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Highly Birefringent Single Mode Spiral Shape Photonic Crystal Fiber Based Sensor for Gas Sensing Applications

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Abstract

This article represents a gas sensor based on spiral photonic crystal fiber (S-PCF) for detecting harmful or colorless gases and monitoring air pollution by metering gas condensate elements in production facilities. The proposed micro-structured S-PCF contains two layers porous core encircled by a spiral shape cladding. . The geometrical parameters are tuned to fix the optimized S-PCF structure. The numerical analysis of the proposed S-PCF is performed by utilizing finite element method (FEM) with circular perfectly match layer (C-PML). The relative sensitivity and birefringence of the recommended structure are 57.61 % and 7.53×10^{-3} respectively at 1.33 µm wavelength on the absorption line of toxic gases (methane and hydrogen fluoride). The exhibited beam divergence is about 4.1^0 at the same wavelength. Besides, beat length, nonlinear coefficient, effective area and V parameters are also described briefly for optimized S-PCF structure over broader wavelength range from 1 µm to 1.8 µm.

Keywords

Birefringence; Beam divergence; Beat length; Effective area; Gas sensor; Non-linear coefficient; Sensitivity; Spiral photonic crystal fiber.