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Data Article

Dataset on photonic crystal fiber based chemical sensor



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ABSTRACT

This article represents the data set of micro porous core photonic crystal fiber based chemical sensor. The suggested structure is folded cladding porous shaped with circular air hole. Here is investigated four distinctive parameters including relative sensitivity, confinement loss, numerical aperture (NA), and effective area (A_{eff}). The numerical outcomes are computed over the E+S+C+L+U communication band. The useable sensed chemicals are methanol, ethanol, propanol, butanol, and pentanol whose are lies in the alcohol series (Paul et al., 2017) [1]. Furthermore, V-parameter (V), Marcuse spot size (MSS), and beam divergence (BD) are also investigated rigorously. All examined results have been obtained using finite element method based simulation software COMSOL Multiphysics 4.2 versions with anisotropic circular perfectly matched layer (A-CPML). The proposed PCF shows the high NA from 0.35 to 0.36; the low CL from $\sim 10^{-11}$ to $\sim 10^{-7}$ dB/m; the high A_{eff} from 5.50 to 5.66 μm^2 ; the MSS from 1.0 to 1.08 μm ; the

Abbreviations: Sen, Sensitivity response; CL, Confinement loss; A_{eff} , Effective area; NA, Numerical aperture; V , V-parameter; MSS, Marcuse spot size; BD, Beam divergence

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BD from 0.43 to 0.46 rad at the controlling wavelength $\lambda = 1.55 \mu\text{m}$ for employing alcohol series respectively.

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Specification Table

Subject area	Optical fiber
More Specific subject area	Photonic crystal fiber, Chemical sensor, Sensitivity, Confinement loss
Type of data	Numerical analyzed data
How data was acquired	Full vectorial finite element method (FV-FEM) based tool COMSOL Multi-physics version 4.2 with circular PML.
Data Format	Raw data.
Data accessibility	Data is within this article.

Value of the data

- Investigated data can assist engineers and researchers who are working with PCF based sensor gas and chemical sensor.
- Proposed PCF based chemical sensor experienced with superior performances than previous PCF based sensor.
- For circular type's air cavities in both the cladding and core region, it can be easily fabricated by vastly used sol-gel method.
- Dataset is desirable for the benchmark of different chemical sensing application using PCF based sensor.

1. Data

This article describes the implementation of the photonic crystal based sensor with circular cladding with circular core. Investigation has done both for circular and elliptical holes. [Table 1](#) is illustrating the dataset for PML depth on fiber properties; [Table 2](#) is describing the variation of $\pm 1\%$ to ± 2 around the optimum structure; [Table 3](#) is describing the behavior of the PCF for different individual index based alcohol all are enumerated at the controlling wavelength $\lambda = 1.55 \mu\text{m}$ and [Table 4](#) shows the Sellmeier coefficient for silica as the PCF forming material.

Table 1

Variations on several PML depths to observe the modal properties of the proposed PCF both of circular and elliptical holes at the operating wavelength $\lambda = 1.55 \mu\text{m}$ and $n = 1.354$ (ethanol).

PML Depth	Sen (%)	CL [dB/m]	$A_{\text{eff}} (\mu\text{m}^2)$	NA	V	MSS (μm)	BD (rad)	PCF Types
5%	65.18	7.57×10^{-7}	5.61	0.36	4.92	1.06	0.44	Core with circular air holes
10%	65.18	9.45×10^{-7}	5.61	0.36	4.92	1.06	0.44	
15%	65.18	1.23×10^{-6}	5.61	0.36	4.92	1.06	0.44	
20%	65.18	1.44×10^{-6}	5.61	0.36	4.92	1.06	0.44	
5%	57.11	6.65×10^{-9}	5.59	0.35	4.62	1.02	0.45	Core with elliptical air holes
10%	57.11	8.20×10^{-9}	5.59	0.35	4.62	1.02	0.45	
15%	57.11	7.80×10^{-11}	5.59	0.35	4.62	1.02	0.45	
20%	57.11	4.10×10^{-11}	5.59	0.35	4.62	1.02	0.45	

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