Electronic Supplementary Material (ESI) for ChemComm.

Experimental Section

1. Preparation of CQDs and C-ZQDs

CQDs were synthesized by a hydrothermal method. In details, 2 g of glucose was heated at 195 °C for 10 min and subsequently dissolved in 50 mL of *N*, *N*-dimthylformamide (DMF) under vigorous agitation.

The C-ZQDs were prepared according to the following procedures. 0.2 mmol CuI, 0.2 mmol $In(CH_3COO)_3$, 5 mL 1-dodecanethiol, 10 mL 1-octadecene and 5 mL oleyl amine were mixed into a 50 mL three-necked round bottom flask, and subsequently heated at 80 °C in argon atmosphere under vigorous agigation for 30 min. The temperature of the reaction mixture was then elevated to 150 ˚C for another 30 min. Nextly, 1 mmol S and 3 mL 1-octadecene were mixed in a 25 mL single-necked round bottom flask at 150 °C under stirring until completely dissolved. Then the prepared solution was rapidly injected into the three-necked flask by syringe. After that, the mixed solution was heated at 180 °C for 5 min and cooled to 100 °C in air. Then 0.5 mL of tributyl phosphine was swiftly injected into the above mixture, and the reaction temperature was increased to 240 °C. Finally, 1 mmol oleylamine zinc prepared by mixing 1 mmol anhydrous zinc acetate with 3 mL oleylamine at 100 °C was added dropwise into above solution. After centrifugation, the $CuInS_2$/ZnS quantum dots (C-ZQDs) were thus synthesized.

2. Assembly of bifacial solar cells

Fluorine-doped tin oxide (FTO) glass was etched by Zn powers and 2 M HCl aqueous solution, and sequentially ultrasonic rinsed with deionized water, ethanol, acetone and isopropanol. The *c*-TiO_2 film was prepared on FTO substrate by spin-coating an ethanol

solution of titanium isopropoxide (0.5 M) and diethanol amine (0.5 M) at 7000 rpm for 30 s, then annealing at 500 °C in a muffle furnace for 120 min. The *m*-TiO_2 film was deposited by spin-coating TiO_2 colloid at 2000 rpm for 30 s, followed by annealing at 450 °C for 30 min. Subsequently, FTO glass supported TiO_2 anode was immersed in 0.04 M $TiCl_4$ aqueous solution at 75 °C for 30 min, rinsed with deionized water and ethanol, annealed at 450°C for another 30 min. The CQDs were dissolved in DMF and then spin-coated at *m*-TiO_2 underlayer at 2000 rpm for 30 s and heat at 80 °C for 10 min.

The $CsPbBr_3$ perovskite film was fabricated by a sequential spin-coating method. In details, 1.0 M $PbBr_2$ in DMF was spin-coated onto *m*-TiO_2 at 2000 rpm for 30 s and dried at 90 °C for 30 min. After that, 0.07 M CsBr methanol soltution was subsequently spin-coated at 2000 rpm for 30 s, and heated at 250 °C for about 5 min. By repeatedly coating CsBr for four times, a high-purity $CsPbBr_3$ layer was formed. C-ZQDs in methylbenzene were then spin-coated onto $CsPbBr_3$ film and heated at 80 °C for 10 min. The PSC device was fabricated by coating carbon layer on the $CsPbBr_3$ film and drying on a hot plate at 90 °C for 10 min. (The conductive carbon ink purchased from Shanghai Materwin New Materials Co., Ltd.)

To assemble a bifacial PSC, the two single-devices with freshly coated carbon electrodes were overlapped swiftly and fixed by clamps, then heated in a vacuum drying oven at 50 °C for 60 min. When testing, the cathode of the test equipment connect carbon electrode and keep still, and the anode connect the FTO of the front and rear when illuminate the front and rear cell, respectively. All the fabrication processes were carried out in atmosphere environment.

3. Photovoltaic measurements and characterizations

The photocurrent *J*-*V* curves of bifacial PSCs were studied using CHI660E electrochemical workstation. The solar simulator equipped with a 100 W xenon arc lamp and the incident light intensity was controlled at 100 mW cm^{-2}. The xenon arc lamp was calibrated with a standard silicon solar cell. The active area of the device was defined by a black mask to prevent stray light and the effective area of the cell was defined as 2.25 mm^2.

