

Sensor Elektrokimia Dopamin Berbasis Screen-Printed Carbon Electrode Modifikasi ZnO/MnO₂/MWCNT = Dopamine Electrochemical Sensor Based on Screen-Printed Carbon Electrode Modified ZnO/MnO₂/MWCNT

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Abstrak

Dopamin memiliki peran penting dalam fungsi sistem saraf pusat manusia. Pelepasan abnormal dopamin berhubungan dengan penyakit neurologis dan depresi. Oleh karena itu, perlu memantau kadar dopamin untuk memahami peran fisiologisnya. Pembahasan deteksi dopamin berfokus pada metode elektrokimia berbasis screen-printed carbon electrode (SPCE) yang dimodifikasi bahan ZnO/MnO₂/MWCNT. Penelitian dilakukan dengan empat tahapan yang terdiri dari preparasi material, karakterisasi material dengan menggunakan Fourier Transform Infrared (FTIR) dan Raman spektroskopi, modifikasi SPCE dengan ZnO/MnO₂/MWCNT, dan pengujian aktivitas elektrokimia menggunakan cyclic voltametry (CV). Modifikasi sensor dilakukan untuk mengetahui perbedaan kinerja analitik biosensor SPCE. Tujuan dari penelitian ini adalah untuk mengetahui performa SPCE dengan pendopingan nanopartikel logam ZnO, MnO₂, serta material karbon MWCNT berdasarkan linearitas, sensitivitas dan limit deteksi. Hasil pembacaan elektrokimia menggunakan CV dilakukan pada rentang deteksi 0,6 – 1,4 mM, sehingga diperoleh deteksi limit (LOD) 0,4946 mM dan sensitivitas 0,282 $\mu\text{A} \cdot \mu\text{M} \cdot \text{cm}^{-2}$. Sensor ini menunjukkan selektivitas yang kurang baik terhadap analit dopamin ketika dideteksi bersama senyawa asam askorbat.

The human central nervous system relies on dopamine to function properly. Neurological disorders and depression are linked to abnormal dopamine release. Monitoring dopamine levels is therefore crucial to comprehend its physiological function. The electrochemical approach of dopamine detection that utilises a screen-printed carbon electrode (SPCE) modified with ZnO/MnO₂/MWCNT material is the main topic of discussion. The study was conducted in four stages, including material preparation, Fourier Transform Infrared (FTIR) and Raman spectroscopy material characterisation, SPCE modification using ZnO/MnO₂/MWCNT, and cyclic voltametry (CV) electrochemical activity testing. To identify variations in SPCE biosensor analytical performance, sensor modifications were made. This study's goal was to evaluate the performance of SPCE doped with ZnO, MnO₂, and MWCNT metal nanoparticles. The goal of this study was to evaluate the linearity, sensitivity, and limit of detection of SPCE doped with metal nanoparticles such as ZnO, MnO₂, and MWCNT carbon materials. In order to achieve a detection limit (LOD) of 0,4946 mM and a sensitivity of 0,282 $\mu\text{A} \cdot \mu\text{M} \cdot \text{cm}^{-2}$, electrochemical readings using CV were performed in the detection range of 0,6 - 1,4 mM. When this sensor is measured with interference-causing substances in the body such as ascorbic acid, it exhibits poor selectivity for dopamine analytes.