Supporting Information

Rapid thermal evaporation for cadmium selenide thin-film solar cells

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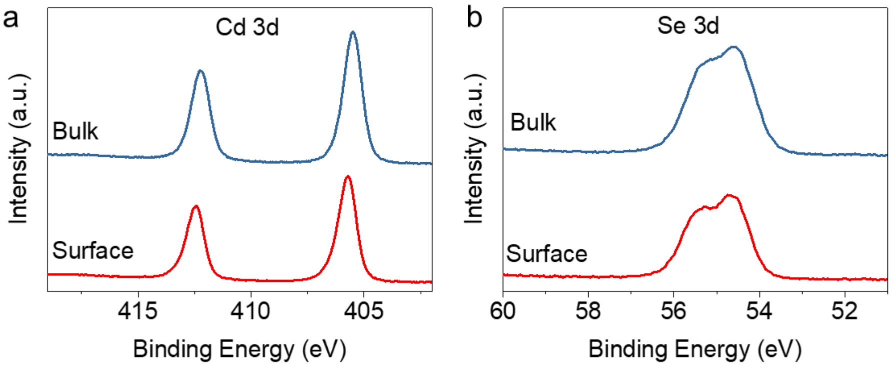

Fig. S1 XPS spectra of Cd 3d and Se 3d in CdSe film

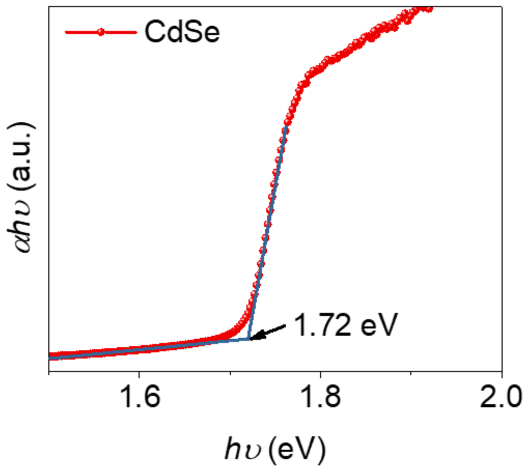

Fig. S2 Absorption of CdSe thin film

It shows a sharp drop at 1.72 eV. The optical bandgap (E_g) is derived from the Tauc plot [1] for direct bandgap:

$$(\alpha h\nu)^2 = A(h\nu - E_g) , \qquad (1)$$

where A is a constant, h is Planck's constant, and ν is the photon frequency. The intersection of the linear segment and the horizontal axis is the width of the forbidden band.

As shown in Fig. S2, we obtain a bandgap of 1.72 eV for CdSe by extrapolating the linear region to the horizontal extension line.

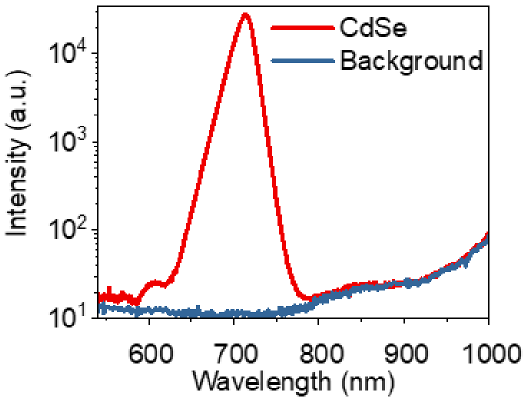

Fig. S3 PL spectra of CdSe and background

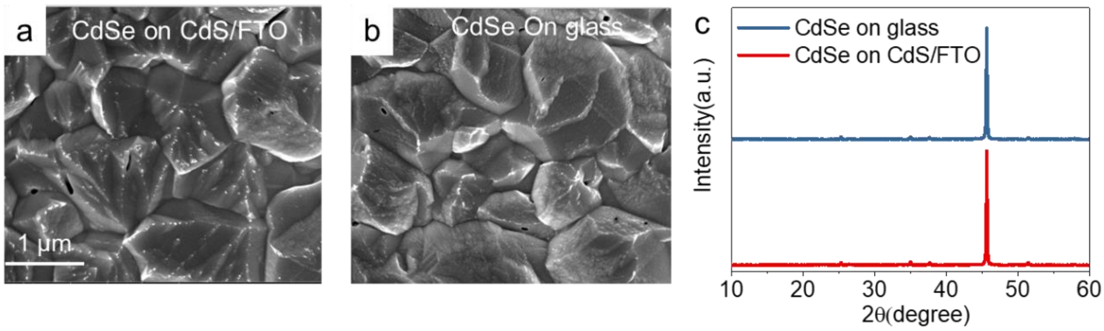

Fig. S4 (a) and (b) SEM surface images. (c) XRD spectra of CdSe thin film on CdS/FTO and glass substrates

