

Supplementary Material

Prebaking of an SnS source with sulfur for achieving higher photovoltaic performance in VTD-SnS thin films for solar cells

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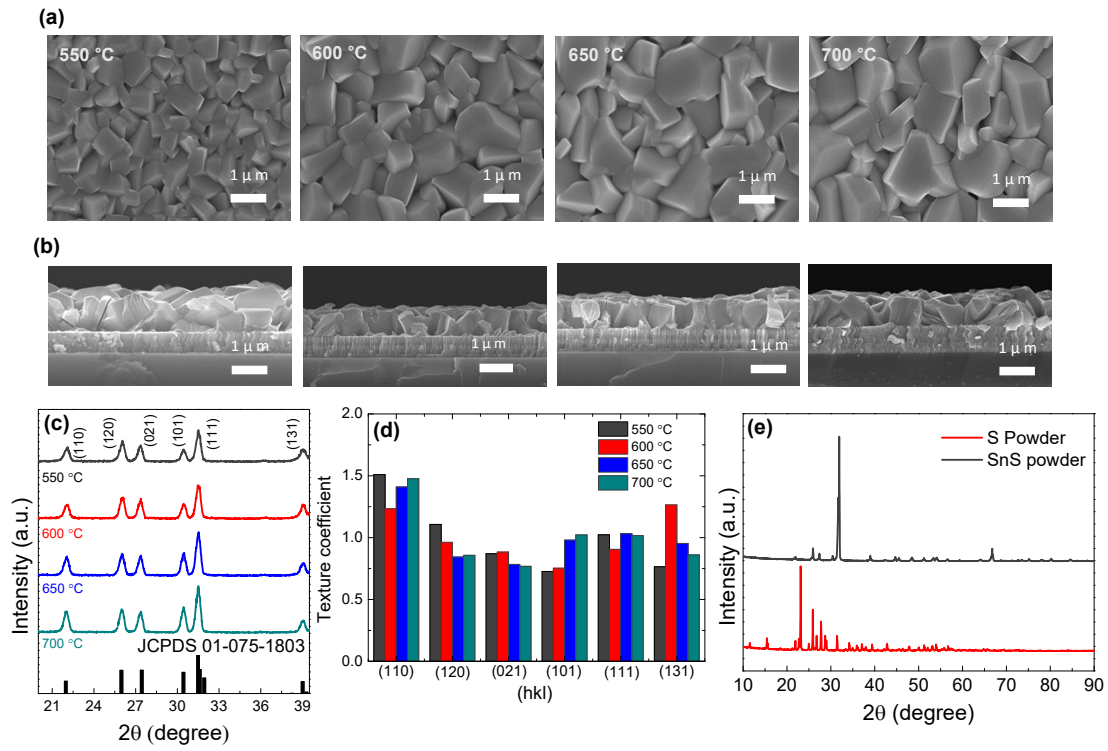


Fig. S1: Scanning electron microscopy (SEM) images of the prebaked tin sulfide (SnS) at different temperatures: (a) top surface morphology and (b) cross-section. (c) X-ray diffraction (XRD) pattern of the prebaked films at different temperatures. (d) Texture coefficient of different planes at different prebaking temperatures, and (e) XRD of SnS, and S powder used for prebaking.

