Cu(In,Ga)Se$_2$ (CIGS) is one of the most promising material for thin film solar cells. However, their production is limited due to the unavailability of the rare materials like indium and gallium. Research on new kind of In-free Cu chalcogenides, like Cu$_2$SnS$_3$ and Cu$_2$SnSe$_3$, are growing interest among the researchers due to the easy availability, high absorption coefficient, different band gap energies etc. Cu$_2$SnS$_3$ (CTS) and Cu$_2$SnSe$_3$ (CTSe) solid solutions were prepared by mixing the elemental powders in required quantity using ball milling technique. Thin CTS and CTSe films were deposited on glass/ITO/ CdS substrates where chemically deposited CdS is used as a window layer for the solar cell device. The post annealing treatment was done at 380°C for 30 minutes. Phase identification was performed using X-ray diffractrometry (Fig.1) and the surface morphology was determined using scanning electron microscopy. Deposited CTS films show a tetragonal phase having lattice parameters $a=5.412$ Å, $b=5.412$ Å and $c=10.860$ Å (JCPDS Card No. 89-4714) whereas CTSe thin films were having cubic phase with lattice parameters $a=6.964$ Å, $b=12.056$ Å and $c=6.972$ Å (JCPDS Card No. 89-2879). Well adhered, smooth surface was found for both the films on the substrate. Better grain growth is observed for the CTS film as compared to CTSe thin film. Electrical characteristics of the deposited films were determined using Hall Effect measurement system. Though both the CTS and CTSe films were having p-type conductivity, CTS thin film shows better mobility and conductivity than CTSe thin film. Capacitance-Voltage (C-V) and Current-Voltage (I-V) measurement was performed on the fabricated device having Al as front contact. The doping density ($N_a$) and junction width ($W_d$) is more for the fabricated device having CTS as absorber layer. Both the films show photovoltaic behavior with relatively low efficiency of 0.3% (CTS) and 0.1% (CTSe) films.

![Figure 1: XRD spectra of the deposited CTS and CTSe thin films from solid solution](image-url)