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Enhanced photoresponse of $Cu_2ZnSn(S, Se)_4$ based photodetector in visible range

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Abstract

Fast switching response of photodetectors is needed for many applications. Therefore, it is necessary to study the photoconductivity properties of earth abundant and cost effective materials. Till now, there are only two reports based on photoconductivity study of $Cu_2ZnSn(S, Se)_4$ **(**CZTS) based materials. In this study, CZTSSe thin film on soda-lime glass substrate was deposited using one-step reactive sputtering from CZTSe target in presence of H_2S followed by annealing. Optical, structural, morphological and elemental composition analyses were carried out to characterize CZTSSe thin film. The value of optical band gap estimated using Tauc's plot was 1.45 eV. The presence of very intense peak corresponding to (112) plane in the XRD pattern suggested growth to be oriented. Similar was the case with Raman studies. Photoconductivity study of CZTSSe thin film in visible region (excitation wavelength – 532 nm) has been studied. At a bias voltage of 5V, response rise time and decay time in visible range for CZTSSe were 330 ms and 0.986 ms, respectively. The values of responsivity, detectivity, sensitivity (I_{light}/I_{dark}) and external quantum efficiency were ~15 mA/W, 3.5×10^9 Jones, 6.9363 and 3.5%, respectively. The shortest reported response decay time by CZTSSe based photodetector is the novelty of this work. This work shows the possibility of utilizing CZTSSe thin film as photodetector for various applications.

Keywords: - *Reactive Sputtering; CZTSSe; Photodetector; Thin Film*

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