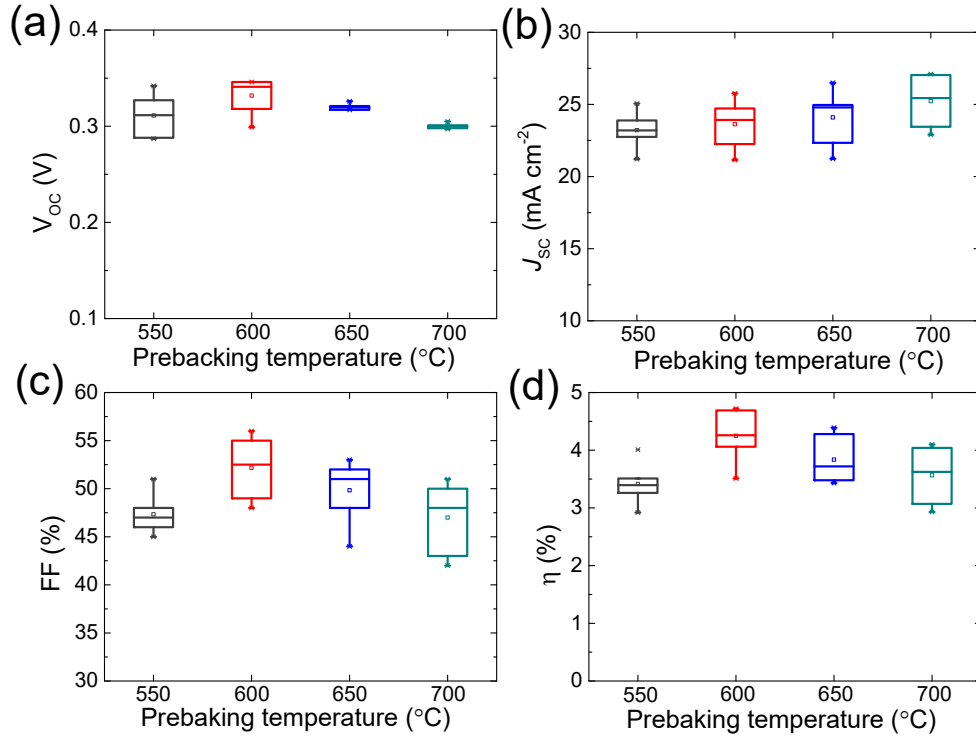


Fig. S2: Average photovoltaic (PV) parameters of the thin-film solar cells (TFSCs) fabricated using the SnS source films prebaked at different temperatures: (a) open circuit voltage (V_{OC}), (b) short circuit density (J_{SC}), (c) fill factor (FF), and (d) η .

Table S1: PV parameters of the best performing prebaked “SnS + S”/CdS TFSCs at different prebaking temperatures.

PV parameters	Prebaking temperature of SnS source with sulfur			
	550 °C	600 °C	650 °C	700 °C
V_{OC} (V)	0.342	0.346	0.319	0.301
J_{SC} (mA cm ⁻²)	23.01	25.77	26.5	26.77
FF (%)	51	53	52	51
η (%)	4.02	4.72	4.39	4.10

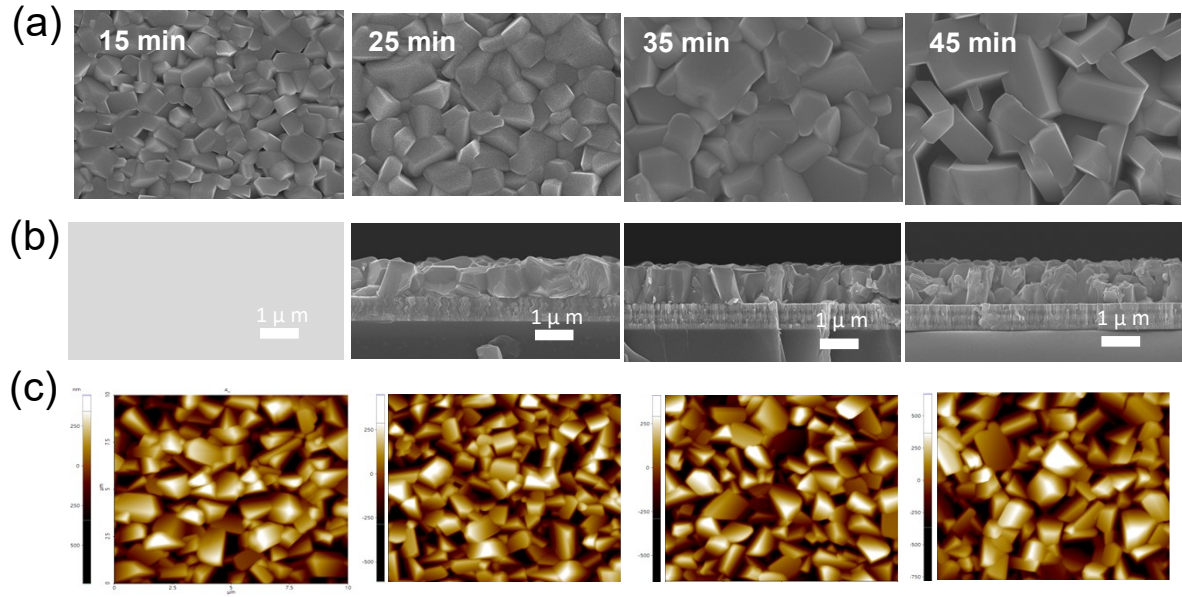


Fig. S3: (a) Top surface SEM image, (b) cross-sectional SEM morphology and (c) surface topography (atomic force microscopy (AFM) image) of the SnS + S source film prebaked at 600 °C for different times.

