

Supporting Information

Fig. S1. SEM top view of CZTS precursor.

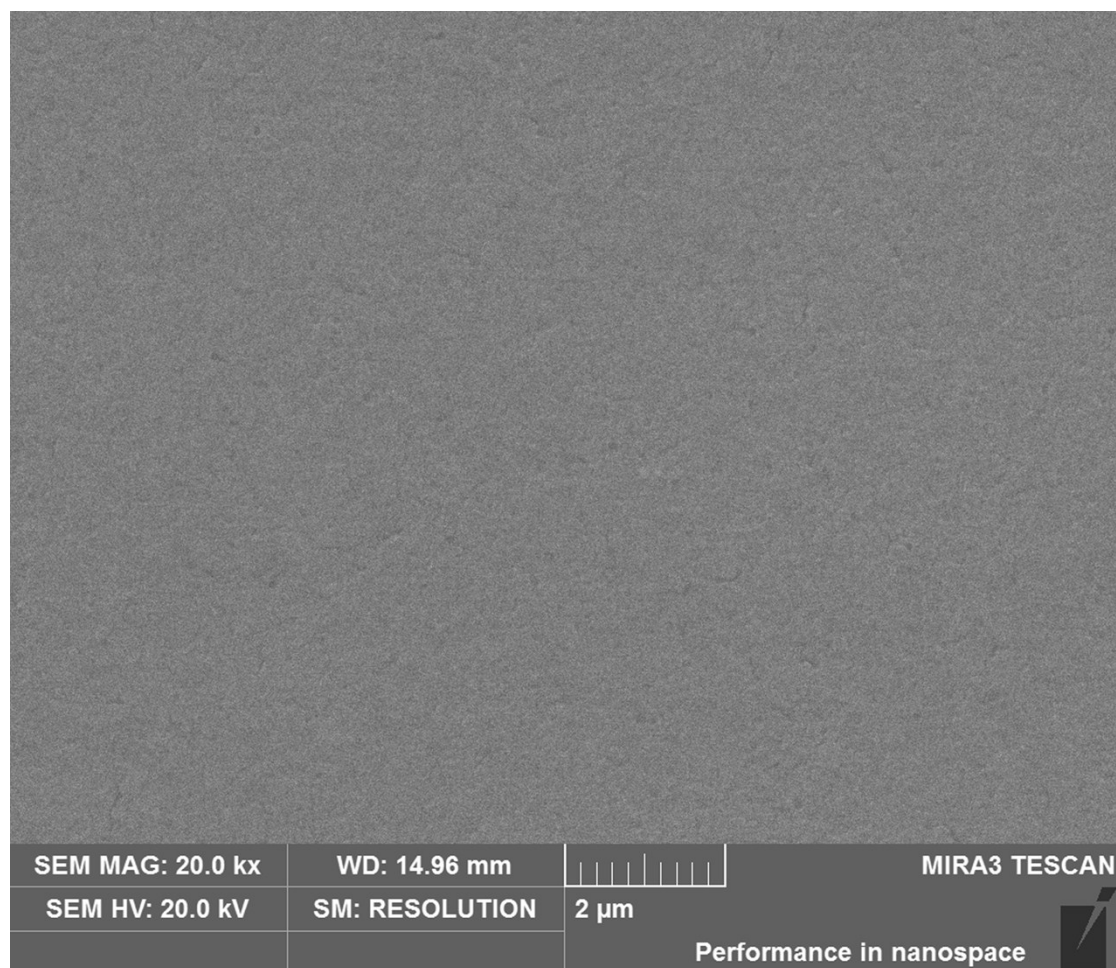


Fig. S2. The EDS component atomic ratio image of the CZTSSe films annealed at 500 °C, 530 °C, 560 °C and 580 °C. The precursor solution was prepared with a ratio of $\text{Cu}/(\text{Zn}+\text{Sn})=0.86$ and $\text{Zn}/\text{Sn}=1.0$.

