**ABSTRACT**

 The recent attention of plasmonic research has turned its focus towards the field of biomedical applications, due to the excitingly appreciable optical, electronic, chemical, thermal and mechanical properties of the 2D materials. Though these materials exhibited good sensing performance, there existed certain shortcomings like the lack of bandgap in graphene, low carrier mobility of TMDCs which hindered their usage in bio-sensing applications leading to the search for a new 2D material with desirable properties for improved sensor parameters. Black phosphorus (BP), an emerging two-dimensional (2D) material has appreciably unique physical, chemical, electronic and optical properties like direct band gap, smaller work function, high charge carrier mobility, better binding of molecules on sensor surface, high surface to volume ratio, above all its biodegradability and negligible toxicity in the biological environment which keeps it par from the other available 2D materials. This has aroused more and more research interest on the biomedical applications of BP. A detailed numerical analysis on the performance parameter of an optical fibre based SPR sensors with BP layers over spr active metals Au/Ag/Co/Ni/Cu have been studied. The parameters such as the thickness of the metal and the BP layer, its dielectric constants and refractive index of the sensing layer is properly chosen and sensitivity evaluation is performed in terms of its FWHM, Sensitivity, Quality Factor and Detection Accuracy. A noticeably high improvement is witnessed in Sensitivity and the other parameters due to the presence of the BP layers. The reason for the enhancement in sensitivity is due to the better binding of biomolecules. The attenuated total internal reflection method along with Krestchmann configuration has been employed for the evaluation of parameters. The effects of the metal structures considered and its thicknesses on the transmitted spectrum of the proposed sensor is analysed by transfer matrix method. The proposed configuration will surely be a promising candidate for high performance bio-sensing applications.