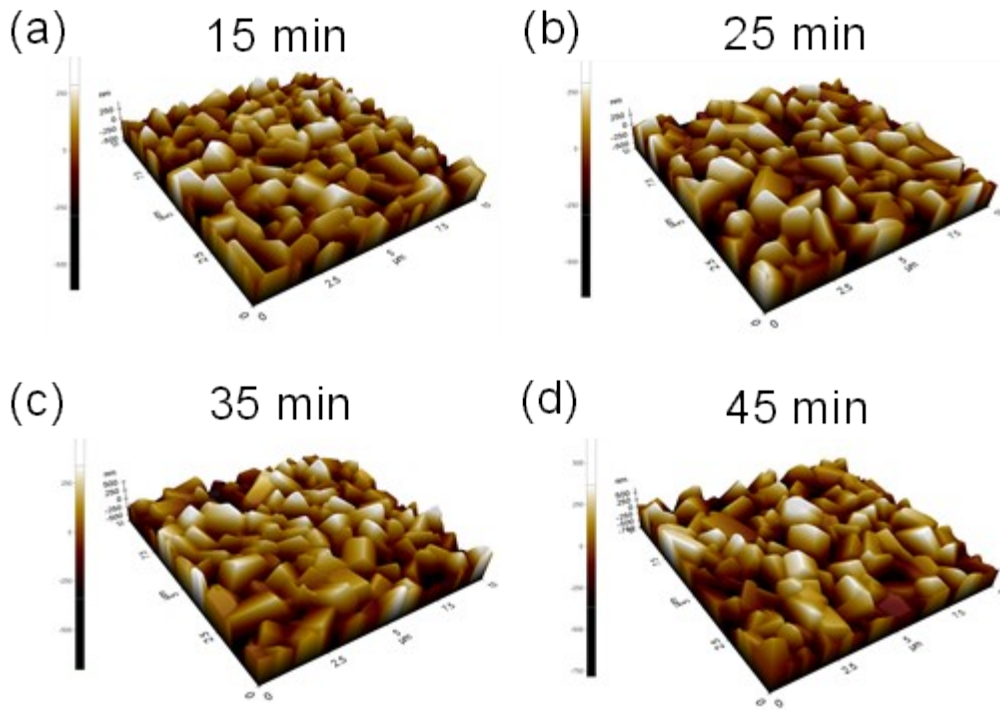


Fig. S4: AFM topography of the source films prebaked at 600 °C for (a) 15 min, (b) 25 min, (c) 35 min, and (d) 45 min.

