

Supplementary data

Light-induced Improvement of Dopant-Free PTAA on Performance of Inverted Perovskite Solar Cells

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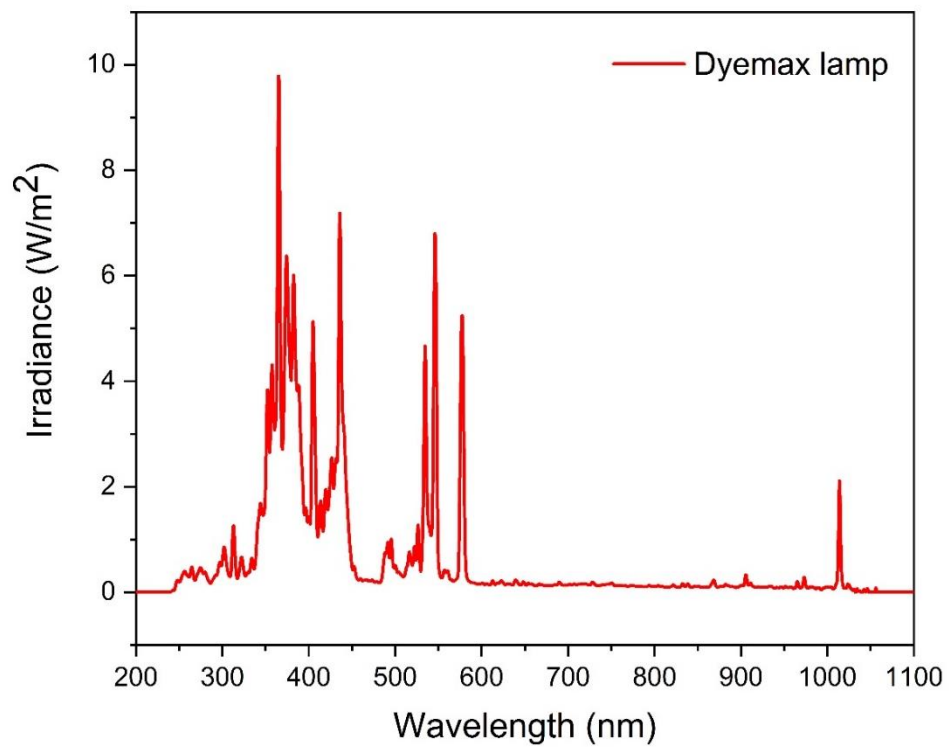
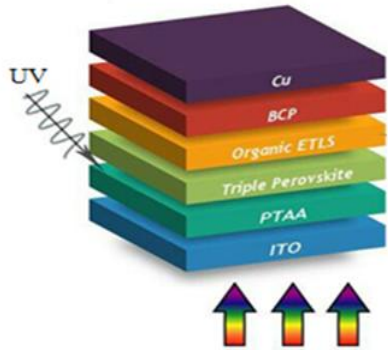


Fig. S1. The spectrum of the UV-A lamp (OSRAM) installed in the UV treatment system.

(a)



(b)

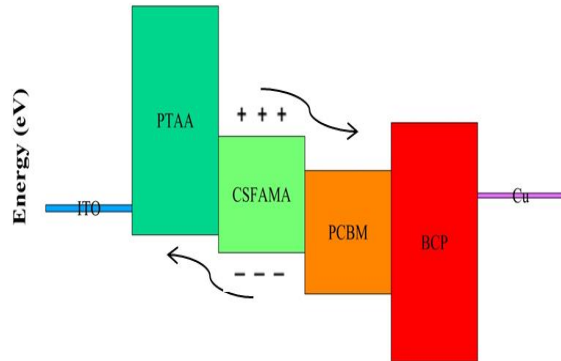


Fig. S2. Illustration of fabricated inverted perovskite solar cells: ITO/PTAA/FAMACs/PCBM/BCP/Cu. (a) Schematic structure of device; (b) Diagram of the energy band alignment.