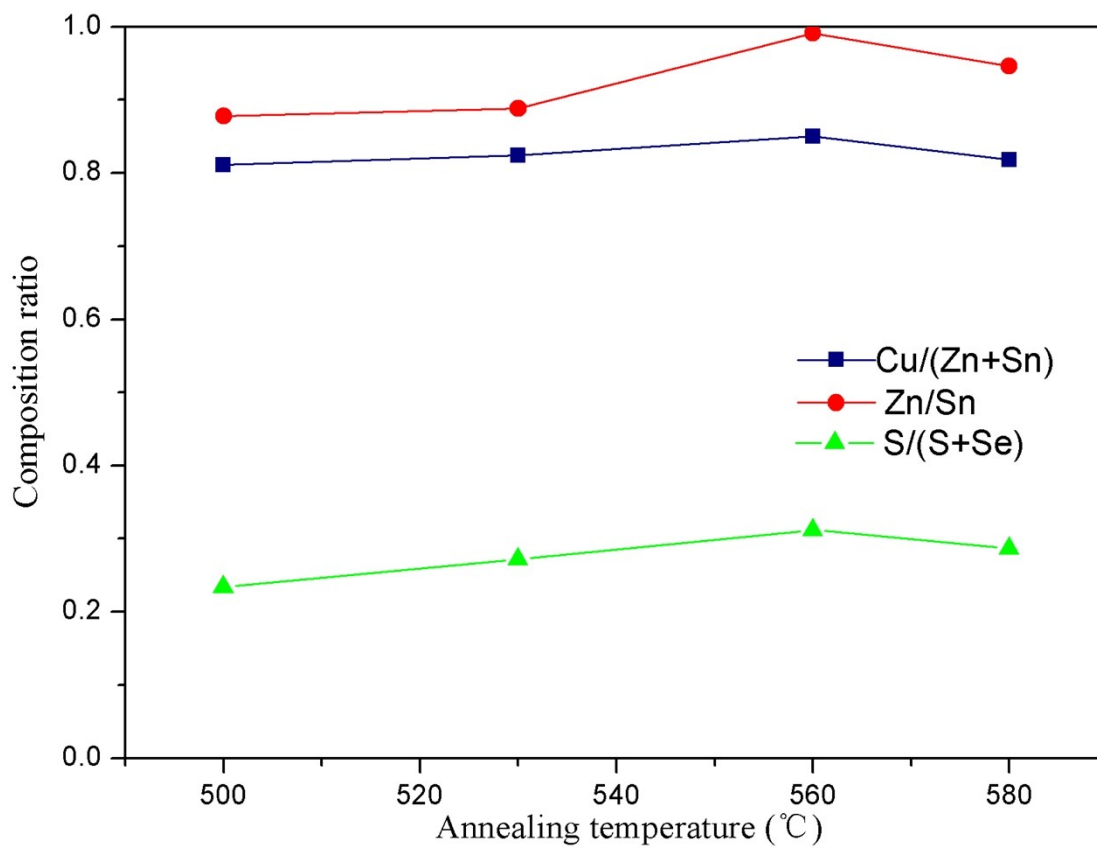


Fig. S3. The EDS component atomic ratio image of the CZTSSe films annealed at 560 °C for 5 min, 20 min, 40 min, and 60 min. The precursor solution was prepared with a ratio of $\text{Cu}/(\text{Zn}+\text{Sn})=0.86$ and $\text{Zn}/\text{Sn}=1.0$.

