光子学报 2011, 40(8) 1154-1160 DOI: 10.3788/gzxb20114008.1154 ISSN: 1004-4213 CN: 61-1235/O4

论文

一种高双折射光子晶体光纤中的脉冲俘获分析

张晓娟,赵建林,方亮

(西北工业大学 理学院 陕西省光信息技术重点实验室|教育部空间应用物理与化学重点实验室,西安 710072)

摘要:

数值模拟分析了一种新型高双折射光子晶体光纤中的脉冲俘获现象,以及泵浦脉冲入射条件对脉冲俘获效果的影响机理.结果表明:泵浦脉冲和信号脉冲处于零色散点附近,且分别处于光子晶体光纤的反常和正常色散区,其走离参量的数值小于10−12 s/m时,可以实现脉冲俘获|泵浦脉冲和信号脉冲的时域中心延迟对泵浦脉冲光谱红移量和信号脉冲光谱蓝移量影响很小,但时域中心延迟越大,信号脉冲的输出频谱越窄,俘获效果越差|提高泵浦脉冲峰值功率,可明显增大泵浦脉冲光谱红移量和信号脉冲光谱蓝移量,为实现不同波长范围的全光开关提供了条件|泵浦脉冲半宽度越大,泵浦脉冲频谱越宽,信号脉冲频谱越窄,俘获效果越不明显.

关键词: 光子晶体光纤 高双折射 脉冲俘获 色散

Analysis of Pulse Trapping Characteristic in Highly Birefringent Photonic Crystal Fiber

ZHANG Xiao-juan,ZHAO Jian-lin,FANG Liang

(Shaanxi Key Laboratory of Optical Information Technology,School of Science|The Key Laboratory of Space Applied
Physics and Chemistry(Ministry of Education),Northwestern Polytechnical University,Xi′ an 710072,China)

Abstract:

A theoretical investigation of the pulse trapping in a highly birefringent photonic crystal fiber was presented.The strict coupled nonlinear Schrdinger equations were numerically solved using a split-step Fourier algorithm.Different incidence conditions were discussed when the two pulses were polarized along the same polarization axes.The pump pulse in abnormal dispersion regime traped the signal pulse in the normal dispersion regime,and the signal pulse shifted to shorter wavelength with the pump pulse of the longer wavelength in order to keep the same group velocity.Different initial temporal separation between the pump pulse and the signal pulse leaded to different effect in the pulse trapping.As the input peak power of the pump pulse was increased,the red-shift of pump pulse was considerably enhanced with the simultaneous further blue-shift if the trapped pulse to satisfy the condition of group velocity matching.Pulse trapping was inconspicuous as the full width at half maximum of the pump pulse was increased.In order to realize pulse trapping,the wavelengths of the pump and signal pulses should be near the zero dispersion point and the discrepancy between two group velocities should be small.

Keywords: Photonic crystal fiber Highly birefringence Pulse trapping Dispersion

收稿日期 2011-03-04 **修回日期** 2011-05-14 **网络版发布日期** 2011-08-25

DOI: 10.3788/gzxb20114008.1154

基金项目:

瞬态光学与光子技术国家重点实验室开放基金和西北工业大学基础研究基金（No.JC200950）资助

通讯作者: 赵建林（1958-）,男,教授,博导,主要研究方向为光信息技术及应用.Email：jlzhao@nwpu.edu.cn

作者简介:

参考文献:

