2016-09-01

Modeling and application of tin oxide sensors for detection of different pathogens

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Modeling and application of tin oxide sensors for detection of different pathogens

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Introduction

The development of biosensors has an important attention over the last two decades. Detection of foodborne pathogens is very important for the food safety and public health. We can define a bio-sensor is an analytical device which can convert the responses from biological activities in the living system to an electrical signal or process able data. In this context, monitoring is the major control to the avoidance of diseases caused by foodborne pathogens. In last decades several methods for detection and monitoring of pathogens have been developed [1]. One of the methods using for the detection of pathogen system is impedance spectroscopy, and it is generally called as impedance microbiology [2]. The first attempt by Stewart et al; was the first to detect a microorganism using impedance technique and afterwards several studies were published explaining impedance detection of microorganism and various pathogens. The impedance and other electrical parameters can be changed because the pathogen medium produces ionic metabolites to the medium during their energy metabolism process in the living cells or microbial growth of pathogens [3].

Methods and Expermental procedure

Application of SnO_2 thick films for monitoring different pathogen system using impedance spectroscopic analysis is presented. For this purpose SnO_2 nanopowder was synthesized using co-precipitation method. The obtained powder was used for the fabrication of sensing device using thick film technology by screen-printing method. Fabricated devices were processed in three different temperatures to tune surface morphology and surface grain density. Moreover, fabricated SnO_2 thick-films were characterized and confirmed its crystallinity using X-ray Diffraction and Raman spectroscopic analysis. Sensing performances were performed using HP-4194A complex impedance analyser. The analysis were carried out using *candida albicans*, *pseudomonas aeruginosa* and pathogen samples, from colonies of 24-hour cultures on blood agar (HiMedia, India) for all mentioned bacteria as well as of the colonies on Sabouraud dextrose agar (HiMedia, India) for *candida*, in sterile tubes, suspensions with the density of 0.5 MCF were made in 4.5 ml of physiological saline using EUCAST standard.

Results

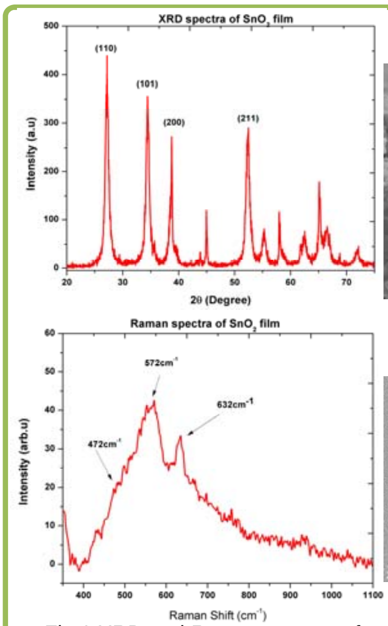

Fig.1 XRD and Raman spectra of SnO_2 films

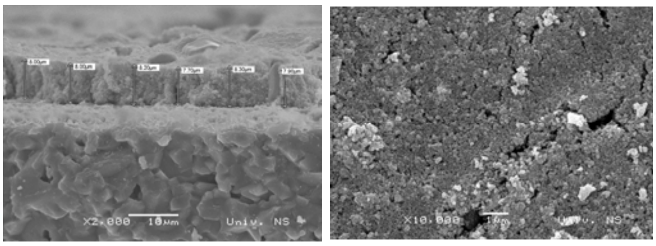

Fig.2 Scanning Electron Microscopic (SEM) images of SnO_2 films

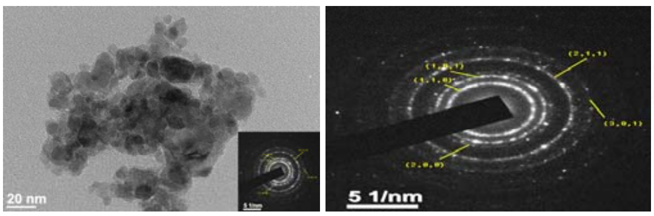

Fig. 3 Transmission Electron microscopic (TEM) images of SnO_2 powder

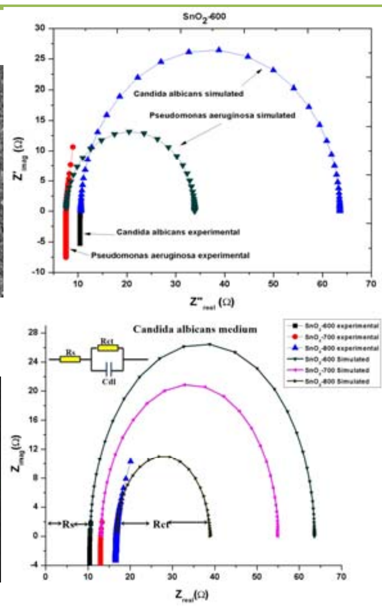

Fig. 4 Nyquist plot response of SnO_2 films in various pathogen media

Conclusion

- Tin oxide nanopowder were synthesised by co-precipitation method us, and Crystallinity and phase formation of SnO_2 is confirmed by X-Ray Diffraction , Raman and Transmission Electron microscopic analysis. From these analysis we confirm the synthesised powder have rutile tetragonal structure.
- TEM micrographs reveals, SnO_2 powder have particle size in nanometer range and SEM micrographs reveals surface morphology and thickness of Screen printed SnO_2 thick film. Screen printed layer has thickness of 7-8 µm range.
- Analysis of performance of biosensing ability of SnO_2 thick films have been tested by Impedance spectroscopic method using *Candia albicans*, and *pseudomonas aeruginosa* pathogen media. Moreover Electrochemical studies have been done by MEISP software using Randles cell as a circuit model, we observe significant change on the Rct and Rs values. Moreover, Influence of sintering temperature on sensing performance SnO_2 thick films is performed in Candida albicans media. We observed that Rs and Rct values increase with increasing sintering temperature.

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Acknowledgement: European Union's Horizon 2020 research and innovationprogramme under the Marie Skłodowska-Curie grant agreement No 690876.