

Enhancement of chitosan-graphene oxide SPR sensor with a multi-metallic layers of Au–Ag–Au nanostructure for lead(II) ion detection

ABSTRACT

We demonstrate the enhancement of surface plasmon resonance (SPR) technique by implementing a multi-metallic layers of Au/Ag/Au nanostructure in the chitosan-graphene oxide (CS-GO) SPR sensor for lead(II) ion detection. The performance of the sensor is analyzed via SPR measurements, from which the sensitivity, signal-to-noise ratio and repeatability are determined. The nanostructure layers are characterized using field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM), X-ray diffraction (XRD), Raman spectroscopy and X-ray photoelectron spectroscopy (XPS). We showed that the proposed structure has increased the shift in the SPR angle up to 3.5° within the range of 0.161 ppm due to the enhanced evanescent field at the sensing layer-analyte interface. This sensor also exhibits great repeatability which benefits from the stable multi-metallic nanostructure. The SNR value of 0.92 for 5 ppm lead(II) ion solution and reasonable linearity range up to that concentration shows that the tri-metallic CS-GO SPR sensor gives a good response towards the lead(II) ion solution. The CS-GO SPR sensor is also sensitive to at least a 10^{-5} change in the refractive index. The results prove that our proposed tri-metallic CS-GO SPR sensor demonstrates a strong performance and reliability for lead(II) ion detection in accordance with the standardized lead safety level for wastewater.

Keyword: Surface plasmon resonance; Multi-metallic; Nanostructured; Chitosan; Graphene oxide; Lead(II) ion detection