructed by two sub-photonic-crystals,hence the structure provided a narrow-frequency pass-band and the bandgap was enlarged.Due to the combination of dielectric and magnetic materials,the proposed design has simple structures with wide bandgaps and narrow-frequency pass-bands.Besides,the effect of magnetic material dispersion on the performance of polarization filters was discussed using a kind of magnetic material which has been reported.

Keywords: One-dimensional magnetic photonic crystal Polarization band-pass filter Heterostructure

收稿日期 2010-11-11 **修回日期** 2011-04-06 **网络版发布日期** 2011-07-25

DOI: 10.3788/gzxb20114007.1076

基金项目:

江苏省自然科学基金（No.BK2010483)和解放军理工大学理学院青年科学基金资助

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参考文献:

[1]YABLONOVITCH E.Inhibited spontaneous emission solid-state physics and electronics[J].Physical Review Letters,1987,58(20):2059-2062.
[2]JOHN S.Strong localization of photons in certain disordered dielectric superlattices[J].Physical Review Letters,1987,58(23):2486-2489.

[3]WINN J N,FINK Y,FAN S H,et al.Omnidirectional reflection from a one-dimensional photonic crystal [J].Optics Letters,1988,23(20):1573-1575.
[4]FINK Y,WINN J N,FAN S H,et al.A dielectric omnidirectional reflector[J].Science,1998,282(27):1679-1682.
[5]ZHANG Ling,LIANG Liang,ZHANG Lin-li,et al.Study of band-structure of 1-D photonic crystal[J].Acta Photonica Sinica,2008,37(9):1815-1818.
张玲,梁良,张琳丽,等.一维光子晶体带隙结构研究[J].光子学报,2008,37(9):1815-1818.
[6]TONG Kai,WU F,WANG Zhi-bin.Fabrication and measurement of optical characterization of one dimensional photonic crystal with defec[J].Chinese Optics Letters,2010,8(1):99-102.
[7]HAN Pei-de,ZHANG Lu,WANG Can,et al.Doped modes of SiO2/CdSe one-dimensional photonic crystal with LiTaO3 in visible region[J].Acta Photonica Sinica,2010,39(1):76-79.
韩培德,张璐,王灿,等.可见光波段SiO2/CdSe一维光子晶体及缺陷模的研究[J].光子学报,2010,39(1):76-79.
[8]LIANG Guan-quan,HAN Peng,WANG He-zhou.Narrow frequency and sharp angular defect mode in one-dimensional photonic crystals from a photonic heterostructure[J].Optics Letters,2004,29(2):192-194.
[9]FANG Yun-tuan,SHEN Ting-gen,TAN Xi-lin.Study on one-dimensional photonic crystal with impurity defects[J].Acta Optica Sinica,2004,24(11):1557-1560.
方云团,沈廷根,谭锡林.一维光子晶体掺杂缺陷模研究[J].光学学报,2004,24(11):1557-1560.
[10]GU Pei-fu,CHEN Hai-xing,QIN Xiao-yun,et al.Design of polarization band-pass filters based on the theory of thin-film photonic crystal superlattice[J].Acta Physica Sinica,2005,54(2):773-776.
顾培夫,陈海星,秦小芸,等.基于薄膜光子晶体超晶格理论的偏振带通滤波器[J].物理学报,2005,54(2):773-776.
[11]FANG Yun-tuan.Polarization beam splitter based on one-dimensional photonic crystals[J].Laser & Infrared,2009,39(6):630-632.
方云团.基于一维光子晶体的偏振分束器[J].激光与红外.2009,39(6):630-632.
[12]ZHANG Wen-fu,LIU Ji-hong,ZHAO Wei.Polarization band-pass filters based on one-dimensional photonic crystal heterostructure[J].Journal of Optoelectronics • Laser,2009,20(2):148-151.
张文富,刘继红,赵卫.一维光子晶体异质结结构偏振带通滤波器[J].光电子•激光,2009,20(2):148-151.
[13]SIGALAS M M,SOUKOULIS C M,BISWAS R,et al.Effect of the magnetic permeability on photonic band gaps[J].Physical Review B,1997,56(3):959-962.
[14]LYUBCHANSKII I L,DADOENKOVA N N,LYUBCHANSKII M I,et al.Magnetic photonic crystals [J].Journal of Physics D:Applied Physics,2003,36(18):R277-R287.
[15]KEE C S,KIM J E,PARK H Y.Omnidirectional reflection bands of one-dimensional magnetic photonic crystals[J].Journal of Optics A:Pure and Applied Optics,2004,6(12):1086-1088.
[16]WANG Zhao-na,LIU Da-he.A few points on omnidirectional band gaps in one-dimensional photonic crystals[J].Applied of Phys ics B:Lasers and Optics,2007,86(3):473-476.
[17]OU-YANG Zheng-biao,MAO De-peng,LIU Chung-ping,et al.Photonic structures based on dielectric and magnetic one dimensional photonic crystals for wide omnidirectional total reflection[J].Journal of the Optical Society America B,2008,25(3):297-301.
[18]WU Z,LEVY M,FRATELLO V J,et al.Gyrotropic photonic crystal waveguide switches[J].Applied Physics Letters,2010,96(5):051125-1-051125-3.
[19]SRIVASTAVA S K,OJHA S P.Photonic band structure and effect of ε and μ on the reflectivity of one-dimensional magnetic photonic crystal structure[J].Optik,2008,119(15):707-712.
[20]BORN M,WOLF E.Principles of optics[M].6th ed.Oxford:Pergamon Press,1980.
[21]孙光飞,强文江.磁功能材料[M].北京:化学工业出版社,2007:23-24.
[22]LIN Zhan-ru.Organometallic polymers with ferromagnetic properties[J].Advanced materials,1999,11(13):1153-1154.
[23]AN Quan-zhang,PENG Hua-qiao,LIN Yun,et al.Studies on the dielectric and magnetic properties of ferrocene type polymeric magnet modified by acrylic acid[J].Journal of Sichuan Normal University (Natural Science),2002,25(5):500-502.
安全长,彭华乔,林云,等.丙烯酸改性二茂铁型高分子磁体的电磁性能研究[J].四川师范大学学报(自然科学版),2002,25(5):500-502.

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[J]. 光子学报, 2005,34(2): 205-208
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5. 王井伟 韩培德 夏伶勤 张瑞珍.Ta_2O_5/MgF_2异质结构三维光子晶体的偏振性[J]. 光子学报, 2010,39(5): 839-841
6. 李秀杰,韩培德,杨毅彪,梁伟.基于光子晶体异质结的高效太阳能电池反射器研究 [J]. 光子学报, 2010,39(10): 1786-1789

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