Electrodeposited ZnS Thin Films for NO_2 Gas Sensing Applications

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Sensors are becoming a consequential part in human's daily life**.** Typically, t**hey** are classified based on the physical parameter sensed itself namely; thermal, mechanical, magnetic, chemical, and optical. Gas sensors are chemical sensors that can be fabricated as metal-oxide or metal-sulfide semiconductor materials viz.; TiO_2, ZnO, CdS and ZnS etc. Among these materials ZnS is a highly abundant and non-toxic material and can be easily adopted for gas sensing applications. Electrodeposition can be identified as an ideal fabrication method owing to its simplicity and low cost in production amid various fabrication methods that have been employed for developing ZnS thin films. This study focuses on the growth of ZnS thin films for gas sensing applications using the technique of electrodeposition. A three electrode electrolytic system consists of an Ag/AgCl reference electrode, FTO glass substrate (1×3 cm^2) working electrode and high purity carbon counter electrode was used in electrodepositing ZnS material in an aqueous electrolyte containing $ZnCl_2$ (0.10 - 0.05 mol/L) and $Na_2S_2O_3$ (0.01 - 0.05 mol/L) precursors. The ZnS depositions were carried out in the cathodic deposition potential (CDP) range of 0.70 - 1.10 V and pH range of 4.0 - 3.5 at temperature of 30 °C for 90 minutes. After deposition, samples were annealed at 300 °C for 10 minutes and characterized for their crystalline structure, surface morphology and elemental composition using the techniques of X-ray diffraction spectroscopy, scanning electron microscopy and energy dispersive X-ray spectroscopy respectively. The sample grown at CDP of 1.05 V at pH of 3.7 were found to have notable material properties and shown 2 Ω average change in resistance with respect to the initial average resistance of 26.2 Ω while exposing to NO_2 gas at $3\times 10^{4\,Pa}$ and 30 °C within a time interval of 2-3 minutes.

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