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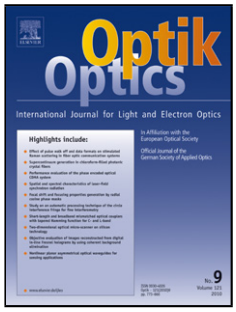

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Dual Core Photonic Crystal Fiber based Surface Plasmon Resonance Biosensor

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Abstract

This article proposed a dual core photonic crystal fiber (DC-PCF) biosensor based on surface plasmon resonance (SPR). The finite element method (FEM), wavelength and amplitude interrogation methods are used to analyze the performance of the proposed sensor. The maximum wavelength sensitivity of 9000 nm/RIU and 25000 nm/RIU, with analyte refractive index (RI) of 1.38, are numerically achieved for *x*-and *y*-polarized modes, respectively. Besides that, the structure shows the maximum amplitude sensitivity of around 470 RIU^{-1} and resolution as high as 1.11×10^{-5} RIU ~ 4×10^{-6} RIU for both polarizations. Therefore, the proposed high sensitive biosensor can be useful in different wavelength ranges for the simultaneous detection of biological and biochemical analytes.

Keywords: Photonic Crystal Fiber; Biosensor; Finite Element Method; Plasmonic Material;

1. Introduction

Biosensing technology based on surface plasmon resonance (SPR) has fascinated much attention due to its wide range of sensing applications and high sensitivity [1, 2]. It can be applicable to biochemistry, medical sciences, environmental and industrial monitoring, because of its real-time, label-free monitoring, and noninvasive nature [3, 4]. Besides that, SPR has already been engaged to the different optoelectronic devices [5–7]. Basically, it is an optical phenomenon where an electromagnetic wave is generated by the interaction of free electrons of the metal and incident photons [8]. Recently, a number of researchers, throughout the world, have tried to design photonic crystal fiber (PCF) based SPR sensors, because the recent SPR technology offers structural contraction, lower cost, robust, high sensitivity, and fabrication flexibility [9].

The PCF based SPR coupling between core guided and surface plasmon polariton (SPP) mode occurs when real parts of both modes are equal at a particular wavelength, called resonance wavelength. Since SPP mode is highly sensitive to the RI of the surrounding analyte, resonance wavelength is red or blue shifted depending on the change of the surrounding analytes [10–13].

Different materials such as gold, silver, indium tin oxide (ITO), graphene can be used as plasmonic materials in different devices [14–25]. Over the few years, a loads of PCF based SPR sensors have been proposed by different researchers with outstanding properties. For example, PCF based SPR sensors using different plasmonic materials have been reported in [15–18]. In these studies, appealing results have been found: designing complex structure for plasmonic material infiltration into the inner region of the PCF for SPR. Furthermore, D-shaped PCF based SPR sensor has been presented along with all circular air-holes [19–20]— the maximum