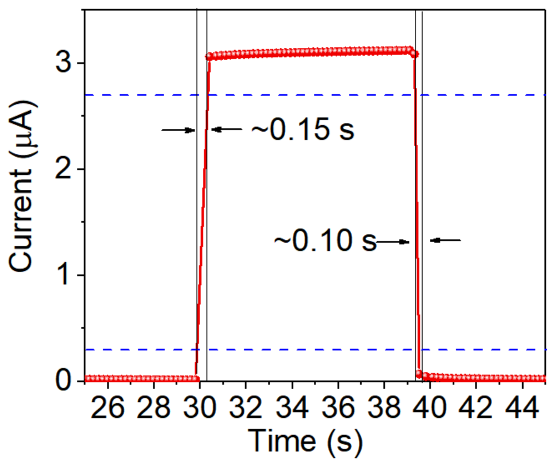

Fig. S5 Current rise and fall durations in CdSe photo-conductance type detector under dark and 530 nm LED illumination

As shown in Fig. S5, the rise/fall time (defined as the time required to switch from 10%/90% of saturated photocurrent to 90%/10%) for the CdSe device showed [2], can be acquired directly from one photoresponse cycle, which was measured to be 0.15/0.1 s.

The conductivity calculation process:

The dark current for CdSe at a bias 1 V is 10 nA.Then, the resistance can be calculated by the following formula：

$$R = U / I = 1\ V / 10\ nA = 10^{8}\ \Omega.$$

The surface area of the sample used to photoresponse is 5×10^{-4} cm^2, and the length is 1 cm, so the conductivity is calculated by the following procedure：

$$\rho = RS / L = 10^{8}\ \Omega \times 5\times10^{-4}\ cm^{2} / 1\ cm = 5\times10^{4}\ \Omega\cdot cm$$

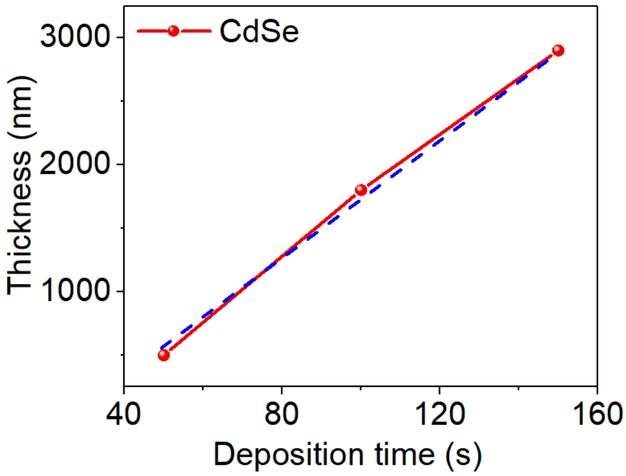

Fig. S6 Approximately linear relationship between deposition time and thickness of CdSe film

According to Fig. S6 corresponding to different evaporation times, when evaporation times were 50, 100, and 150 s, the corresponding film thicknesses were 500, 1800, and 2900 nm respectively. The deposition time is linearly related to the thickness of CdSe film.

References

1. Lu S, Zhao Y, Chen C, Zhou Y, Li D, Li K, Chen W, Wen X, Wang C, Kondrotas R, Lowe N, Tang J. Sb_2Se_3 thin-film photovoltaics using aqueous solution sprayed SnO_2 as the buffer layer. Advanced Electronic Materials, 2018, 4(1): 1700329

2. Zhong J, Yu J, Cao L, Zhong J, Yu J, Cao L, Zeng C. High-performance polarization-sensitive photodetector based on a few-layered $PdSe_2$ nanosheet. Nano Research, 2020 13: 1780–1786