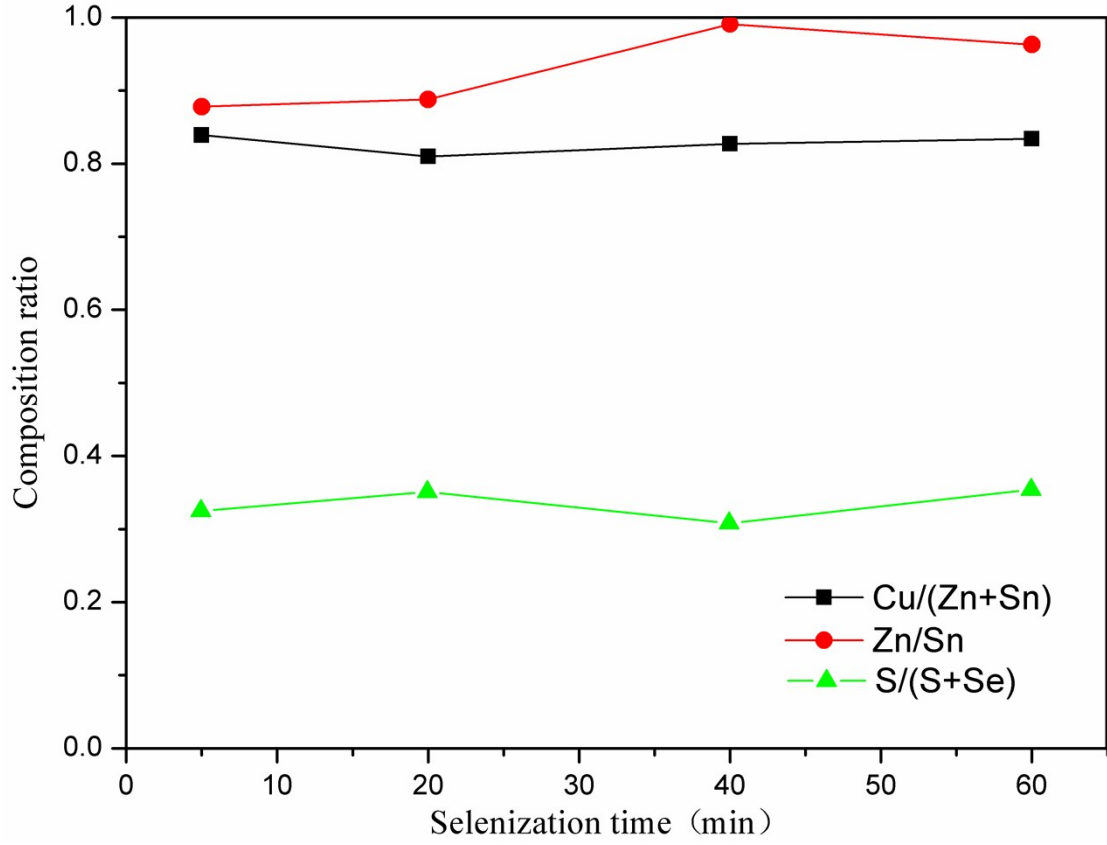


Fig. S4. (a) XRD pattern and (b) Raman spectrum of the CZTSSe absorber layer with the Cu/(Zn+Sn), Zn/Sn and S/(S+Se) ratios of 0.86, 1.0 and 0.10, respectively.

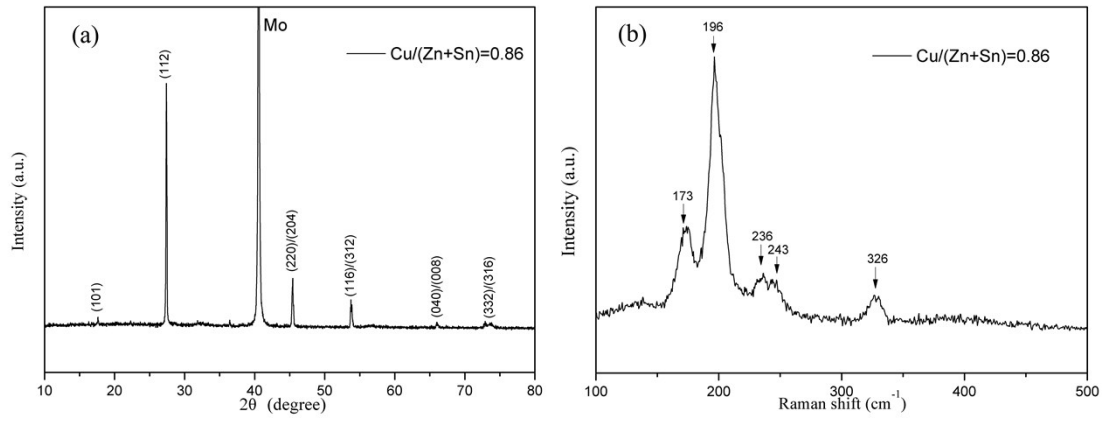


Fig. S5. The EDS spectrum of CZTSSe absorber. The corresponding CZTSSe device has the highest photoelectric conversion efficiency of 8.08 %.