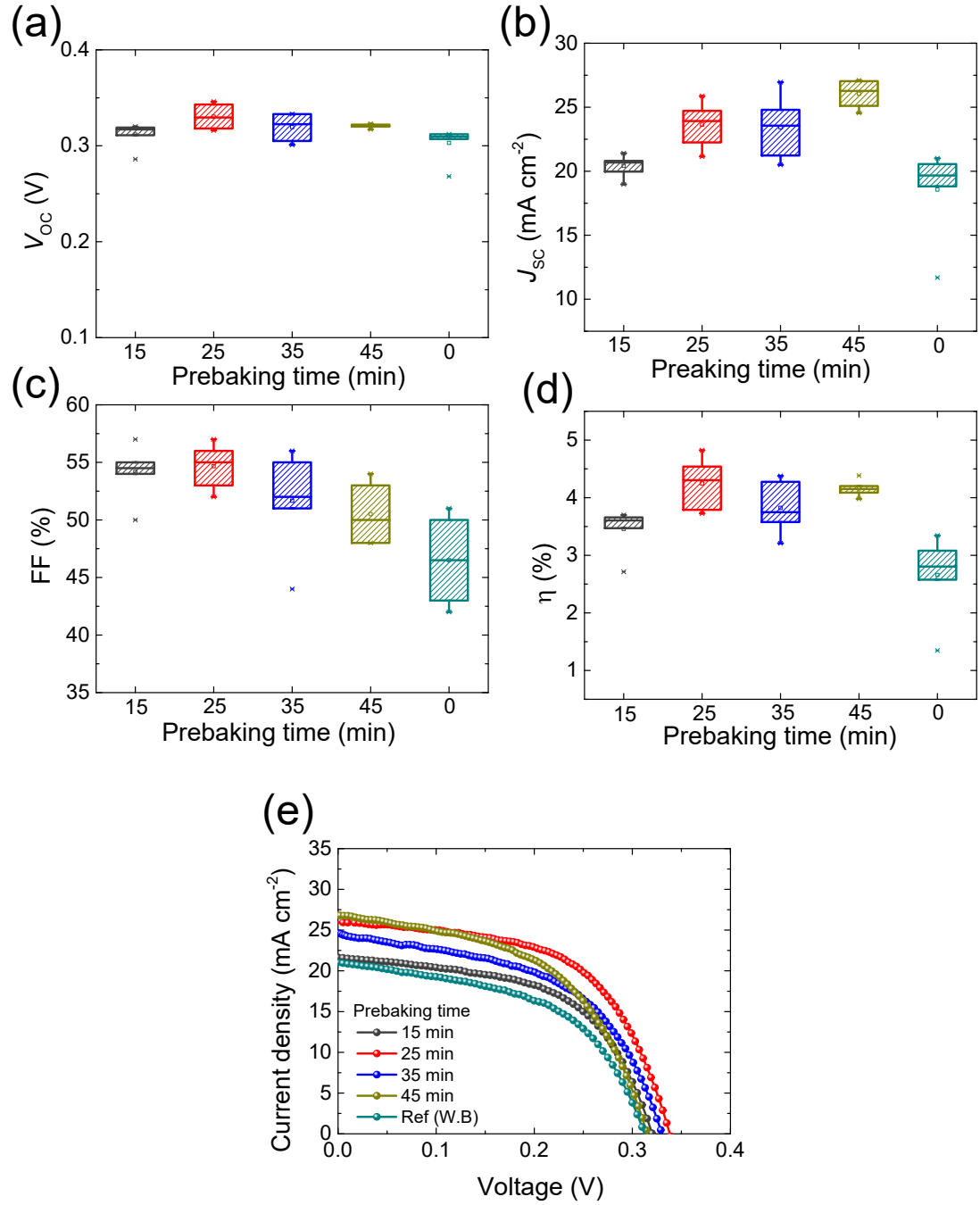


Fig. S5: Box plot of the PV parameters with respect to the prebaking time of the SnS + S source: (a) V_{OC} , (b) J_{SC} , (c) FF , and (d) η . (e) Light $J-V$ curve.

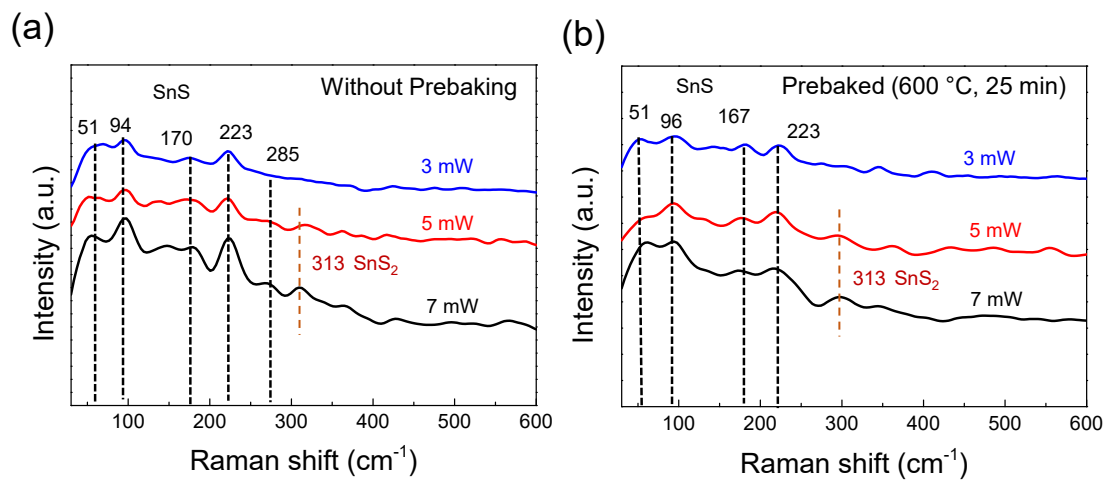


Fig. S6: Raman spectra of (a) without prebaked SnS source films, and (b) prebaked SnS + S source films (600 °C and 25 min) at different power of laser.

