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 mM. Results showed that the NIDE glucose biosensor has a much higher detection sensitivity of 0.32 μA/mM 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 H₂O₂ (ascorbic acid). The linear equation was $B_{\text{response}} (\mu\text{A}) = 0.323 [\text{glucose}] (\text{mM}) + 0.634 (\mu\text{A})$; $n = 24$, $r^2 = 0.994$.

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.