Exploration of surface plasmon resonance for sensing copper ion based on nanocrystalline cellulose-modified thin film

ABSTRACT

In this research, surface plasmon resonance (SPR) spectroscopy was used for sensing copper ion by combining the SPR with nanocrystalline cellulose modified by hexadecyltrimethylammonium bromide and graphene oxide composite (CTA-NCC/GO) thin film. The binding of Cu2+ on CTA-NCC/GO thin film was monitored by using SPR spectroscopy. By using the obtained SPR curve, detection range, binding affinity, sensitivity, full width at half maximum (FWHM), data accuracy (DA), and signal-to-noise ratio (SNR) have been calculated. The results showed that the sensor detection range was 0.01 until 0.5 ppm, and that it reached a saturation value. Moreover, the resonance angle shift followed the Langmuir isotherm model with a binding affinity constant of 4.075 × 103 M−1. A high sensitivity of 3.271° ppm−1 also was obtained for low Cu2+ concentration ranged from 0.01 to 0.1 ppm. For the FWHM, the lowest value calculated was at 0.08 and 0.1 ppm, which is 3.35°. The DA of the SPR signal consecutively highest at 0.08 and 0.1 ppm. Besides that, the SNR of the SPR signal increases with the Cu2+ concentrations. The CTA-NCC/GO thin film morphological properties were also studied by using atomic force microscopy. The rms roughness values, which were obtained before and after in contact with Cu2+, were 3.51 nm and 2.46 nm, respectively.

Keyword: Surface plasmon resonance; Sensing copper ion; Nanocrystalline cellulose-modified; Thin film