The surface morphology of the prepared film was characterized by means of field-emission scanning electron microscopy (FESEM, Japan Hitachi field emission SU8220). The crystal structure of the obtained $CsPbBr_3$ film was assessed by an X-ray diffraction (PHILIPSPW1800 diffractometer with Cu-K_α radiation). The detailed microstructures of the samples were analyzed by using JEOL 200kV field emission transmission electron microscope (JEM-2100F). The incident-photo-to-current conversion efficiency (IPCE) was characterized by a power source (Newport 300 W xenon lamp, 66920) with amonochromator (Newport Cornerstone 260) in the 300–850 nm wavelength range at room temperature. The electrochemical impedance spectroscopy (EIS) was carried out with an electrochemical station (Corrtest, CS350) under dark condition. The devices were held at their respective open circuit potentials obtained from the *J*–*V* measurements. The EIS spectra were fitted by Zview software. UPS measurements were carried out using a Kratos AXIS ULTRA system with a helium discharge lamp, and with a concentric hemispherical analyzer for photoexcited electron detection. The absorption spectra of the CQDs and C-ZQDs were measured by an ultraviolet–visible spectrophotometer (UV-3600, Shimadzu) in the 400–850 nm wavelength range at room temperature. The Time-resolved PL measurement was carried out using time-

resolved fluorescence (Horiba Jobin Yvon, FL).

Supporting tables

Table S1 Photovoltaic parameters of bifacial PSCs under simulated sunlight irradiation (AM1.5, 100 mW cm^{-2}).

Modification	Irradiation	V_{oc} / V	J_{sc} / mA cm^{-2}	*FF* / %	*PCE* / %	*BF* / %
w/o CQDs, C-ZQDs	Front	1.236	6.59	75	6.17	98.7
	Rear	1.24	6.57	75	6.09	
w/ CQDs	Front	1.334	6.74	76	6.84	99.0
	Rear	1.3	6.72	77	6.77	
w/ CQDs, C-ZQDs	Front	1.388	7.1	77	7.55	98.5
	Rear	1.372	6.8	80	7.44	

Table S2 Photovoltaic parameters under different scan conditions of bifacial PSCs under simulated sunlight irradiation (AM1.5, 100 mW cm^{-2}).

Irradiation	Scan direction	V_{oc} / V	J_{sc} / mA cm^{-2}	*FF* / %	*PCE* / %
Front	Backward	1.388	7.10	77	7.55
	Forward	1.376	6.95	73	6.94
Rear	Backward	1.372	6.8	80	7.44
	Forward	1.368	6.79	72	6.65

Table S3 Photovoltaic parameters under different scan conditions of bifacial PSCs under simulated sunlight irradiation (AM1.5, 100 mW cm^{-2}).

Modification	V_{oc} / V	J_{sc} / mA cm^{-2}	*FF* / %	*PCE* / %
w/o CQDs,	1.206	12.2	71.4	10.51
C-ZQDs	1.302	12.9	74.5	12.51
w/ CQDs, C-ZQDs	1.376	13.3	71.6	13.10

Supporting figures

Fig. S1 The photographs of the actual bifacial devices.