Table S1. Data extracted from different measurements of CA for bare and treated PTAA films.

Sample	Test No.	CA (°)	Average CA (°)
Pristine film	1	97.8	97.4
	2	96.9	
	3	97.6	
Treated film	1	83.9	85.7
	2	86.7	
	3	86.4	

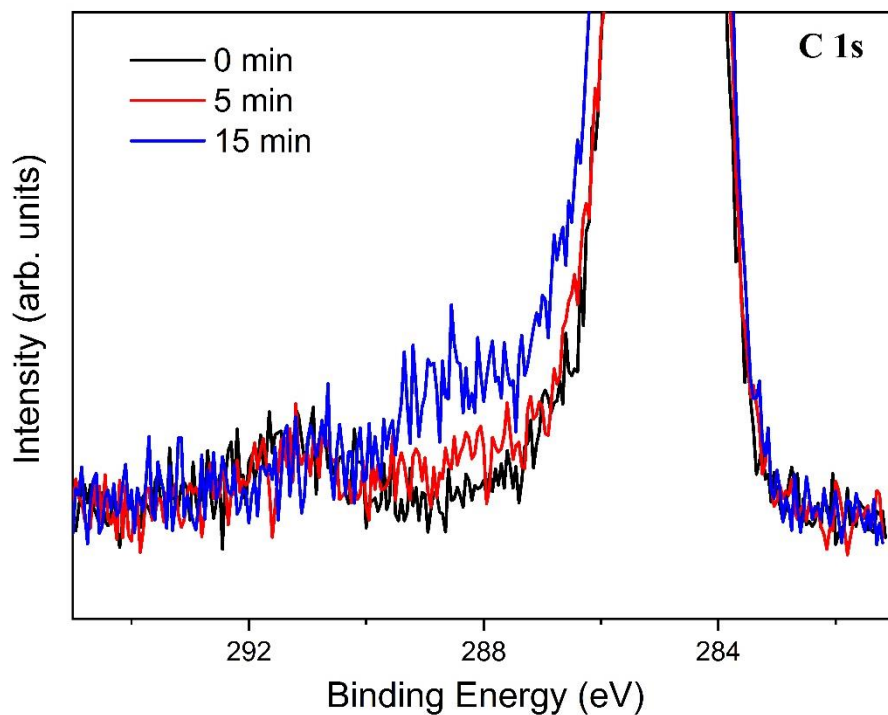


Fig. S3. Magnified portion of C 1s XPS region showing a comparison among pristine PTAA (black) and 5min- (red) and 15min-UV-cured (blue) PTAA films. Spectra were acquired at 21° take-off angle.

