

**UNIVERSITI TEKNOLOGI MARA**

**GLUCOSE AND BREAST CANCER 1  
(*BRCA1*) BIOSENSOR BASED ON  
ZINC OXIDE NANOSTRUCTURES**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
**Master of Science**

**Faculty of Applied Sciences**

**January 2016**

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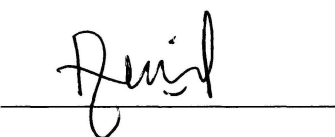
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## ABSTRACT

Nanostructure metal-oxides have been extensively explored in the development of biosensors. This work reports a sensitive electroanalytical sensing nanomaterial for the development of a glucose biosensor based on ZnO nanoparticles deposited on Silicon wafer, (ZnO/Si), also a new electrochemical DNA biosensor was fabricated using Zinc Oxide Nanowires on gold electrode (ZnONWs/Au). First of all, the crystalline form of the nano-ZnO film was obtained by sputtering technique. Glucose oxidase (GOx) was immobilized on the surface of ZnO/Si and was then covered with nafion film. The nafion acted as GOx surface binder which resulted in higher sensitivity. The Nafion/GOx/ZnO/Si modified electrode operates in phosphate buffer solution (pH 7.4). The morphologies and electrochemical behavior of the Nafion/GOx/ZnO/Si modified electrode film were investigated using field emission scanning electron microscopy (FESEM) and electrochemical techniques including chronoamperometry and cyclic voltammetry respectively. Results show that the biosensor give a linear response to glucose in the concentration range from 0.05 to 0.70 mM ( $R^2=0.997$ ). The apparent Michaelis-Menten constant,  $K_M$  is calculated to be 3.4 mM. The response time of 0.9 s, detection limit of  $1.50 \pm 0.50 \mu\text{M}$  and sensitivity of  $18.6 \pm 2.66 \mu\text{Acm}^{-2}/\mu\text{M}$  ( $n=3$ ) were observed making ZnO nanofilm as a promising material in biosensor application. The nanomaterial inclusions in electrochemical biosensors based-DNA offer important applications in clinical diagnostics and treatment of viral and immune diseases. In this research, the zinc oxide (ZnO) nanowires were synthesized and applied in the development of electrochemical DNA biosensor for detection of the breast cancer genes (*BRCA1*). The synthetic single stranded oligonucleotide (ssDNA) was immobilized onto gold electrode that has been grown with zinc oxide nanowires beforehand. Then, the probes were hybridized with different concentration of complementary nucleic acid sequences and mismatch ssDNA in the samples. Under the optimal conditions stated in this report, the specific *BRCA1* ssDNA sequences could be detected by differential pulse voltammetric responses on double stranded oligonucleotide (dsDNA) molecules. The linear concentration range was achieved from 10.0 to 100.0  $\mu\text{M}$  with the detection limit of 3.32  $\mu\text{M}$ . This electrochemical DNA sensor exhibited excellent selectivity. The polymerase chain reaction (PCR) product of *BRCA1* gene that extracted from MCF-7 breast cancer cells was successfully detected, which indicated that this electrochemical DNA sensor could be further used for the detection of specific ssDNA sequence in real biological samples.

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