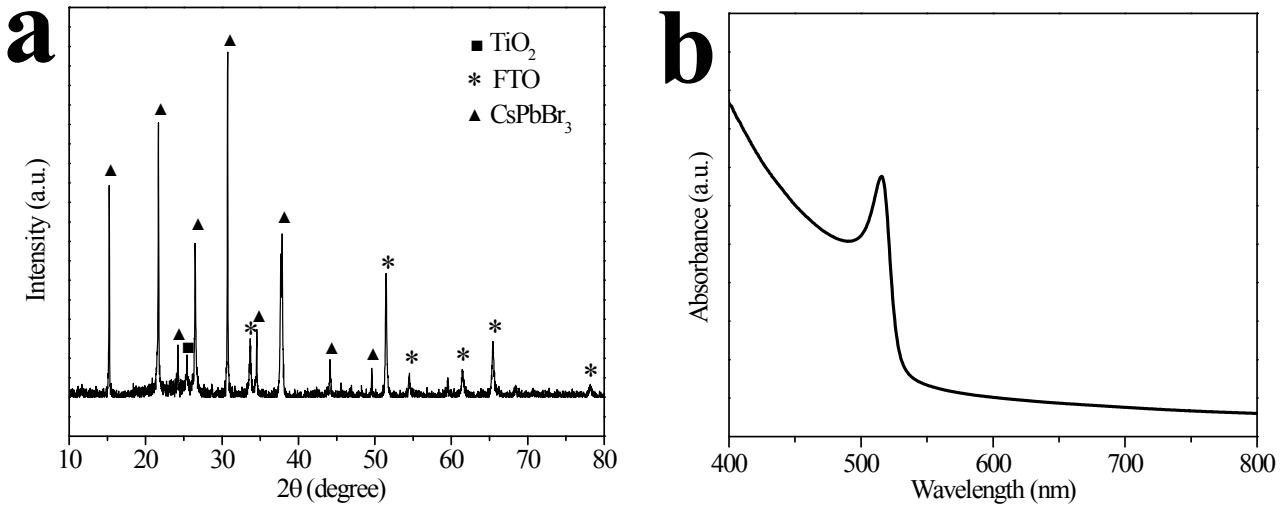

Fig. S2 (a) XRD pattern of FTO/TiO_2/$CsPbBr_3$ configuration. (b) Typical UV-vis absorption spectrum of all-inorganic $CsPbBr_3$ layer.

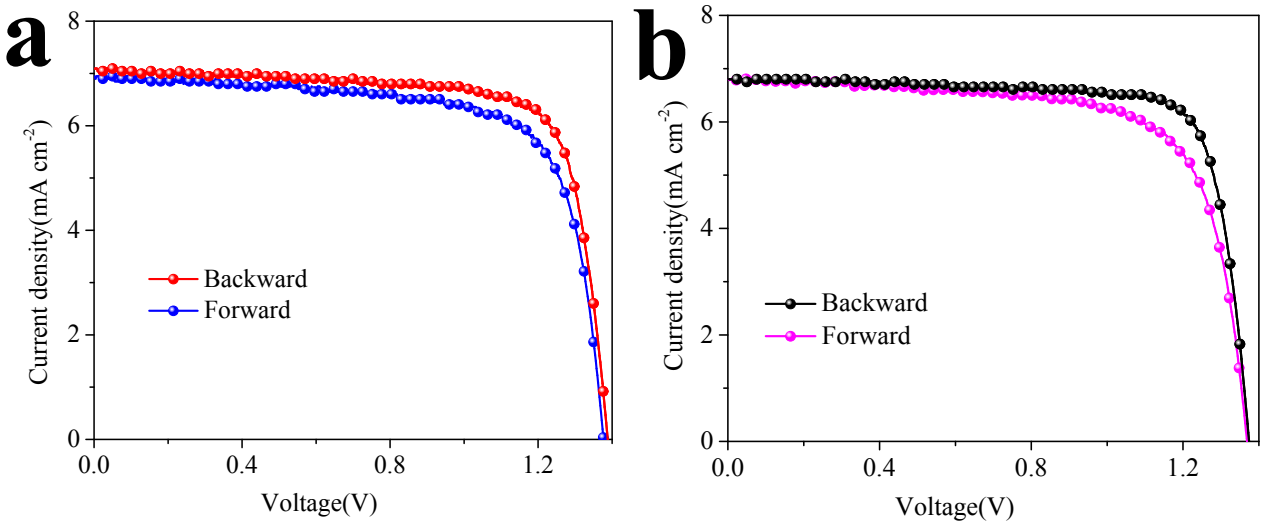

Fig. S3 *J*−*V* curves of the CQDs/C-ZQDs modified bifacial PSCs under different scan conditions: (a) upon irradiation from front side and (b) upon irradiation from rear side.