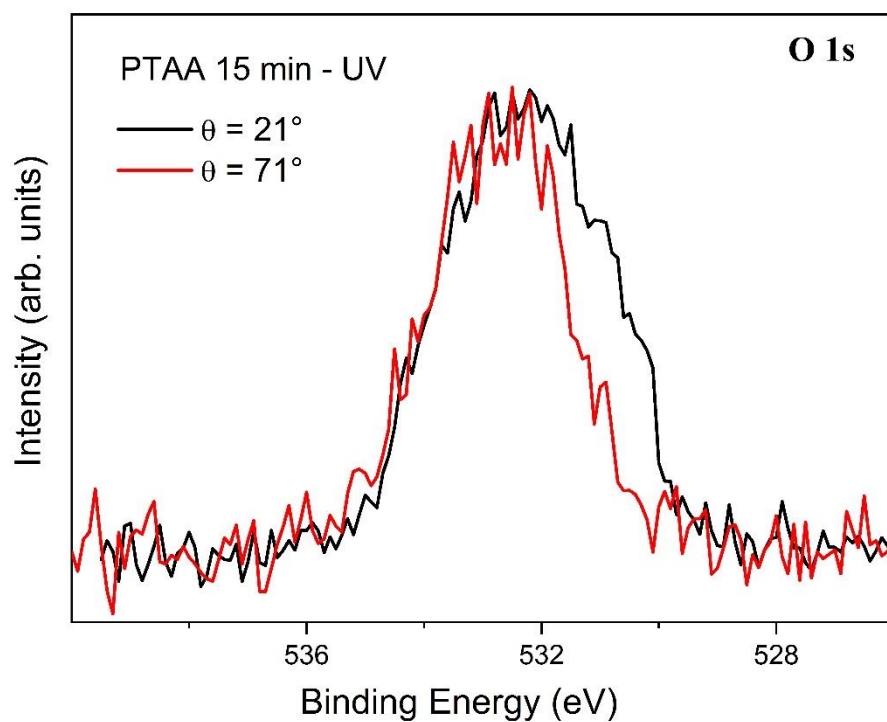


Fig. S4. O 1s XPS spectra of 15min- UV-cured PTAA film. Comparison between 21° (black) and 71° (red) take-off angles.

