UNIVERSITI TEKNOLOGI MARA

GLUCOSE SENSING BEHAVIOR OF ZnO, CuO AND THEIR COMPOSITES FOR EXTENDED-GATE FIELD EFFECT TRANSISTOR SENSOR

NUR DALILA HAZIRAH BINTI ABD PATAH

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ABSTRACT

Within the sensor group, biosensor has a very important role in medicine, biology and biotechnology. The biosensor was first proposed by Clark and Lyons in 1962 and described as an 'enzyme electrode' for measuring glucose levels. The development of glucose sensors has since then received continuous interest. There are two types of glucose sensors which are enzymatic and non-enzymatic. Non-enzymatic sensors have been favoured in the research field more than their enzymatic counterparts, as enzymatic glucose sensors are less stable and more costly. The objective of this work is to determine the best metal-oxides for non-enzymatic extended-gate field effect transistor-based glucose sensor application. The metal oxides used in this investigation are copper oxide (CuO) and zinc oxide (ZnO), deposited by the spin coating method. These oxides were chosen due to their unique characteristics in sensing applications. Several experimental parameters in spin-coating deposition process have been studied; these include the precursor molar concentration and number of layer or thickness of thin films which was varied to obtain optimal parameters to suit the sensing membrane fabrication. The physical structures of the thin films were observed by using field emission scanning electron microscope (FESEM) and Atomic Force Microscope (AFM). The electrical properties were examined using extended-gate field effect transistor (EGFET) measurement setup and cyclic voltammetry. Through the investigations, we found that the CuO thin films deposited at 3 layers and 0.6 M gave the best results meanwhile for ZnO thin films deposited also at 3 layers and 0.4M gave the best results. Further investigation on the optimization of both materials has been done. Both materials have been combined as bilayers. From the characterization results, it was found that the CuO/ ZnO bilayer films showed the best electrical properties compared to ZnO/CuO bilayer films. This was supported by the cyclic voltammetry results. In conclusion, the glucose sensor shows the sensitivity 58mV/M for CuO thin film and 60.4mV/M for ZnO thin film. Meanwhile for bilayer composites, CuO/ZnO shown higher sensitivity compared ZnO/CuO which is 38mV/M and 13mV/M respectively.