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Aluminum oxide interdigitated capacitors (AOIC) - Past, present and possible future in the biosensing applications

Luis Moreno Hagelsieb
Université catholique de Louvain, Belgium

Simple, low cost and low consumption devices are required in medical and agronomical applications and environmental monitoring. Producing a faster response, high response, highly sensitive, highly selective sensor devices for application in bacteria detection have become very critical. Current detection system takes minimum 2 hours (expensive devices) to one week, while some fast detectors can make detections in less than an hour but only when the concentrations of the target is high. In previous works at "Université catholique de Louvain", high-performance sensors and MEMS with; very low power consumption and broad applications, were developed. In collaboration with its microelectronics laboratory, aluminum oxide interdigitated capacitors (AOIC) have been developed and successfully tested on DNA hybridization and on bacteria and spores detection test as well as on breathing monitoring. All of them have shown comparable results to the state of the art using existing standard biological protocols procedures. The related projects included also the deposit of nanoparticle functionalized nanostructured metal oxides (Al_2O_3, WO_3, SnO_2, and HfO_2) directly onto an optimized AOIC with the aim of producing a high response, highly sensitive, highly selective sensor devices for application in bacteria and in gas detection (i.e. breathing and environmental). The market trends are well analyzed. This presentation will cover the complete story about this biosensor, how it was conceived, the applications results, comparative measurement to similar methods as well as its possible future developments.

sieb07@hotmail.com

Zinc oxide nanorods biosensors based on electrochemical reaction for glucose sensing

Mohammed Marie and **M O Manasreh**
University of Arkansas, USA

Glucose biosensor based on zinc oxide ZnO nanorods was investigated. A sol – gel technique was used in the fabrication process and the working electrode was deposited on glass coated indium tin oxide with an area 0.3x0.3 cm^2. Zinc oxide nanorods were well aligned in a hexagonal structure with variety of diameters between 68 – 116.3 nm as it shown the scanning electron microscopy image. The Raman and absorbance spectroscopy were used to characterize the material. The absorbance optical peak was observed ~ 370 nm corresponding with the band gap of ZnO 3.37 eV and the measured was performed in the range from 300 – 1000 nm. The observed peak in Raman spectrum was at 440 cm^{-1} matching with the lattice vibration of ZnO. Glucose oxidase GO_x and nafion membrane were spin coated with a speed 4000 rotation per minute on top of the nanorods to increase the sensitivity and prevent any undesired chemical reaction. The time response of the fabricated biosensor was 3 sec and the cyclic voltammetry curve illustrates the oxidation reduction process of glucose by GO_x and the oxidation peak was around 0.5 V. The obtained sensitivity was 10.911 mA/mM cm^2 and the lower limit of detection was 0.22 µM which indicates the high performance of the fabricated ZnO biosensor.

msmarie@uark.edu