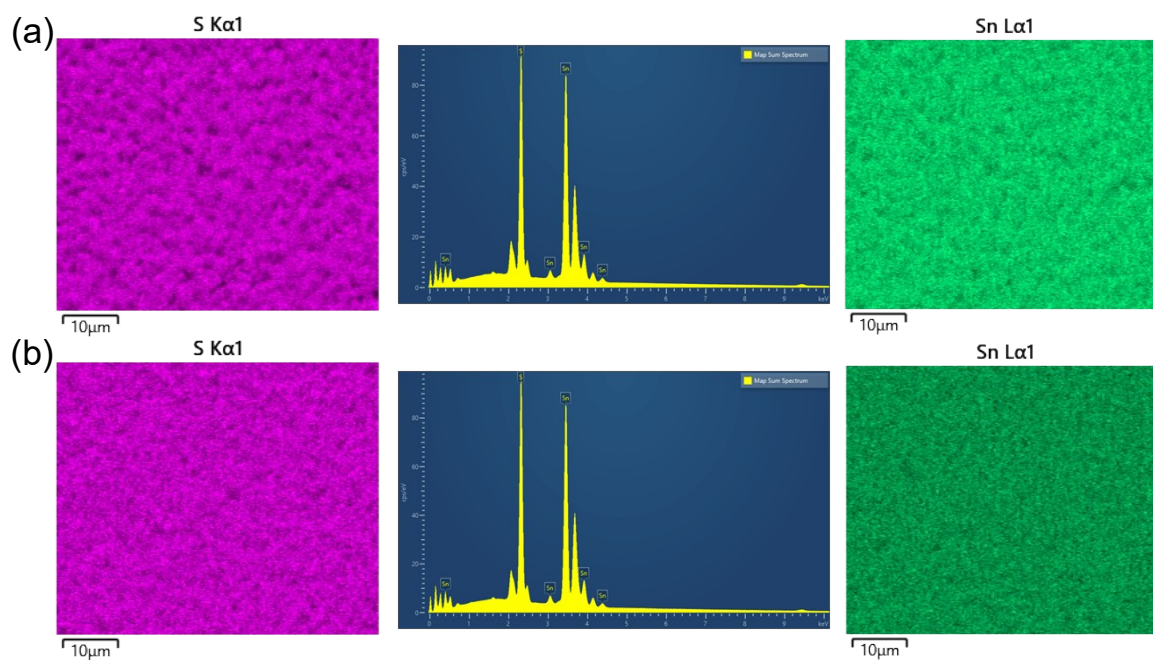


Fig. S7: Elemental mapping and energy dispersive X-ray analysis (EDAX) results showing the elemental ratio of the (a) Ref. film (without prebaking), and (b) SnS + S source film prebaked at 600 °C for 25 min.

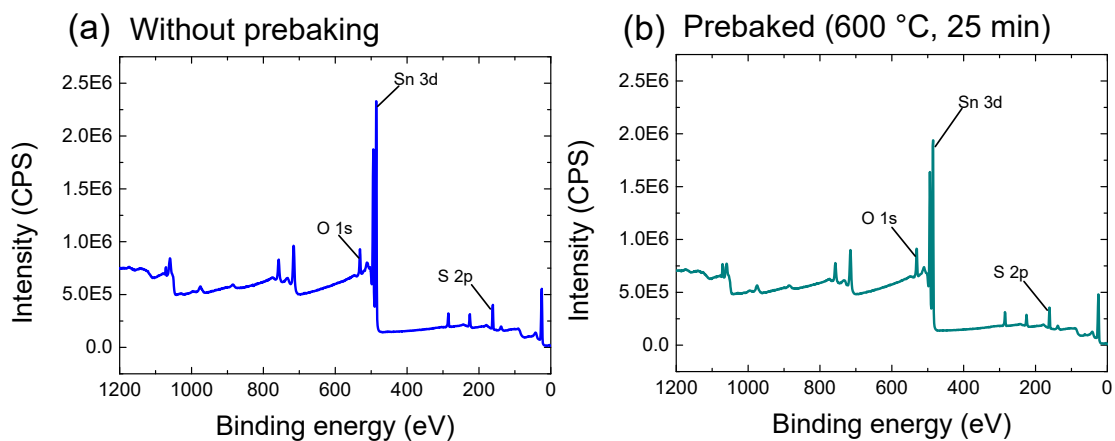


Fig. S8: XPS spectra of the absorber films (a) without prebaked SnS source films, and (b) prebaked SnS source film at 600 °C, and 25 min.