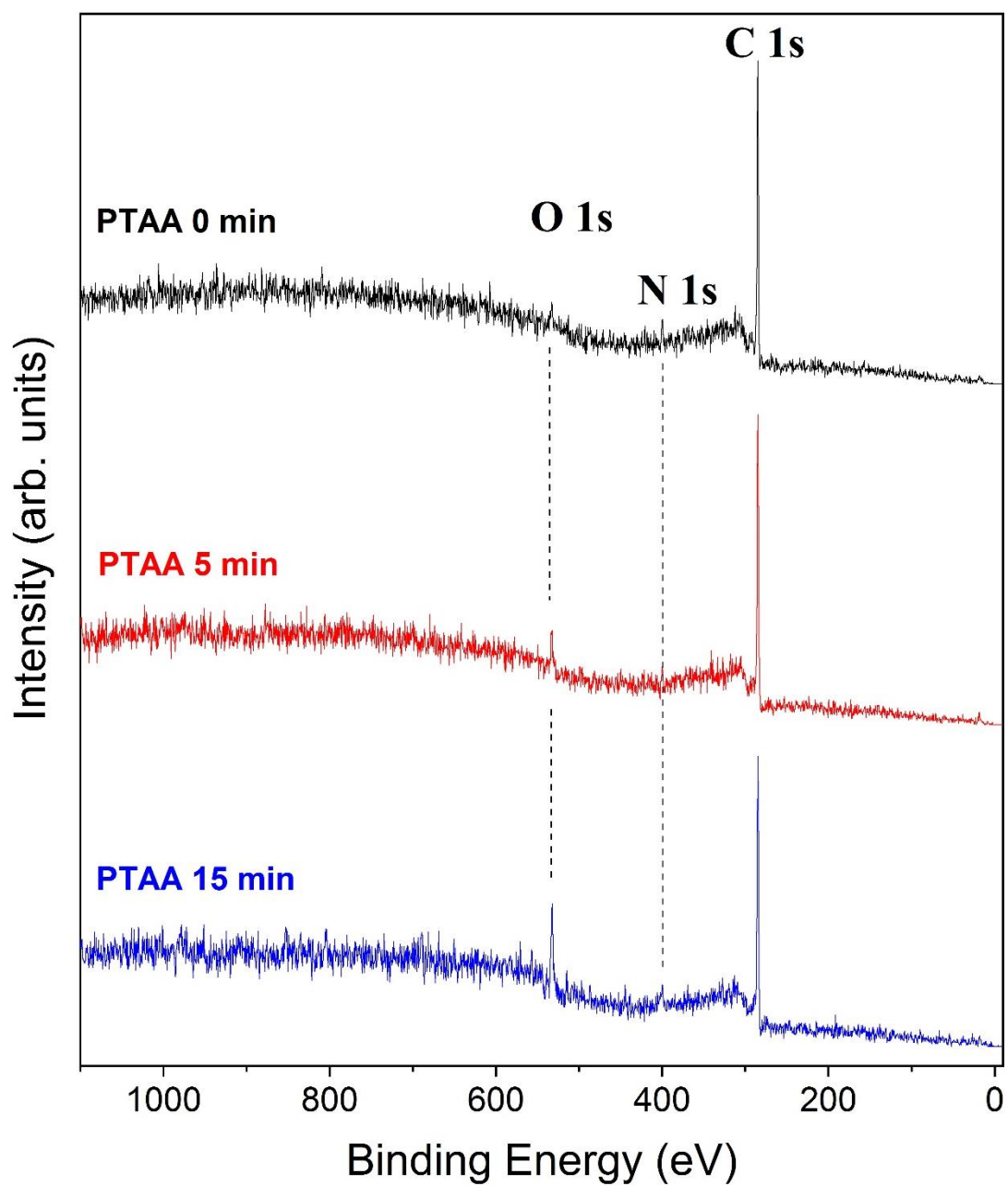


Fig. S5. Survey XPS spectra of pristine (black), 5min-UV-cured (red), and 15min-UV-cured (blue) PTAA films. Spectra were acquired at 71° take-off angle.

Table S2. O/C and N/C atomic ratios determined by XPS spectra of PTAA films.				
Sample	UV exposure time (min)	take-off angle (°)	O/C	N/C
PTAA 1	0	21	0.057 ^a	0.053
		71	0.062	0.076
PTAA 2	5	21	0.11 ^a	0.056
		71	0.13	0.057
PTAA 3	15	21	0.19 ^a	0.057
		71	0.24	0.075
^a In O/C values from spectra collected at 21° take-off angle the contribution from ITO substrate was removed				

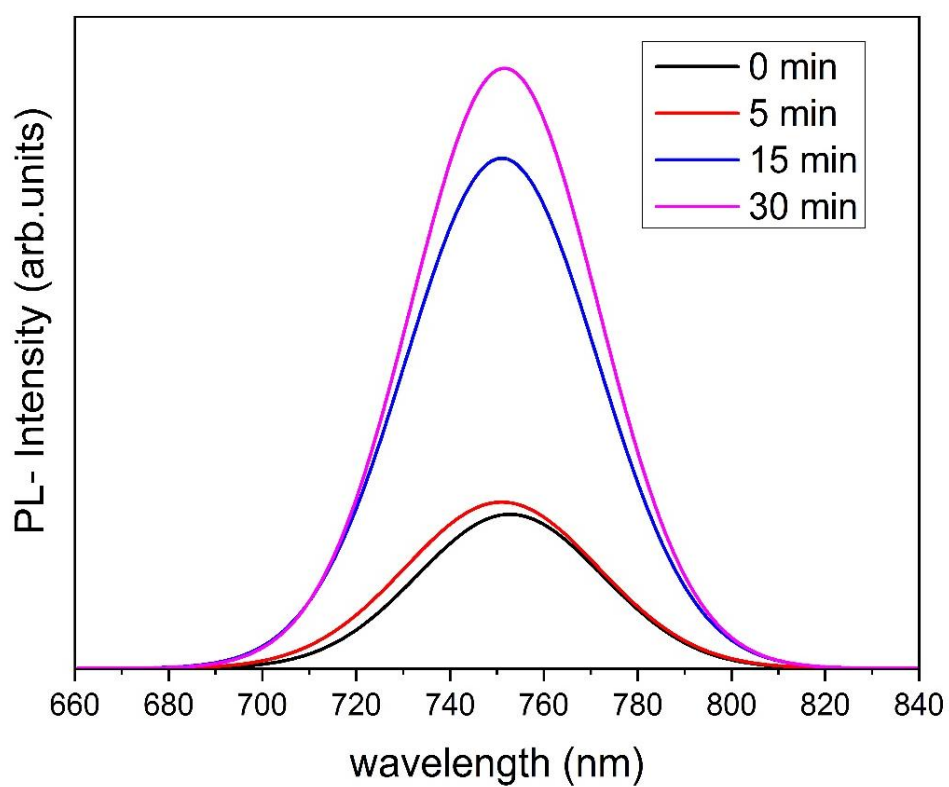


Fig. S6. Steady-state PL response of perovskite films on illuminated PTAA in different time duration.

