Exploration on structural and optical properties of nanocrystalline cellulose/Poly(3,4-Ethylenedioxythiophene) thin film for potential plasmonic sensing application

ABSTRACT

There are extensive studies on the development of composite solutions involving various types of materials. Therefore, this works aims to incorporate two polymers of nanocrystalline cellulose (NCC) and poly(3,4-ethylenethiophene) (PEDOT) to develop a composite thin film via the spin-coating method. Then, Fourier transform infrared (FTIR) spectroscopy is employed to confirm the functional groups of the NCC/PEDOT thin film. The atomic force microscopy (AFM) results revealed a relatively homogeneous surface with the roughness of the NCC/PEDOT thin film being slightly higher compared with individual thin films. Meanwhile, the ultraviolet/visible (UV/vis) spectrometer evaluated the optical properties of synthesized thin films, where the absorbance peaks can be observed around a wavelength of 220 to 700 nm. An optical band gap of 4.082 eV was obtained for the composite thin film, which is slightly lower as compared with a single material thin film. The NCC/PEDOT thin film was also incorporated into a plasmonic sensor based on the surface plasmon resonance principle to evaluate the potential for sensing mercury ions in an aqueous medium. Resultantly, the NCC/PEDOT thin film shows a positive response in detecting the various concentrations of mercury ions. In conclusion, this work has successfully developed a new sensing layer in fabricating an effective and potential heavy metal ions sensor.

Keyword: Nanocrystalline cellulose; Poly(3,4-ethylenedioxythiophene); Structural properties; Optical properties; Surface plasmon resonance