UNIVERSITI TEKNOLOGI MARA

STUDIES OF CHITOSAN THIONINE-REDUCED GRAPHENE OXIDE NANOCOMPOSITE AS ELECTRODE FOR GANODERMA DISEASE BIOSENSOR

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ABSTRACT

Biosensor is a device that applies biological components to detect target substances involving electrochemistry. In this research, DNA-based biosensor was developed to sensitively detect *Ganoderma boninense* (GB) which is a fungus that causes basal stem rot to oil palm trees. The DNA-based biosensor applies indium-tin-oxide (ITO) coated glass electrode fabricated with materials that enhances the electrochemical properties and the sensitivity of the sensor. The electroconductive reduced graphene oxide (rGO) was used to fabricate ITO electrode as it promotes electroconductivity which allows the sensor to be more sensitive. Another material used, thionine, has a large amount of amino groups to promote immobilization of DNA strands onto the electrode. The composition of thionine with 0.1 mg/mL rGO was successfully determined to induce highest stability to rGO molecules when operating with water-based solvents as thionine makes it more hydrophilic. The ITO electrode was identified to express the highest current density of 581.54 μA/cm^2 after fabricated with thionine-reduced graphene oxide (Th-rGO) as compared to gold electrode and glassy carbon electrode. The Th-rGO nanocomposite was embedded in chitosan (CHIT) matrix with different volume ratios of which gives added advantage of increasing the effective surface area. The volume ratio of 40% CHIT-Th-rGO in 10μL fabrication was identified to be the optimum percentage obtaining the highest calculated effective surface area of 0.2010 cm^2. The ssDNA probe immobilized on the CHIT-Th-rGO is sensitive to the sequence that specifically translates into 18S ribosome of GB. Electrochemical characterizations of the prepared biosensor was continously done to monitor the effects of each individual fabrication layers on the electrode using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The electrode prepared was exposed to different ssDNA sequences which are closely ressembled to test for its selectivity. Only the specific DNA sequence that matches the probe on the sensor hybridized and caused an increase in the charge transfer resistant value (R_{ct}). The R_{ct} value of the biosensor prepared shows a linear relation with the logarithm of the concentration of the target DNA in the range of 1.0 fM to 1.0 μM. The detection limit was low at 4.5×10^{-17} M (S/N=3). The prepared biosensor exhibited a very good selectivity and reproducibility rate with relative standard deviation of 6.9% (n=6).

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“Undoubtedly, with every hardship, there is ease” (Al-insyirah, verse 6)

“The roots of education are bitter, but the fruit is sweet” (Aristotle)

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