The solar simulator used in the Center for Hybrid and Organic Solar Energy (CHOSE) (ABET Sun 2000, class A) at AM1.5 G and 1 Sun ($100 \text{ mW}\cdot\text{cm}^{-2}$) illumination conditions, calibrated with an EKO MS-602 pyranometer accompanied by a digital source meter (Keithley 2420). The system used in the Helmholtz-Zentrum Berlin für Materialien und Energie GmbH Institute for Silicon Photovoltaics is a Wavelabs Sinus-70 LED class AAA calibrated with a reference Silicon solar cell certified by Fraunhofer ISE. A LabView program controls a Keithley 2400 SMU to adjust the working point of the cell and perform the current-voltage scan with a voltage step of 20 mV and adjustable scan rate. **Fig. S7.** Shows the J-V comparison for an inverted PSC device measured in CHOSE and HZB Labs at AM1.5 1 Sun illumination condition.

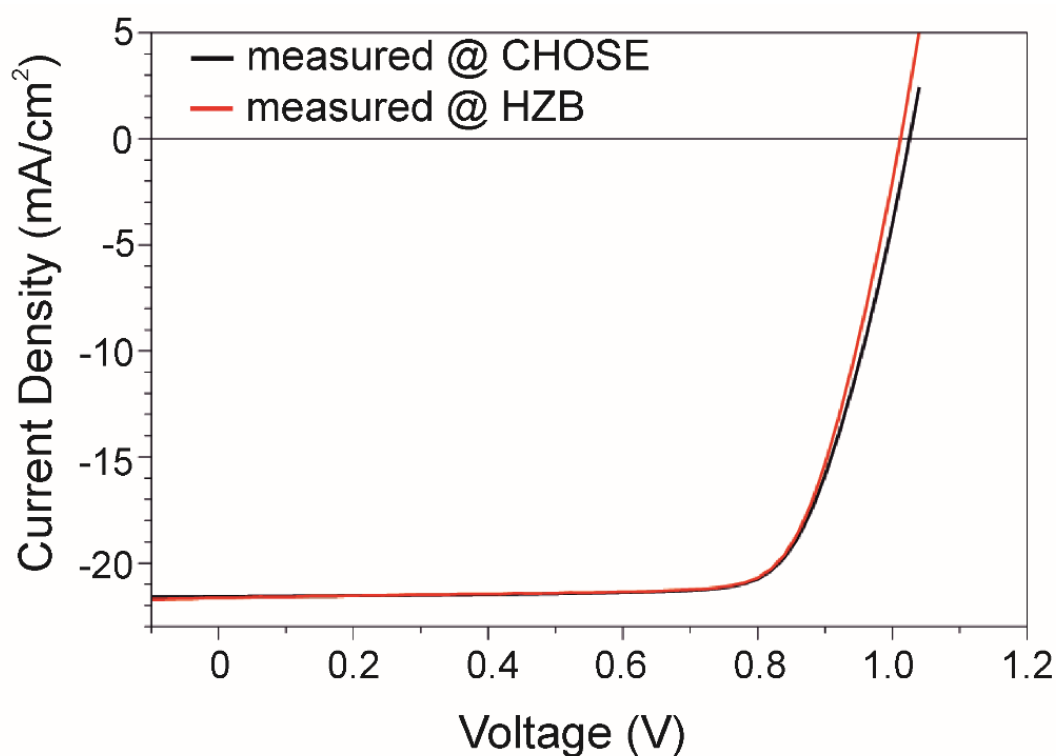


Fig. S7. J-V comparison for an inverted PSC device measured in CHOSE and HZB Labs at AM1.5 1 Sun illumination condition.

