Synergy effect of nanocrystalline cellulose for the biosensing detection of glucose

ABSTRACT

Integrating polypyrrole-cellulose nanocrystal-based composites with glucose oxidase (GOx) as a new sensing regime was investigated. Polypyrrole-cellulose nanocrystal (PPy-CNC)-based composite as a novel immobilization membrane with unique physicochemical properties was found to enhance biosensor performance. Field emission scanning electron microscopy (FESEM) images showed that fibers were nanosized and porous, which is appropriate for accommodating enzymes and increasing electron transfer kinetics. The voltammetric results showed that the native structure and biocatalytic activity of GOx immobilized on the PPy-CNC nanocomposite remained and exhibited a high sensitivity (ca. 0.73 μA·mM−1), with a high dynamic response ranging from 1.0 to 20 mM glucose. The modified glucose biosensor exhibits a limit of detection (LOD) of (50 ± 10) μM and also excludes interfering species, such as ascorbic acid, uric acid, and cholesterol, which makes this sensor suitable for glucose determination in real samples. This sensor displays an acceptable reproducibility and stability over time. The current response was maintained over 95% of the initial value after 17 days, and the current difference measurement obtained using different electrodes provided a relative standard deviation (RSD) of 4.47%.

Keyword: Glucose biosensor; Cellulose nanocrystals; GOx; PPy-CNC nanocomposite; Chemical polymerization; Direct electrochemistry