光子学报 2011, 40(4) 529-532 DOI: 10.3788/gzxb20114004.0529 ISSN: 1004-4213 CN: 61-1235/O4

论文

Kerr缺陷一维耦合腔光波导的双稳态方向性

李文慧[a],毕卫红[a],王金生[b]

（燕山大学 a.信息科学与工程学院|b.继续教育学院,河北 秦皇岛 066004）

摘要：

本文提出一种只在一层高折射率介质层中掺杂Kerr介质的一维耦合腔光波导.利用一维传输矩阵理论和非线性传输矩阵方法研究了此结构的光学双稳态.根据一维传输矩阵理论分析了此结构的线性特性,包括低频带边模的偏移及场分布的特点,讨论了此结构实现双稳态的原理.研究发现:由于缺陷层中场分布与入射光方向密切相关,而缺陷层光场的局域,将激发Kerr介质的三阶非线性效应,从而改变了缺陷层的折射率,所以不同方向的入射光具有不同的双稳态阈值.利用非线性传输矩阵方法研究了光学双稳态特性.结果表明:由于缺陷层的位置导致缺陷模正方向（由左到右）入射的场分布大于反方向（由右到左）入射的场分布,正方向的阈值低于反方向的阈值,相差一倍.

关键词： 耦合腔 光开关 光子晶体 Kerr效应

Bistable Anisotropy in One-dimensional Coupled Cavity Optical Waveguides with Kerr Defect

LI Wen-hui[a],BI Wei-hong[a],WANG Jin-sheng[b]

（a.College of Information Science and Engineering|b.School of Continuing Education,Yanshan University,Qinhuangdao,Hebei 066004,China）

Abstract:

An one-dimensional (1D) coupled cavity optical waveguides (CCOWs) with Kerr defect was proposed.It was a Kerr medium doped into a high refractive index medium layer in CCOWs.The optical bistability (OB) of the structure was investigated by using one-dimensional transfer matrix method and nonlinear transfer matrix method.The linear properties of this structure,including the characterics of the field distribution and the shift of low-frequency band edge modes,were analyzed by one-dimensional transfer matrix method.The principle of the OB realized by the structure was discussed.It is found that different incident directions have different bistability threshold,because the refractive index of the defect layer is changed by three order nonlinear effect of Kerr medium stimulated by the localization of optical field in the defect layer.The field distribution in defect layer was related to the incident light direction.The properties of the OB were studied by the nonlinear transfer matrix method.The results indicate that the threshold of the forward direction (from left to right) is a half lower than that of the backward one (from right to left),because the localization behaviour of the forward direction is larger than that of the backward direction due to the position of the defect layer.

Keywords: Coupled cavity Optical switching Photonic crystal Kerr effect

收稿日期 2010-08-18 **修回日期** 2010-11-12 **网络版发布日期** 2011-04-25

DOI: 10.3788/gzxb20114004.0529

基金项目:

国家重点基础研究发展计划（No.2010CB327800)、河北省博士后基金(No.2009174)、河北省自然科学基金(No.F2009000465)和燕大博士基金(No.B317)资助

通讯作者: 李文慧

作者简介:

参考文献：

[1]YABLONOVITCH E.Inhibited spontaneous emission in solid-state physics and electronics[J].Physical

