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ORIGINAL ARTICLES

Fabrication of Nanoindented Electrodes for Glucose Detection

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Abstract

Background:

The objective of this article was to design, fabricate, and evaluate a novel type of glucose biosensors based on the use of atomic force microscopy to create nanoindented electrodes (NIDEs) for the selective detection of glucose.

Methods:

Atomic force microscopy nanoindentation techniques were extended to covalently immobilized glucose oxidase on NIDEs via composite hydrogel membranes composed of interpenetrating networks of inherently conductive poly(3,4-ethylenedioxythiophene) tetramethacrylate grown within ultraviolet cross-linked hydroxyethylmethacrylate-based hydrogels to produce an *in vitro* amperometric NIDE biosensor for the long-term monitoring of glucose.

Results:

The calibration curve for glucose was linear from 0.25 to 20 m*M*. Results showed that the NIDE glucose biosensor has a much higher detection sensitivity of 0.32 μA/m*M* and rapid response times (<5 seconds). There was no interference from the competing interferent (fructose) present; the only interference was from species that react with H_2O_2 (ascorbic acid). The linear equation was $B_{response}$ (μA) = 0.323 [glucose] (m*M*) + 0.634 (μA); $n = 24$, $r^2 = 0.994$.

Conclusion:

Results showed that the resultant NIDE glucose biosensor increases the dynamic range, device sensitivity, and response time and has excellent detecting performance for glucose.

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Abbreviations: (AFM) atomic force microscopy, (GO_x) enzyme glucose oxidase, (HEMA) hydroxyethyl methacrylate, (NIDE) nanoindented electrode, (PEDOT) poly(3,4-ethylenedioxythiophene), (PEG) poly(ethylene glycol), (PEGMA) poly(ethylene glycol methacrylate), (PME) planar microelectrode, (TEGDA) tetraethyleneglycol diacrylate, (UV) ultraviolet

Keywords: amperometric, atomic force microscopy, glucose biosensor, hydrogel, nanoindented electrodes, poly(3,4-ethylene dioxythiophene)

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