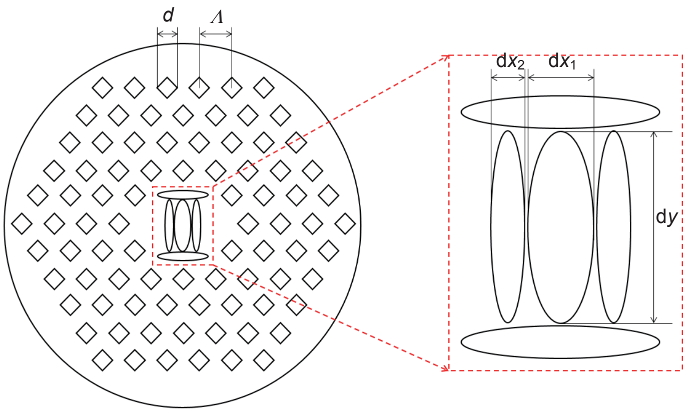
Characteristics in square air hole structure photonic crystal fiber

Zhang Xuedian, Yuan Manman, Chang Min*, Lu Xinglian, Chen Nan, Nie Fukun, He Menghui, Qi Ningning, Zhuang Songlin

Shanghai Key Laboratory of Mordern Optical System, School of Optical-Electrical and Computer Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China



Elliptical core, square air hole cladding PCF structure

Overview: Photonic crystal fibers (PCFs) have attracted a considerable amount of attention recently because of their unique properties that can not be realized in conventional optical fibers. Owning to their flexible design for the cross section, PCFs can realize particular properties such as high birefringence, high nonlinearity, ultra-flatten dispersion, large effective mode area, endlessly single mode, and etc. In this paper, in order to achieve high birefringence and flattened chromatic dispersion at the same time, a smaller sized elliptical air hole in the core is introduced as a defected core in square air holes. The present design has the asymmetry in both fiber core and the cladding region by one kind of air holes (elliptical). The role of an elliptical defected core in the proposed fiber is not only to control the chromatic dispersion to be flattened, but also to increase the value of birefringence up to the order of 10^{-1}. Among them, the structure of the square air hole is not easy to be deformed and thus has a more stable characteristic. Hexagonal structure of square air holes is the best way to obtain high birefringence and flattened chromatic dispersion. In the designed structure, one elliptical air hole is arranged in the core region and four elliptical air holes are ordered in the upper and lower sides. In our simulation, the plane wave expansion method and full-vector finite element method (FEM) with the perfectly matched layer (PML) boundary condition are applied, which have been the most common and accurate methods to investigate the eigen-mode problems of guided modes in PCFs. The effects of different core ellipticity and core filling materials on the birefringence, dispersion and nonlinearity of the photonic crystal fiber are discussed. The results show that the birefringence and maximum nonlinear coefficient are up to the value of 0.37 and 277.76 $W^{-1}\cdot km^{-1}$ at 1.55 μm when the ellipticity of the core is different and the filling material is the same. The birefringence and maximum nonlinear coefficient are up to the value of 0.34 and 307 $W^{-1}\cdot km^{-1}$ at 1.55 μm in the condition where the ellipticity of the core is the same and the filling material is different. Besides, the dispersion has a dispersionless flat characteristic. The range of change is not more than ±12.5 ps/(nm·km), and the bandwidth is 0.6 μm in the range of wavelengths from 1.26 μm to 1.8 μm.

Citation: Zhang X D, Yuan M M, Chang M, *et al*. Characteristics in square air hole structure photonic crystal fiber[J]. *Opto-Electronic Engineering*, 2018, **45**(5): 170633

Supported by the National Key Scientific Instrument and Equipment Development Projects of China (2014YQ09070903)
* E-mail: changmin@usst.edu.cn