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DETERMINATION OF FUNDAMENTAL PROPERTIES OF CZTS SEMICONDUCTOR MATERIAL DEPOSITED BY THE SPRAY PYROLYSIS METHOD

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Copper zinc tin sulfide (CZTS) which is a p-type, kesterite, a semiconductor material with a narrow band gap around 1.5 eV is a promising and an ideal light-harvesting material for thin film solar cell. In recent years, there is a wide interest on CZTS based thin film solar cell as CZTS harvest solar energy from UV to far IR region. The electronic, as well as physical properties of CZTS, highly depend on the atomic ratio of the elements while sulfur in CZTS plays a significant role in determining the properties of CZTS. As such, in this experiment, we carried out to determine the fundamental properties such as material type, band energy positions, band gap, crystal structures, etc of a CZTS semiconductor material when the variation of sulfur content in CZTS. The CZTS was synthesized by a two-step process in which, metal salts and different ratios of thiourea are dissolved in dimethylsulfoxide (DMSO) and the precursor solution was sprayed on FTO followed by sulfurization at nitrogen environment at 500^{o}C. Mott–Schottky plot is used to determine the flat-band potential and type of material. UV-Visible spectrometry, powder X-ray diffraction were used to determine the band gap and crystal structure of the material respectively. The Mott – Schottky plots confirm the complete p-type nature of the CZTS while the flat band potentials negatively shifts from 0.66V to 0.03V and charge carrier density decreases from $2.38\times10^{16}cm^{-2}$ to $3.36\times10^{15}cm^{-2}$ with the increase of the sulfur ratio in CZTS. These results offer guidance to improve the properties of CZTS and their applications in solar energy conversion applications.

Keywords: CZTS, Semiconductor, Flat band potential