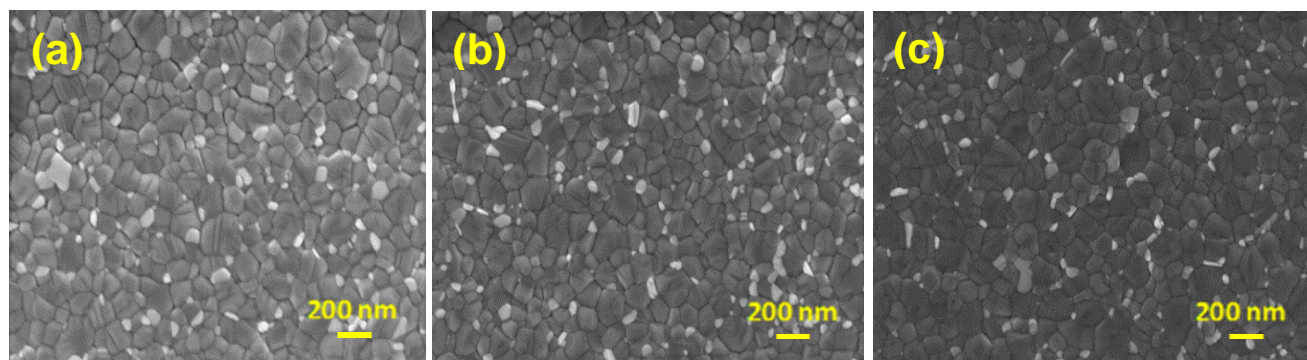


Fig. S8. Top-view SEM images of perovskite deposited on PTAA films with molecular weight. (a) 10 KDa-Low; (b) 37 KDa-Medium; (c) 100 KDa-High. The scale bar is 200 nm.

