FABRICATION OF BISMUTH SULFIDE THIN FILMS USING L-CYSTEINE AS A NOVEL SULFUR SOURCE

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Bismuth sulfide (Bi_2S_3) thin films have recently attracted considerable attention, due to their suitable optical and electro-optical properties for the use in optoelectronic devices. Bi_2S_3 is a non-toxic, earth-abundant n-type semiconductor with a tunable band gap between 1.3 and 2.2 eV and a high absorption coefficient of 10^5 cm^{-1} [1]. It serves as an industrially available and environmentally friendly alternative n-type layer for the use in photovoltaic applications.

In our research, we investigate the chemical bath deposition method to fabricate FTO (fluorine doped tin oxide) glass substrates by using L-cysteine as a sulfur source. L-cysteine is a simple and promising, yet underexplored sulfur precursor, hence why it is chosen as a novel sulfur source in this experiment. Firstly, $Bi(NO_3)_3{\cdot}5H_2O$ was dissolved in 1 M nitric acid and diluted with distilled water to obtain a 0.1 mol/L solution. Secondly, a 0.025 mol/L solution of EDTA-Na_2 was added, thouroughly mixed, and heated to 80 °C. EDTA-Na_2 acts as a chelating agent, coordinating to bismuth ions to make the reaction slower, hence making the final Bi_2S_3 nuclei better dispersed [2]. Once the solution reached the optimal temperature, L-cysteine was added and mixed thoroughly. FTO glass substrates were subsequently immersed and kept for 8 h at 80 °C to form thin Bi_2S_3 films. The obtained samples were cleaned with distilled water and annealed in an inert atmosphere.

All samples were analyzed by UV-Vis absorption spectroscopy and X-ray diffraction (XRD) analysis on the Bruker D8 Advance diffractometer. Thin films were scanned over the range $2\theta = 3–70°$ at a scanning speed of 1° min^{-1} using a coupled two theta/theta scan type. This test determined structural characterization of the obtained materials. Results were studied and compared.

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