[1]ISLAM M N,SUNDERMAN E R,STOLEN R H,et al.Soliton switching in a fiber nonlinear loop mirror [J].Optics Letters,1989,14(15):811-813.
[2]WANG B,BABY V,TONG W,et al.A novel fast optical switch based on two cascaded Terahertz Optical Asymmetric Demultiplexers (TOAD) [J].Optics Express,2002,10(1):15-23.
[3]TAJIMA K,NAKAMURA S,SUGIMOTO Y.Ultrafast polarization-discriminating Mach-Zehnder all-optical switch [J].Applied Physics Letters,1995,67(25):3709-3711.
[4]SHARPING J E,FIORENTINO M,KUMAR P,et al.All-optical switching based on cross-phase modulation in microstructure fiber[J].IEEE Photonics Technology Letters,2002,14(1):77-79.
[5]ANDREKSON P A,OLSSON N A,SOMPSON J R.16Gbit/s all-optical demultiplexing using four-wave mixing[J].Electronics Letters,1991,27(11):922-924.
[6]NISHIZAWA N,UKAI Y,GOTO T.Ultrafast all optical switching using pulse trapping in birefringent fibers[J].Optics Express,2005,13(20):8128-8135.
[7]LI S F,ZHU H,WEN S C,et al.Ultrafast all optical switching based on pulse trapping in photonic crystal fibers[C].SPIE,2005,6019:60191N-1-7.
[8]KNIGHT J C,BIRKS T A,RUSSELL P S J,et al.All silica single-mode optical fiber with photonic crystal cladding[J].Optics Letters,1996,21(19):1547-1549.
[9]ZHANG Xiao-juan,ZHAO Jian-lin,HOU Jian-ping.A novel photonic crystal fiber with high birefringence [J].Acta Physica Sinica,2007,56(8):4668-4676.
张晓娟,赵建林,侯建平.一种新型高双折射光子晶体光纤[J].物理学报,2007,56（8）：4668-4676.
[10]ISLAM M N,POOL E C D,GORDON J P.Soliton trapping in birefringent optical fibers[J] .Optics Letters ,1989,14(10):1011-1013.
[11]NISHIZAWA N,GOTO T.Characteristics of pulse trapping by use of ultrashort soliton pulses in optical fibers across the zero-dispersion wavelength[J] .Optics Express,2002,10(21):1151-1159.
[12]NISHIZAWA N,GOTO T.Trapped pulse generation by femtosecond soliton pulse in birefringent optical fibers[J].Optics Express,2002,10(5):256-261.
[13]GORBACH A V,SKRYABIN D V.Light trapping in gravity-like potentials and expansion of supercontinuum spectra in photonic-crystal fibres[J].Nature Photonics,2007,1(11):653-657.
[14]HILL S C,KUKLEWICZ E,LEONHARDT U,et al.Evolution of light trapped by a soliton in a microstructured fiber[J].Optics Express,2009,17(16):13588-13607.
[15]CHENG C F,WANG X F,FANG Z B,et al.Enhanced dispersive wave generation by using chirped pulses in a microstructured fiber[J].Optics Communications,2005,244(1-6):219-225.
[16]YAO M,WEN S C,ZHU H,et al.Pulse trapping characteristics for nonlinear propagation of two pulses in birefringent photonic crystal fibers[C].SPIE,2006,6351:63513U-1-7.
[17]ZHANG X J,ZHAO J L.High birefringence photonic crystal fiber with low loss and broad single-mode range[J].Nuclear Instruments and Methods in Physics Research Section A,2011,637(s1):s123-s126.

本刊中的类似文章

1．王肇颖;李智勇;王永强;倪文俊;林冉;李世忱.利用普通色散位移光纤得到的超宽带超连续谱[J]. 光子学报, 2004,33(11): 1324-1326
2．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
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．刘玉敏;俞重远;杨红波;张娜;张晓光.优化二元相位取样光纤布喇格光栅及对色散和色散斜率补偿的应用[J]. 光子学报, 2005,34(11): 1701-1705
5．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
6．姚敏 陈林 .基于偏振度椭球的PMD补偿的前馈信息提取方法[J]. 光子学报, 2007,36(4): 710-714
7．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
8．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
9．张校逸 陈琦玮 邵钟浩.相敏光放大器对光纤偏振模色散进行补偿的探讨[J]. 光子学报, 2007,36(5): 861-864
10．刘启能 .一种简便的研究一维光子晶体禁带特征的新方法[J]. 光子学报, 2007,36(6): 1031-1034
11．张亚妮 苗润才 任立勇 王丽莉 赵卫.椭圆芯非六角对称高双折射聚合物PCFs[J]. 光子学报, 2007,36(6): 1035-1039
12．何晶 陈林 文双春.40 Gb/s差分相移键控格式抗偏振模色散的性能研究[J]. 光子学报, 2009,38(3): 660-664
13．陆司琦 宋英雄 林如俭.长距离光纤CATV系统中色散补偿位置的研究[J]. 光子学报, 2009,38(3): 665-669
14．胡涛平;颜森林;罗青.零色散附近的交叉相位调制不稳定性分析[J]. 光子学报, 2006,35(9): 1367-1373
15．汪舰,王丽莉.聚合物光子晶体光纤作为新型传像光纤应用的初步探索 [J]. 光子学报, 2009,38(6): 1419-1422

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	3750