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Performance Analysis of Optimized Screen-Printed Electrodes for Electrochemical Sensing

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Abstract

The screen-printed electrode (SPE) sensor is widely employed in food analysis , environmental health monitoring, disease detection, toxin detection and other applications. As it is crucial for the SPE sensor

to have an outstanding performance , this study examined the effects of manipulating the working electrode (WE) radius, gap spacing between electrodes , and counter electrode (CE) width on the performance of an SPE sensor. Finite element simulation on various geometrical dimensions was done prior to screen-printed electrode SPE sensor's fabrication at Jabil Circuits Sdn Bhd. The electrodes performance is measured through cyclic voltammetry (CV) using a potentiostat at an optimum scan rate of 0.01 V/s and a voltammetry potential window range of -0.2 to 0.8 V in 0.01 M Phosphate Buffered Saline (PBS) solution. It is discovered that adjusting the WE area and the gap separation between the electrodes had the most impact on sensor performance compared to varying the CE width. In both simulation and CV measurements, WE with the highest radius of 0.9 mm with an effective area of 2.54 mm2, and the smallest gap spacing of 0.7 mm has shown the highest current density of 0.04 A/mm2 (simulation) and 0.3 μA/mm2 (experiment) which can be translated as the highest sensitivity for the SPE sensor. Further CV measurement in nicotine sensing application has proven that the SPE sensor can effectively detect the nicotine oxidation indicating its promising potential as a biosensor. Combination of optimum SPE dimension together with suitable electrode modification process serves as the basis for an effective and sensitive SPE sensor for various biosensing applications.

Author keywords

Area; Current density; Performance ; Screen-printed electrode ; Sensor; Simulation; Spacing; Voltammetry

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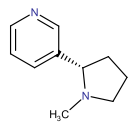

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