**ABSTRACT**

 In the last few decades, Surface Plasmon Resonance based optical sensors has created a niche for itself in the field of bio, chemical and gas sensing applications due to their surprising superior characteristics such as its high sensitivity, reliability, real time sensing ability, compactness and flexibility. Recently a new family of 2d transition metal carbide/ nitride materials known as MXene has drawn increased attention due to their exceptional properties like excellent thermal stability, easily tunable structure, large interlying surface, high electrical conductivity and large surface area. A detailed analysis on the performance parameters of SPR based fiber optic sensors having a Four layer model - Core/metal/Mxene/Sensing medium is performed. Kretschmann configuration and the N layer matrix model has been employed for the performance study and a novel SPR sensor based on Au/Ag/Co/Ni with MXene layers is theoretically presented. The thickness of the metal layer, Mxene and the RI of the multi layers have been properly chosen. Enhanced sensitivity is observed in the MXene based Sensor compared to the bare metal based SPR sensor as well as the conventional metal film sensors. The other sensor parameters such as the Quality Factor, Detection Accuracy, Signal to Noise ratio has also shown desired values. Owing to their unique properties, MXene has demonstrated promising nature for various applications such as energy storage, chemical, photo and electrocatalyst, photothermal therapy, gas sensing etc.