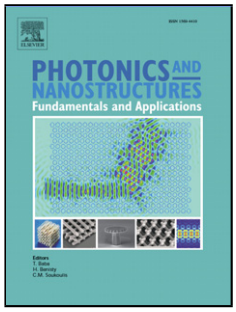

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PII: S1569-4410(16)30083-9
DOI: http://dx.doi.org/doi:10.1016/j.photonics.2017.03.005
Reference: PNFA 580

To appear in: *Photonics and Nanostructures – Fundamentals and Applications*

Received date: 17-10-2016
Revised date: 19-2-2017
Accepted date: 14-3-2017

Please cite this article as: R.Boufenar, M.Bouamar, A.Hocini, Simulation and numerical analysis of highly birefringent photonic crystal fiber temperature sensor, Photonics and Nanostructures - Fundamentals and Applicationshttp://dx.doi.org/10.1016/j.photonics.2017.03.005

Simulation and numerical analysis of highly birefringent photonic crystal fiber temperature sensor

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Highlights

- Thermo-optical response of highly birefringent photonic crystal fiber infiltrated with ethanol, is numerically analyzed.
- Results shows a linear dependence between the PCF birefringence and the temperature.
- The sensitivity S can easily reach $7{,}51 \times 10^{-6}$ order of magnitude by Celsius degree.
- In comparison with other temperature sensor based on birefringent Photonic crystal fiber, our designed sensor has higher sensitivity.

Abstract. In the present paper, we propose and we investigate theoretically by full vector finite element method a novel temperature sensor, based on highly birefringent photonic crystal fiber infiltrated with ethanol along the fiber length. Simulation results shows a linear dependence between the fiber birefringence and the temperature, the birefringence is an increasing function of temperature, and the temperature sensitivity coefficient can reach $7{,}51 \times 10^{-6}$ order of magnitude by celsius degree. In comparison with other temperature sensor based on birefringent photonic crystal fiber, our designed sensor has higher sensitivity.

Key words— Photonic crystal fiber (PCF); Birefringence; Temperature sensor; Sensitivity; Full vector finite element method.

1. Introduction

Photonic crystal fiber (PCF) also called micro structured optical fiber (MOF), is a new class of optical fiber based on the properties of photonic crystals, made from single material such as silica glass, with a periodically arranged air holes running through the entire length of the fiber [1]. In PCF, light can be guided by two different mechanisms, index guiding or band gap guiding, as a function of the principle of the light confinement. This index guiding PCF are also called modified total internal reflection (m-TIR) PCF.

The guiding mechanism is similar to the conventional single mode optical fiber, the effective index contrast between the core and cladding is much higher than the conventional optical fiber. Thus, the light confinement is much stronger.

Other PCF that use a perfectly periodic structure exhibits photonic band gap (PBG) effect and this PBG–PCF guide light in a low-index core region [2].