光子学报 2011, **40**(11) 1728-1732 **DOI**: 10.3788/gzxb20114011.1728 **ISSN**: 1004-4213 **CN**: 61-1235/O4

论文

基于椭圆孔包层和微型双孔纤芯的新型高双折射光子晶体光纤

刘旭安[1,2], 吴根柱[1,2], 陈达如[1,2], 刘军[1,2], 卢启景[1,2]

1. 浙江师范大学 信息光学研究所,浙江 金华 321000;
2. 浙江师范大学和浙江大学联合实验室,杭州 310058

摘要:

设计了一种新型高双折射光子晶体光纤,即其包层引入椭圆形空气孔,且以三角晶格方式周期排列,纤芯引入亚波长尺寸(~0.16 μm)的微型双孔结构阵列.采用全矢量有限元法和各向异性完美匹配层边界条件分析了该型光子晶体光纤的双折射特性和色散特性,详细介绍了该光子晶体光纤在不同的椭圆率、椭圆归一化面积、微型双孔孔径、两小孔之间间距的情况下双折射和限制损耗随波长的变化曲线.模拟结果表明,通过同时在包层和纤芯引入非对称性,获得了较高的双折射(~10^{-3}量级)和极低(~10^{-4} dB/km)的限制损耗.提供了一种新的光子晶体光纤设计方法,即通过同时在包层和纤芯引入新结构来同时获得高双折射和低损耗.

关键词: 光子晶体光纤 椭圆空气孔 双折射 限制损耗

Novel Highly Bireferingent Photonic Crystal Fiber Based on an Elliptical Hole Fiber Cladding and a Fiber Core of Double-micro-hole Units

LIU Xu-an[1,2], WU Gen-zhu[1,2], CHEN Da-ru[1,2], LIU Jun[1,2], LU Qi-jing[1,2]

1. Institute of Information Optics, Zhejiang Normal University, Jinhua, Zhejiang 321004, China;
2. Joint Research Laboratory of Optics of Zhejiang Normal University and Zhejiang University, Hangzhou 310058, China

Abstract:

A novel highly birefringent photonic crystal fiber (PCF) with elliptical air holes in the fiber cladding and arrays of subwavelength double-hole units with size of about 0.16 μm in the fiber core was proposed. Dispersion and birefringence property of the proposed PCFs was investigated by using a full-vector finite-element method (FEM) and anisotropic perfectly matched layers. Curves between modal birefringence (confinement loss) of the proposed PCFs and the wavelength of the input light for PCFs with different parameters of ellipticity, normalized area,diameter of the two microholes, distance between the two microholes are reported in details. Simulation results showed that high birefringence (larger than 0.001) and ultralow confinement loss (less than 0.000 2 dB/km) are achieved. The proposed design of the PCF is an approach to achieve both the high birefringence and the low confinement loss by introducing asymmetric microstructure both in the fiber cladding and in the fiber core.

Keywords: Photonic crystal fiber(PCF) Elliptical air holes Birefringent Confinement loss

收稿日期 2011-05-23 **修回日期** 2011-08-16 **网络版发布日期** 2011-11-25

DOI: 10.3788/gzxb20114011.1728

基金项目:

浙江省自然科学基金(No.Y1100041)资助

通讯作者: 吴根柱(1967-),男,教授,博导,主要研究方向为光纤传感、半导体激光器理论与技术.Email: wugenzhu@zjnu.cn

作者简介:

参考文献:

[1] LI Chun-lei, SHENG Qiu-qing. The relation between the noninear coefficient of PCF and its geometry parameters and the optical wavelength[J]. Acta Photonica Sinica, 2006, 35(5): 734-737. 李春雷,盛秋琴.光子晶体光纤非线性系数与其结构参量及波长的关系[J].光子学报,2006,35(5):734-737.

[2] HE Zhong-jiao. Highly birefringent photonic crystal fiber based on index-enhanced fiber core[J]. Acta Photonica Sinica, 2008, 37(2): 302-303. 何忠蛟.基于纤芯折射率增强的高双折射光子晶体光纤[J].光子学报,2008,37(2):302-303.

[3] CHEN Da-ru, SHEN Lin-fang. Ultrahigh birefringent photonic crystal fiber with ultralow confinement loss[J].IEEE Photonics Technology Letters, 2007, 19(4): 2700-2705.

[4] CHEN Da-ru, TSE V M L, TAM H Y. Optical properties of photonic crystal fibers with a fiber core of arrays of sub-wavelength circular air holes:birefringence and dispersion[J]. Progress in Electromagnetics Research, 2010, 105(12): 193-212.

[5] HE Zhong-jiao. Highly birefringent photonic crystal fibers based on micro-structured fiber core of elliptical holes[J]. Acta Photonica Sinica, 2007, 36(7): 1216-1218. 何忠蛟.基于椭圆孔微结构纤芯的高双折射光子晶体光纤[J].光子学报,2007,36(7):1216-1218.

[6] HE Zhong-jiao. Highly birefringent photonic crystal fibers based on micro-hole-structured fiber core[J]. Acta Photonica Sinica, 2008, 37(11): 2218-2221. 何忠蛟.基于小圆孔结构纤芯的高双折射光子晶体光纤[J].光子学报,2008,37(11):2218-2221.

[7] CHEN D, SHEN L. Highly birefringent elliptical-hole photonic crystal fibers with double defect[J].J Lightw Technol, 2007, 25(9): 2700-2705.

[8] SAPULAK M G, STATKIEWICZ J, OLSZEWSKI T, *et al.* Experimental and theoretical investigations of birefringent holey fibers with a triple defect[J].Applied Optics, 2005, 44(13): 2652-2658.