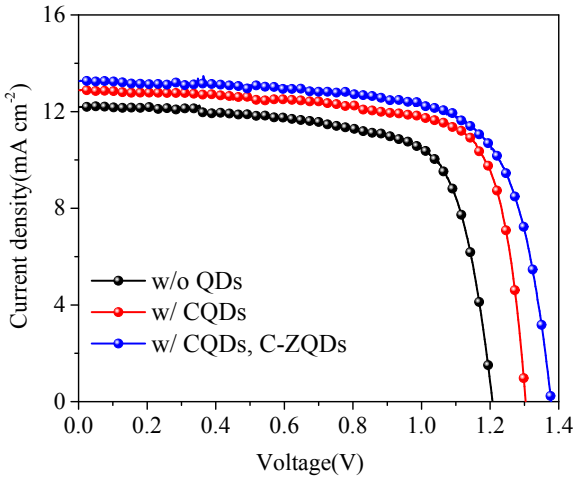

Fig. S4 The *J*–*V* curves of various solar cells with both side light illumination at a time.

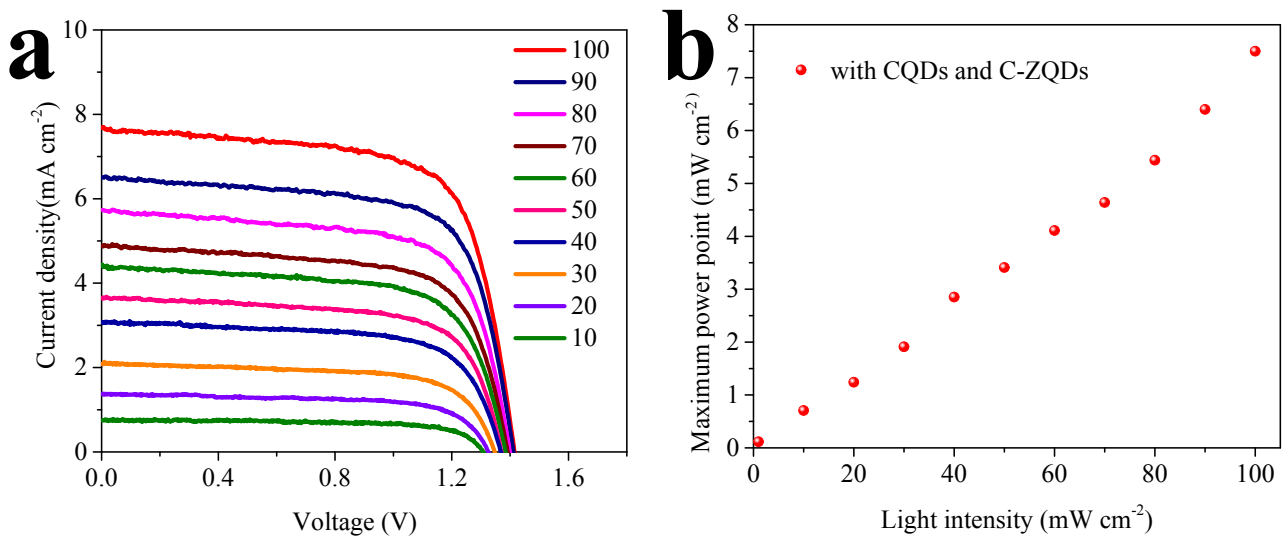

Fig. S5 (a) The *J-V* curves of CQDs/C-ZQDs modified PSC under front illumination with simulated sunlight intensity from 10 to 100 mW cm^{-2}. (b) The plots of front P_{max} as a function of P_{in}.

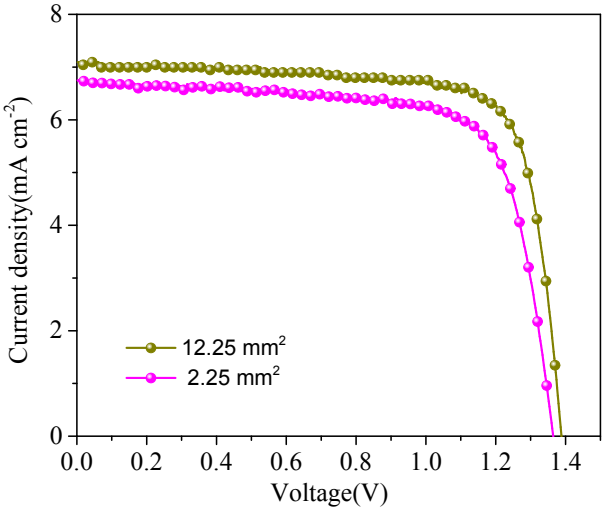

Fig. S6 The *J*–*V* curves of solar cells with different area (upon irradiation from front side).

