**ABSTRACT**

In this paper the performance of surface plasmon resonance (SPR) biosensor in modified kretchmann configuration utilizing nanocomposite layer consisting of nickel and ZnO as plasmonic material is analyzed numerically using N-layered transfer matrix method. The performance parameters of proposed sensor are investigated in terms of sensitivity (S), detection accuracy (DA) and quality factor (QF) at the operating wavelength of 633 nm. Parameters such as the influence of refractive index of the coupling prism, the thickness of the nanocomposite layer, the constituent components of the nanocomposite layer and the number of the graphene layers over the nanocomposite layer are investigated and the optimal values are identified to achieve maximum sensitivity. The numerical results shows that upon suitable optimization of the above parameters, the proposed SPR sensor is found to exhibits sensitivity as high as 378.34°/RIU with quality factor (QF) as 39.78/RIU. Compared with existing similar type of SPR sensors, the proposed sensor exhibits higher sensitivity, lower FWHM and better quality factor which would make our design to have more applications in the field of biosensor.