**ABSTRACT**

This Theoretical study aims at improving the sensitivity of surface plasmon resonance biosensor under angular interrogation. We observed that the sensor configuration composed of bimetallic layer of Cu–Ni attached with 2D materials MoS2/WS2/MoSe2/WSe2/graphene enhanced the sensitivity of the sensor to a great extends. The thickness of the bimetallic layers and the number of layers of 2D materials are optimized to achieve maximum sensitivity. Numerical results shows that sensitivity as high as 480∘/RIU is achieved for the well optimized bimetallic configuration consist of 35 nm of Cu and 20 nm of Ni thickness for the analyte refractive indices ranging from 1.33–1.335. Up on functionalizing the metal layers with bimolecular recognizing 2D materials, we noted that configuration with 35 nm of Cu, 15 nm of Ni with monolayer of 2D material WS2 enhanced the sensitivity as high as 426∘/RIU. We expect that such a simple structure and promising results will lead the proposed sensor as a suitable and potential candidate for detecting biomolecules organic elements and other analytes.