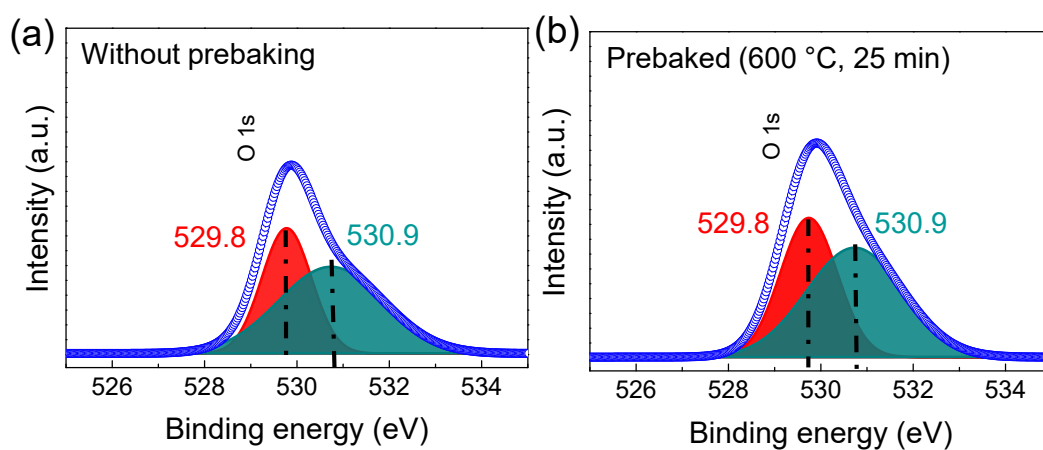


Fig. S9: XPS spectra of the absorber films (a) O 1s peaks of without prebaked SnS source films, and (b) O 1s peaks of prebaked SnS source film at 600 °C, and 25 min.

Table S2: Diode parameters with respect to prebaking time of source calculated from dark the $J-V$

Prebaking time of SnS + S (min)	R_s ($\Omega\text{-cm}^2$)	G_s (mS cm^{-2})	J_0 (mA cm^{-2})	A
15	2.09	7.61	0.36	2.07
25	1.65	1.58	0.08	1.4
35	1.02	4.11	0.18	1.8
45	1.24	7.63	0.36	2.10
Ref (W.B.)	0.52	16.80	0.60	3.6

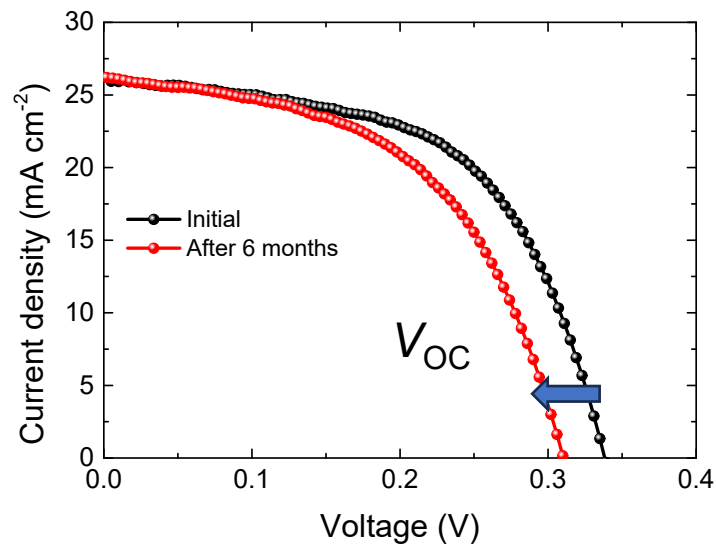


Fig. S10: Stability of the champion device after six months air exposure.