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A Theoretical Modelling and Simulation of a Surface Plasmon Resonance Biosensor for the Detection of Glucose Concentration in Blood and Urine

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Abstract : The present work reports a theoretical model to develop a plasmonic biosensor for the detection of glucose concentrations in human blood and urine as the abnormality of glucose label is the major cause of diabetes which becomes a life-threatening disease worldwide. This study is based on the surface plasmon resonance (SPR) sensor applications which is a well-established, highly sensitive, label-free, rapid optical sensing tool. Here we have introduced a sandwich assay of two dielectric spacer layers of MgF2 and BaTiO3which gives better performance compared to commonly used SiO2 and TiO2 dielectric spacers due to their low dielectric loss and higher refractive index. The sensitivity of our proposed sensor was found as 3242 nm/RIU approximately, with an excellent linear response of 0.958, which is higher than the conventional single-layer Au SPR sensor. Further, the sensitivity enhancement is also optimized by coating a few layers of two-dimensional (2D) nanomaterials (e.g., Graphene, h-BN, MXene, MoS2, WS2, etc.) on the sensor chip. Hence, our proposed SPR sensor has the potential for the detection of glucose concentration in blood and urine with enhanced sensitivity and high affinity and could be utilized as a reliable platform for the optical biosensing application in the field of medical diagnosis.

Keywords : biosensor, surface plasmon resonance, dielectric spacer, 2D nanomaterials
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