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Sensitivity Enhancement of Photonic Crystal Fiber Biosensor

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Abstract : The surface plasmon resonance (SPR) sensors are widely used due to its high sensitivity with molecular labels free. The commercial SPR sensors depend on the conventional prism-coupled configuration. However, this type of configuration suffers from miniaturization and integration. Therefore, the search for compact, portable and highly sensitive SPR sensors becomes mandatory.In this paper, sensitivity enhancement of a novel photonic crystal fiber biosensoris introduced and studied. The suggested design has microstructure of air holes in the core region surrounded by two large semicircular metallized channels filled with the analyte. The inner surfaces of the two channels are coated by a silver layer followed by a gold layer.The simulation results are obtained using full vectorial finite element methodwith perfect matched layer (PML) boundary conditions. The proposed design depends on bimetallic configuration to enhance the biosensor sensitivity. Additionally, the suggested biosensor can be used for multi-channel/multi-analyte sensing. In this study, the sensor geometrical parameters are studied to maximize the sensitivity for the two polarized modes. The numerical results show that high refractive index sensitivity of 4750 nm/RIU (refractive index unit) and 4300 nm/RIU can be achieved for the quasi (transverse magnetic) TM and quasi (transverse electric) TE modes of the proposed biosensor, respectively. The reportedbiosensor has advantages of integration of microfluidics setup, waveguide and metallic layers into a single structure. As a result, compact biosensor with better integration compared to conventional optical fiber SPR biosensors can be obtained.

Keywords : photonic crystal fibers, gold, silver, surface plasmon, biosensor
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