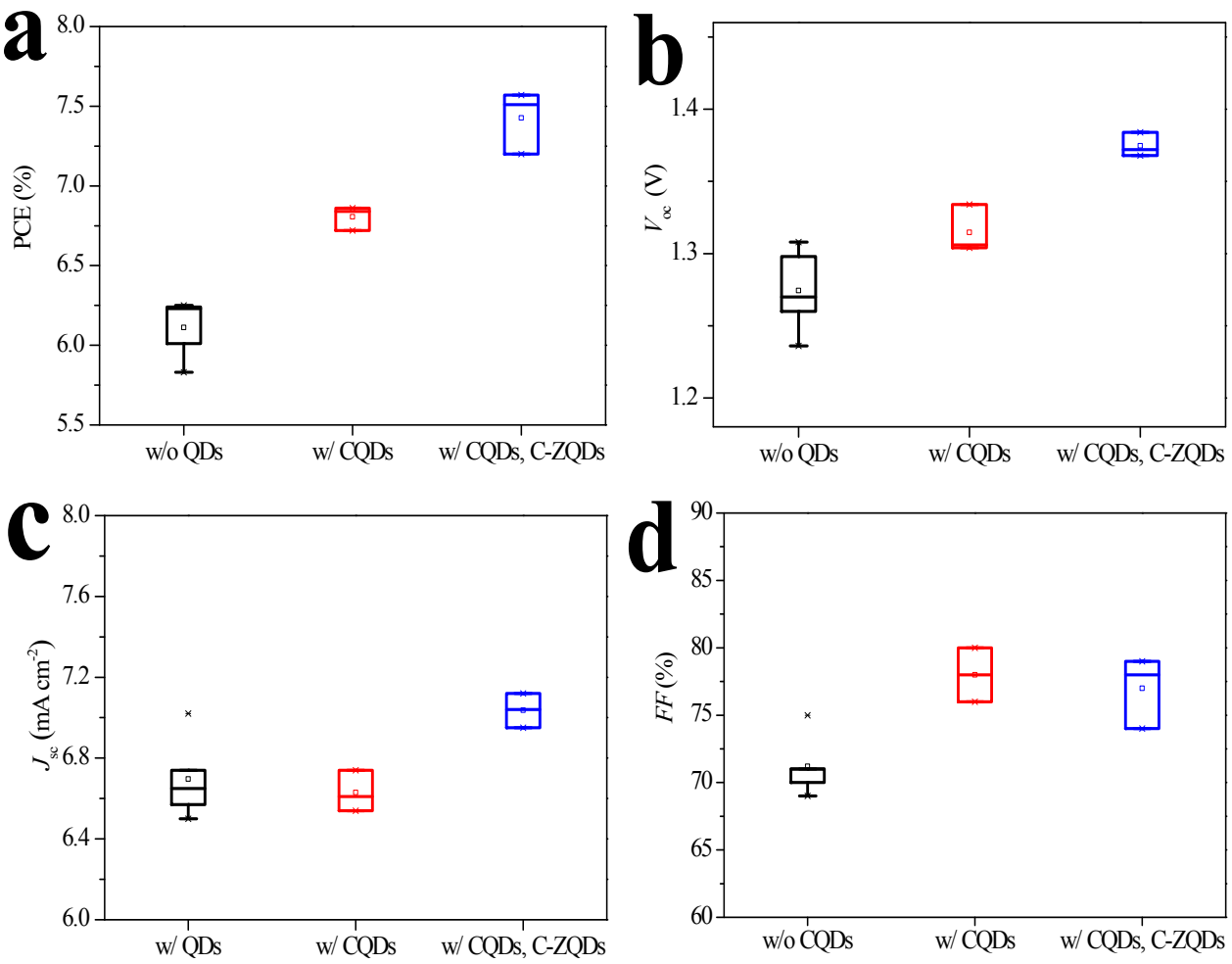

Fig. S7 The statistical distribution of front photovoltaic parameters for three bifacial PSCs: (a) PCE, (b) $V_{oc,}$ (c) J_{sc} and (d) *FF*.