[9] ANTHKOWIAK M, KOTYNSKI R, NASILOWSKI T, *et al.* Phase and group modal birefringence of triple-defect photonic crystal fibres[J]. J Opt A: Pure Applied Optics, 2005, 7(12): 763-766.

[10] SHEN L P, HUANG W P, JIAN S S. Design of photonic crystal fibers for dispersion-related applications[J]. J Lightwave Technol., 2003, 21(7): 1644-1651.

[11] WU Wei-qing, CHEN Xun-wen, ZHOU Hui, *et al*. Investigation of the ultraflattened dispersion in photonic crystal fibers with hybrid cores[J]. Acta Photonica Sinica, 2006, 35(1): 109-113. 吴维庆,陈雄文,周辉,等.混合纤芯光子晶体光纤超平坦色散的研究[J].光子学报,2006,35(1):109-113.

[12] SAITOH K, KOSHIBA M. Single-polarization single-mode photonic crystal fibers[J]. IEEE Photon Technol Lett, 2003, 15(10): 1384-1340.

[13] EGUCHI Masashi, TSUJI Yasuhide. Single-mode single-polarization holey fiber using anisotropic fundamental space-filling mode

扩展功能

本文信息

- Supporting info
- PDF(1305KB)
- HTML
- 参考文献

服务与反馈

- 把本文推荐给朋友
- 加入我的书架
- 加入引用管理器
- 引用本文
- Email Alert
- 文章反馈
- 浏览反馈信息

本文关键词相关文章

- 光子晶体光纤
- 椭圆空气孔
- 双折射
- 限制损耗

本文作者相关文章

- 刘旭安
- 吴根柱
- 陈达如
- 刘军
- 卢启景

[J].Optics Letters, 2007, 32(15): 2112-2114.

[14] WANG Li-wen, LOU Shu-qin, CHEN Wei-guo, *et al*. Design of a single-polarization single-mode photonic crystal fiber with a near-Gaussian mode field and wide bandwidth[J]. Applied Optics, 2010, 49(32): 6196-6200.

[15] KNIGHT J C, SKRYABIN D V. Nonlinear waveguide optics and photonic crystal fibers[J].Optics Express, 2007, 15(13): 15365-15376.

[16] FOLKENBERG J, NIELSEN M, MORTENSEN N, *et al.* Polarization maintaining large mode area photonic crystal fiber[J].Optics Express, 2004, 12(5): 956-960.

[17] ROSTAMI Ali, SOOFI Hadi.Correspondence between effective mode area and dispersion variations in defected core photonic crystal fibers[J].Journal of Lightwave Technology, 2011, 29(2): 234-241.

[18] MATSUI Takashi, SAKAMOTO Taiji, TSUJIKAWA Kyozo, *et al.* Single-mode photonic crystal fiber design with ultralarge effective area and low bending loss for ultrahigh-speed WDM transmission[J]. Journal of Lightwave Technology, 2011, 29(4): 511-515.

[19] GUENNEAU S, LASQTMLLCC S. Modeling of photonic crystal optical fibers with finite elements[J]. IEEE Transactions on Magnetics, 2002, 38(21): 1261-1264.

[20] SAITOH K, KOSHIBA M. Full-vectorial imaginary-distance beam propagation method based on finite element scheme: Application tophotonic crystal fibers[J]. IEEE J Quantum Electron., 2002, 38(7): 927-933.

[21] BELARDI W, BOUWMANS G, PROVINO L, *et al*. Form-induced birefringence in elliptical hollowphotonic crystal fiber with large mode area[J]. IEEE J Quantum Electron, 2005, 41(12): 1558-1564.

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．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

3．杨淑连.一种新型光纤压力传感器的设计[J]. 光子学报, 2007,36(5): 838-841

4．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

5．任广军;姚建铨;李国华;王鹏.液晶磁控偏光特性的研究[J]. 光子学报, 2007,36(1): 152-155

6．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

7．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

8．汤炳书,沈廷根,王刚.C6v对称TIR-PCF结构参量对基模非线性系数的影响数值研究 [J]. 光子学报, 2009,38(6): 1438-1441

9．张亚妮;王丽莉;王学忠;任立勇;赵 卫;苗润才.高保偏聚合物光子晶体光纤的化学制备技术研究[J]. 光子学报, 2006,35(9): 1349-1353

10．何忠蛟.硅基二氧化硅波导和SOI脊型波导应力双折射研究[J]. 光子学报, 2006,35(2): 201-204

11．黄宗军;康崇*;王政平;刘宁宁.Faraday镜预转角对FMOCT输出光偏振态的影响[J]. 光子学报, 2006,35(8): 1203-1206

12．张瑞宝;刘红军;杨延龙;赵卫;王屹山;陈国夫;李永放;董淑福.双泵浦光子晶体光纤参量放大研究[J]. 光子学报, 2006,35(8): 1137-1141

13．刘建国;开桂云;薛力芳;张春书;王志;李燕;孙婷婷;刘艳格;董孝义.带隙型光子晶体光纤的泄露谱分析[J]. 光子学报, 2006,35(11): 1623-1626

14．王政平;刘晓瑜;黄宗军.光学玻璃电流互感器中互易性问题的理论研究[J]. 光子学报, 2006,35(9): 1333-1336

15．王政平;王晓忠;李庆波.保偏膜式光学玻璃电流传感头温度特性理论分析[J]. 光子学报, 2006,35(6): 846-849

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 2109

反馈内容

提交