

Title: Gold nanowire-infused square-clad SPR-PCF biosensor for detection of various cancer cells

Author: Atiqul Alam Chowdhury, Md Rezaul Hoque Khan, Mohammad Rakibul Islam, A.N.M. Iftekher, Md Sanowar Hosen , Mhamud Hasan Mim, Mirza Muntasir Nishat

Abstract: This research work introduces a Surface Plasmon Resonance (SPR) based Photonic Crystal Fiber (PCF) sensor using gold nanowires as plasmonic material designed for the detection of various cancer cells, boasting remarkable sensitivity and ease of fabrication. The sensor's structure was devised and analyzed using the Finite Element Method (FEM) of COMSOL v5.5, with a focus on exploring the impact of varying geometric parameters on its overall performance. The simulation utilized extremely fine mesh elements to ensure the utmost accuracy. Excitation between the core and plasmonic modes is achieved using Gold (Au) nanowires. The determination of the sensor's wavelength sensitivity involves assessing the resonance wavelength shift between samples of normal and cancerous cells. Simultaneously, the measurement of amplitude sensitivity is accomplished through a comparison of the amplitudes associated with their respective confinement losses. Various parameters of the PCF were varied during the experimentation, leading to the achievement of exceptionally high Amplitude Sensitivity (AS) of RIU-1, RIU-1, RIU-1, RIU-1 and RIU-1 for Skin Cancer, Cervical Cancer, Blood Cancer, Adrenal Gland Cancer, Breast Type-1 Cancer and Breast Type-2 Cancer respectively. Additionally, the Wavelength Sensitivity (WS) values were found to be nm/RIU, nm/RIU, nm/RIU, nm/RIU, nm/RIU, and nm/RIU for the same cancer types, respectively. The achieved resolutions for wavelength sensitivity are RIU, RIU, RIU, RIU, RIU and RIU, while the resolutions for amplitude sensitivity are RIU, RIU, RIU, RIU, RIU and RIU for the respective cancer types mentioned above. The design of the presented biosensor is notably uncomplicated and can be readily manufactured using contemporary fabrication techniques. In summary, the remarkable sensitivity exhibited by the proposed SPR-based PCF (SPR-PCF) biosensor, shows significant potential for enhancing the detection of cancer cells.

Keywords: Biosensor, SPR-PCF, Cancer cell, Confinement loss, Wavelength sensitivity, Amplitude sensitivity, Resolution

DOI: <https://doi.org/10.1016/j.sbsr.2024.100670>

<https://www.sciencedirect.com/science/article/pii/S2214180424000527>