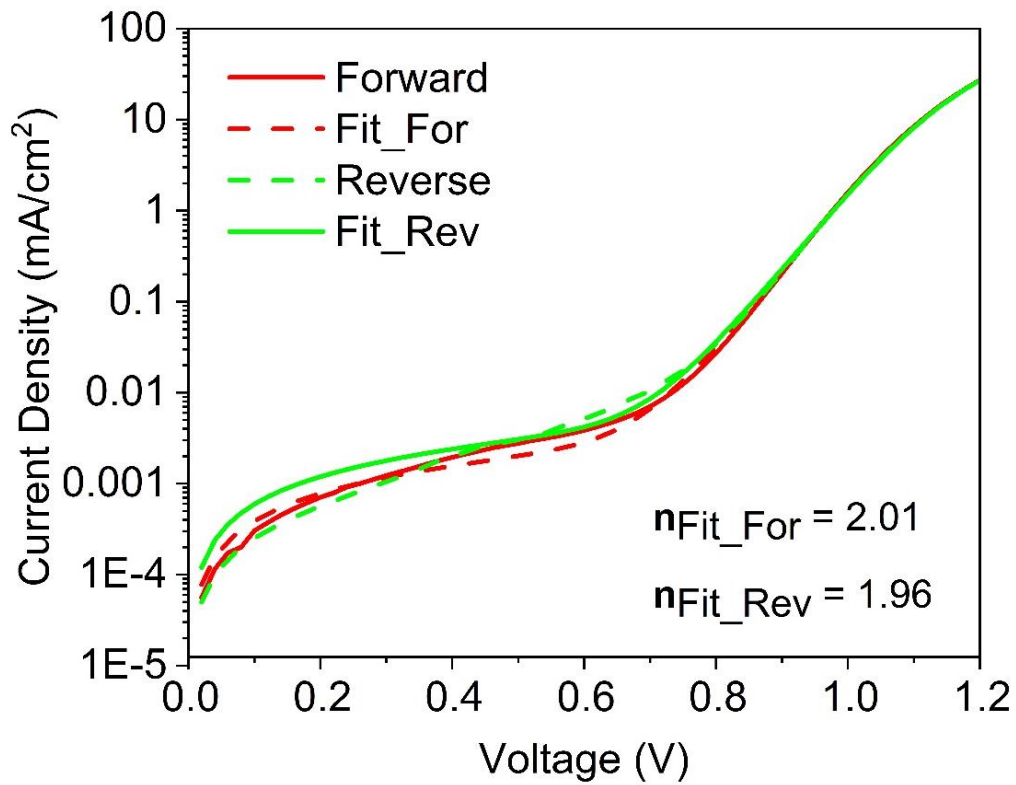


Fig. S9. Dark JV measurements under reverse (green curve) and forward (red curve) scan directions. Fitting curves (dash lines) using single exponential diode modeling are reported for both scans.

Table S3. Parameters of the fitting using ideal diode modeling.				
	R_s (Ω)	R_{sh} (Ω)	J_0 (A/cm^2)	n
Reverse Scan	12.3	0.99×10^6	4.75×10^{-12}	2.01
Forward Scan	13.5	1.514×10^6	2.84×10^{-12}	1.96