Review Letters,1987,58(20):2059-2062.
[2]SCALORA M,DOWLING J P,BOWDEN C M,et al.Optical limiting and switching of ultrashort pulses in nonlinear photonic band gap materials[J].Physical Review Letters,1994,73(10):1368-1371.
[3]SCALORA M,DOWLING J P,BOWDEN C M,et al.The photonic band edge optical diode[J].Journal of Applied Physics,1994,76(4):2023-2026.
[4]CHEN L X,DENG X X,DING W Q,et al.Finite-difference time-domain analysis of optical bistability with low threshold in one-dimensional nonlinear photonic crystal with Kerr medium[J].Optics Communications,2002,209(4-6):491-500.
[5]YARIV A,Xu Y,Lee R K,et al.Coupled-resonator optical waveguide:a proposal and analysis[J].Optics Letters,1999,24(11):711-713.
[6]LI W H,CHEN L X,TANG D H,et al.Broadband frequency down-conversion using coupled cavity structures in one-dimensional photonic crystals[J].Chinese Physics Letters,2006,23(4):845-848.
[7]DING W Q,CHEN L X,LIU S T.Broadband optical bistable switching in a one-dimensional nonlinear coupled cavity structure[J].Optics Communications,2005,246(1-3):147-152.
[8]DING W Q,CHEN L X,LIU S T.Large bandwidth optical limiting by kerr medium doped one-dimensional coupled cavity optical waveguides[J].Chinese Physics Letters,2004,21(8):1539-1541.
[9]LI Wen-hui,CHEN Li-xue,TANG Dong-hua,et al.Parametric amplification and compression of high order band edge modes in compounding period photonic crystals[J].Journal of Harbin Institute of Technology,2008,40(4):603-606.
李文慧,陈历学,汤冬华,等.复合周期光子晶体高阶带边模参量放大与压缩[J].哈尔滨工业大学学报,2008,40(4):603-606.
[10]CHEN Li-xue,DING Wei-qiang,LI Wen-hui et al.Transfer matrix algorithm of one-dimensional inhomogeneous kerr medium[J].Acta Photonica Sinica,2004,33(4):497-500.
陈历学,丁卫强,李文惠,等.一维非均匀Kerr介质的传输矩阵算法[J].光子学报,2004,33(4):497-500.
[11]CHEN L X,KIM D,SONG Y L,et al.Localization and threshold of bistable switching by gap-edge shifting[J].Chinese Physics Letters,2003,20(9):1514-1516.

本刊中的类似文章

1．于永芹;阮双琛;程超;杜晨林;姚建铨.采用保偏光子晶体光纤在1.6 μm区域产生超连续谱[J]. 光子学报, 2004,33(11): 1301-1303
2．车明;刘江涛.六角形散射子光子晶体的界面态[J]. 光子学报, 2004,33(11): 1393-1396
3．杨广强;张霞;林健飞;宋继恩;黄永清;任晓敏.高双折射光子晶体光纤偏振模色散测量[J]. 光子学报, 2005,34(8): 1133-1136
4．袁明辉;张明德;孙小菡.偏振模色散对非线性光纤环镜微波光子开关的影响及其补偿[J]. 光子学报, 2006,35(7): 1008-1012
5．吴永刚; 林小燕; 顾春时; 顾牡; 马晓辉; 魏军明; 陈玲燕.一维金属/介质光子晶体用于BaF2晶体闪烁光谱修饰[J]. 光子学报, 2005,34(1): 94-97
6．蒋美萍;陈光;陈宪锋;沈小明;巢小刚;是度芳.含负折射率介质非线性Bragg腔的双稳态特性[J]. 光子学报, 2006,35(4): 535-539
7．李真;蔡志岗;陈振强;张灵志;梁兆熙;周建英.

偶氮苯聚合物薄膜光致微结构的研究

[J]. 光子学报, 2007,36(3): 416-420
8．刘靖 孙军强 黄重庆 黄德修 吴铭 陈敏 .基于渐变折射率光量子阱的密集波分复用研究[J]. 光子学报, 2007,36(12): 2350-2354
9．钱祥忠.

铁电液晶缺陷光子晶体调谐滤波器的设计

[J]. 光子学报, 2007,36(3): 425-428
10．许桂雯;欧阳征标.

一种新型光子晶体双色谐振腔

[J]. 光子学报, 2007,36(3): 429-433
11．谢东华;何晓东;佟传平;于海霞;冯金顺.

平板型光子晶体谐振腔性能分析

[J]. 光子学报, 2007,36(3): 434-438
12．王维江;肖万能;周金运.非线性光子晶体的单向透射性[J]. 光子学报, 2007,36(3): 439-443

13. 偶晓娟 周渭 郑胜峰 李琳 王凤伟.电子学领域的群速超光速实验[J]. 光子学报, 2007,36(5): 873-876

14. 邵潇杰 杨冬晓 耿丹.基于光子晶体光纤四波混频效应的波长转换研究[J]. 光子学报, 2009,38(3): 652-655

15. 朱志宏;叶卫民;季家镕;袁晓东;曾淳.用三维并行时域有限差分算法研究光子晶体薄板W3波导传输特性[J]. 光子学报, 2006,35(6): 815-818

文章评论 (请注意:本站实行文责自负, 请不要发表与学术无关的内容!评论内容不代表本站观点.)

反馈人		邮箱地址	
反馈标题		验证码	7566