



Development of CdS thin films for H₂S sensing applications

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Production of H₂S due to eutrophication of water bodies in urban areas is a major problem for the residents and commuters because of its irritant nature. Therefore, detecting H₂S is important to improve health and well-being of residents and commuters. Out of various types of commercially available gas sensors, semiconductor gas sensors (SGS) are considered as a set of versatile sensors. The most common sensing materials used in SGS are metal oxides. However, due to their drawbacks, now metal sulphides are being extensively investigated as a novel gas sensing material. In this study, CdS which is a group II-VI metal sulphide semiconductor with a band gap of 2.42 eV, is investigated as a suitable candidate for the H₂S sensing application. A three-electrode electrolytic system consists of a saturated calomel reference electrode, Fluorine-doped tin oxide (FTO) glass substrate (1×3 cm², sheet resistance: 7Ω/sq) working electrode, and high purity carbon counter electrode was used in electrodeposition of CdS material in an aqueous electrolyte containing CdCl₂ (0.10 mol/L) and Na₂S₂O₃ (0.01 mol/L) precursors. The CdS depositions were carried out in the cathodic deposition potential (CDP) range of 0.65 to 0.70 V and pH range of 1.5 to 2.0 at temperature of 55 °C for 30 minutes at the stirring rate of 60 rpm. After the depositions, samples were annealed at 400 °C for 10 minutes and gas sensing measurements were carried out by measuring resistance of the deposited films in the absence and presence of H₂S gas (6.9×10³ Pa, 29 °C, 2 min) in a closed gas chamber. Subsequently, films were characterized for their crystalline structure and surface morphology using X-ray diffraction and scanning electron microscopy. The sample grown at CDP of 0.67 V at pH of 1.5 was found to have notable material properties and shown 1.2 Ω average change in resistance with respect to the initial average resistance of 36.0 Ω while exposing to H₂S gas.

Keywords: Gas sensor, cadmium sulphide, H₂S sensing, electrodeposition

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