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## Growth and characterization of CZTS and CZTSSe for solar cell application

In this study, copper zinc tin sulphide (CZTS) and copper zinc tin sulphur selenide (CZTSSe) thin films were deposited on molybdenum (Mo), indium tin oxide (ITO) and fluorine-doped tin oxide (FTO) by sputtering deposition and were annealed in nitrogen at 500°C for 60 minutes. The XRD patterns on all substrates showed tetragonal kesterite CZTS with  $I4^-$  space group and tetragonal kesterite CZTSSe with  $I4$  space group. Raman spectra further confirmed CZTS and CZTSSe. Dominant peaks showing red shifts from 337.2 $\text{cm}^{-1}$  for Mo/CZTS to 335.8 and 329.8 $\text{cm}^{-1}$  for FTO/CZTS and ITO/CZTS, respectively. Similarly, red shifts were observed for Mo/CZTSSe from 334.3  $\text{cm}^{-1}$  to 331.4 and 322.5  $\text{cm}^{-1}$  for FTO/CZTSSe and ITO/CZTSSe, respectively. The presence of copper tin sulphide (CTS) and zinc sulphide (ZnS) residue on CZTSSe were also revealed by the Raman. UV-Vis analysis depicted the bandgaps of ITO/CZTS, ITO/CZTSSe, FTO/CZTSSe to be 1.26, 1.16 and 1.35 eV, respectively. The sheet resistance, resistivity and conductivity of the thin films was measured using a four point probe. The smallest value resistivity of  $2.095 \times 10^{-6} \Omega \cdot \text{m}$  was obtained on Mo/CZTSSe while ITO/CZTS had the largest value ( $115.2 \times 10^{-3} \Omega \cdot \text{m}$ ). These findings shed light on the structural, optical and electrical properties of ITO/CZTS, ITO/CZTSSe, FTO/CZTS, FTO/CZTSSe as possible bottom layers of tandem solar cells.

Keywords: CZTS, CZTSSe, FTO, ITO, sputtering deposition, solar cell.

### Apply to be considered for a student ; award (Yes / No)?

Yes

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MSc

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