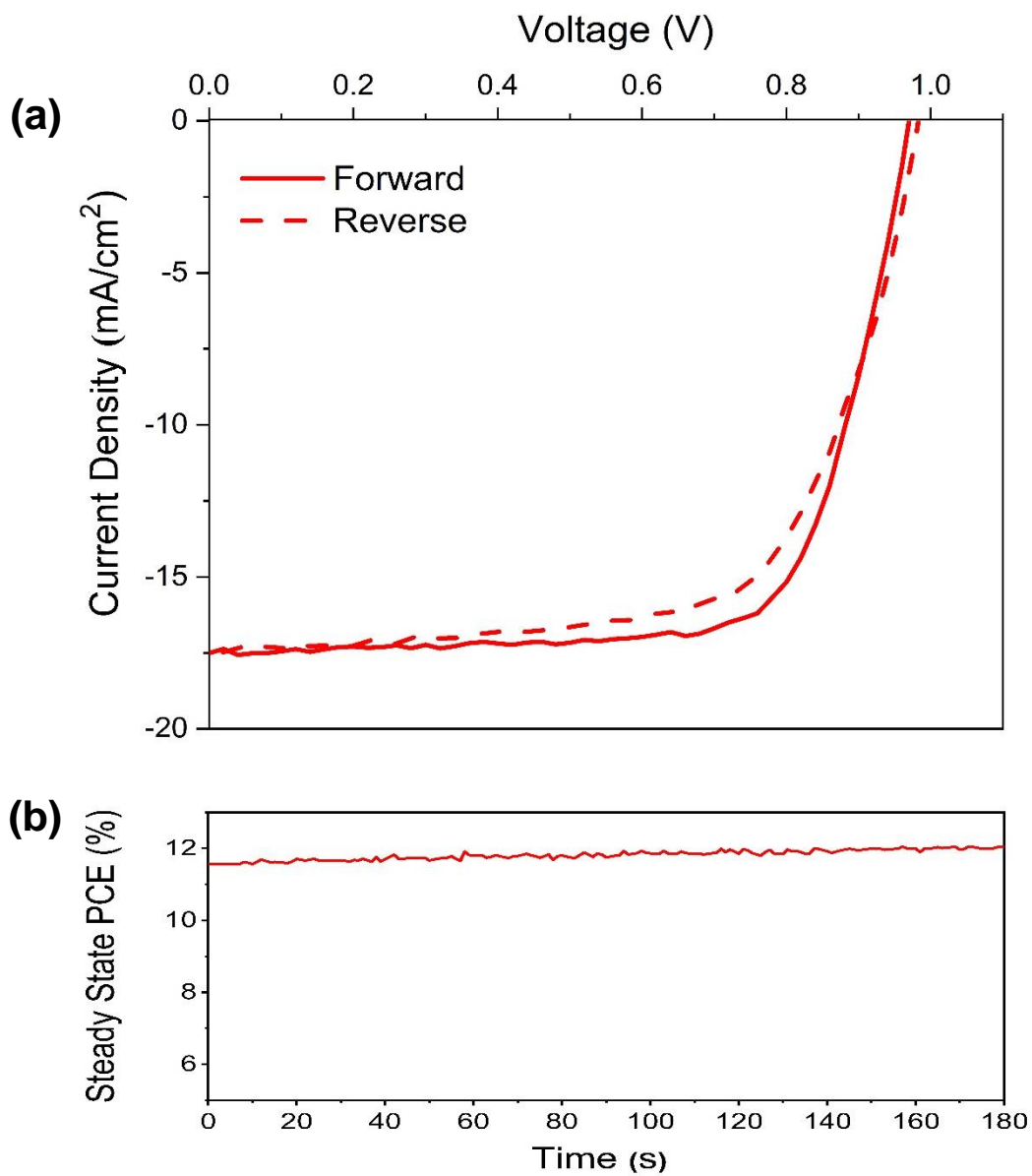


Fig. S10. (a) J-V and; (b) MPPT curve for 1cm²-sized PSC for forward and reverse scan directions measured at AM1.5 1 sun illumination condition.

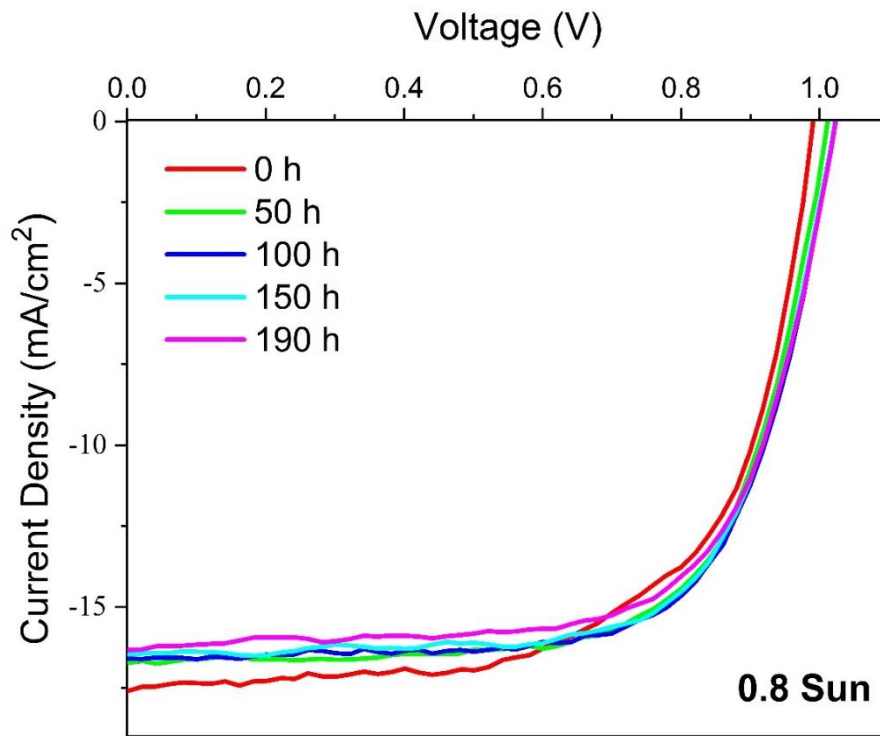


Fig. S11. J-V curves measured during the light soaking test (0h, 50h, 100h, 150h, 190h) for reverse scan direction under 0.8 Sun illumination condition using LED based light soaker.