2020-10-04

Dual-Core Photonic Crystal Fiber-Based Plasmonic RI Sensor in the Visible to Near-IR Operating Band

Mahfuz, Mohammad Al

IEEE

In this paper, a dual-core photonic crystal fiber (DC-PCF) based surface plasmon resonance (SPR) bio-compatible sensor is proposed for various bio-organic molecules and biochemical analytes refractive index (RI) detection in the visible to near-infrared region (0.5 to 2 μm). Two hexagonal ring lattice with all circular air-holes are used to simplify the sensor structure. To make the practical applications feasible, plasmonic material and analyte sensing layer both are employed at the outer surface of the fiber. Noble plasmonic material gold (Au) having a thickness of 30 nm is used to excite the surface plasmons. A thin layer of titanium oxide (TiO_2) having a thickness of 5 nm is also considered as an adhesive layer between the Au and silica glass. The sensor response is investigated using the mode solver based finite element method (FEM). Numerical results indicate that the proposed sensor shows a maximum amplitude sensitivity (AS) of 6829 RIU^{-1}, amplitude resolution (AR) of 5×10^{-6} RIU, maximum wavelength sensitivity (WS) of 28,000 nm/RIU, and wavelength resolution (WR) of 3.57×10^{-6} RIU, using the amplitude and wavelength interrogation methods, respectively. Moreover, a maximum figure of merit (FOM) of 2800 RIU^{-1} is obtained, which is the highest among the reported PCF-SPR sensor. Owing to the promising sensitivity and simple structure, the proposed sensor can be potentially applicable for the detection of biochemical solutions and biological samples.