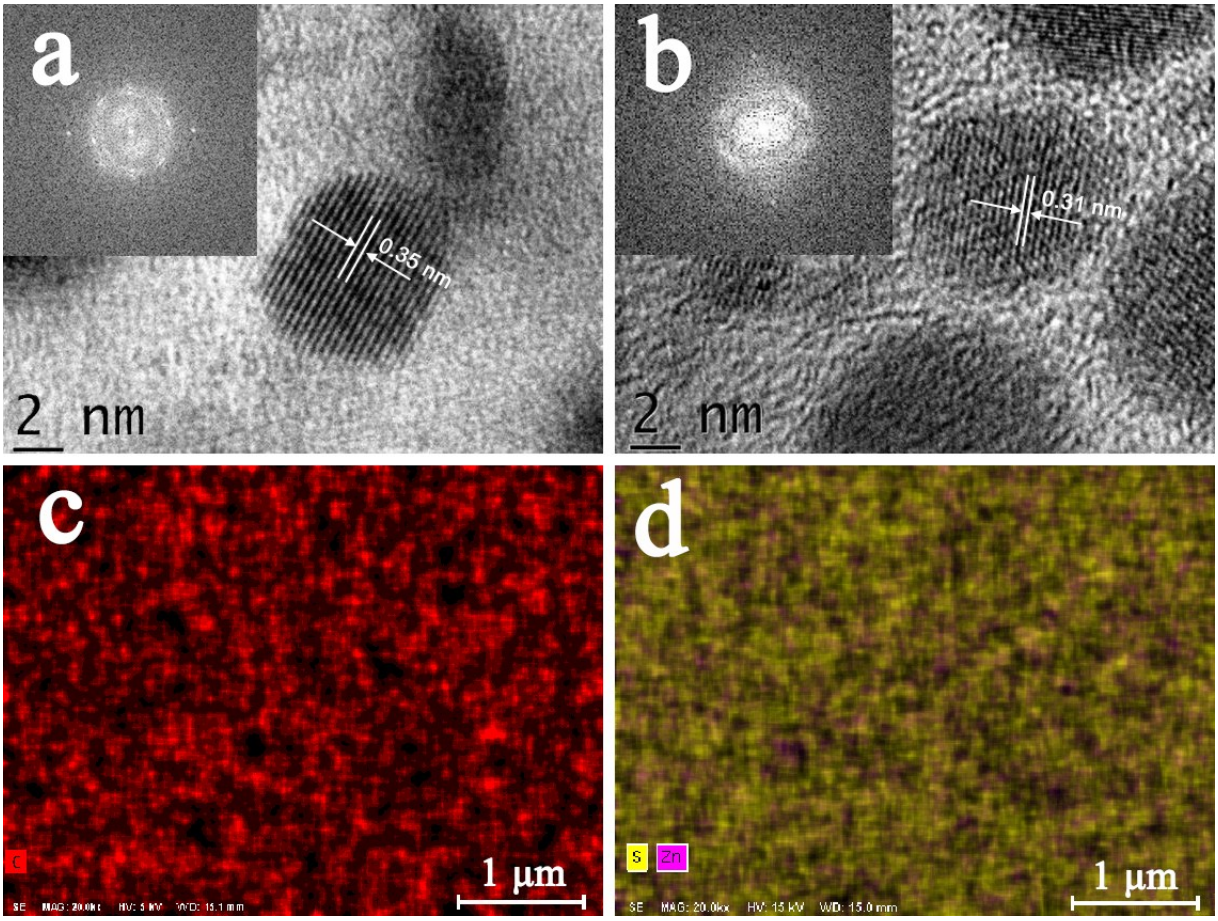

Fig.S8 High-resolution TEM images of (a) CQDs and (b) C-ZQDs. SEM mapping of (c) CQDs at *m*-TiO_2 film and (d) C-ZQDs at $CsPbBr_3$ film. The inserts show the selected area electron diffraction patterns of CQDs and C-ZQDs.

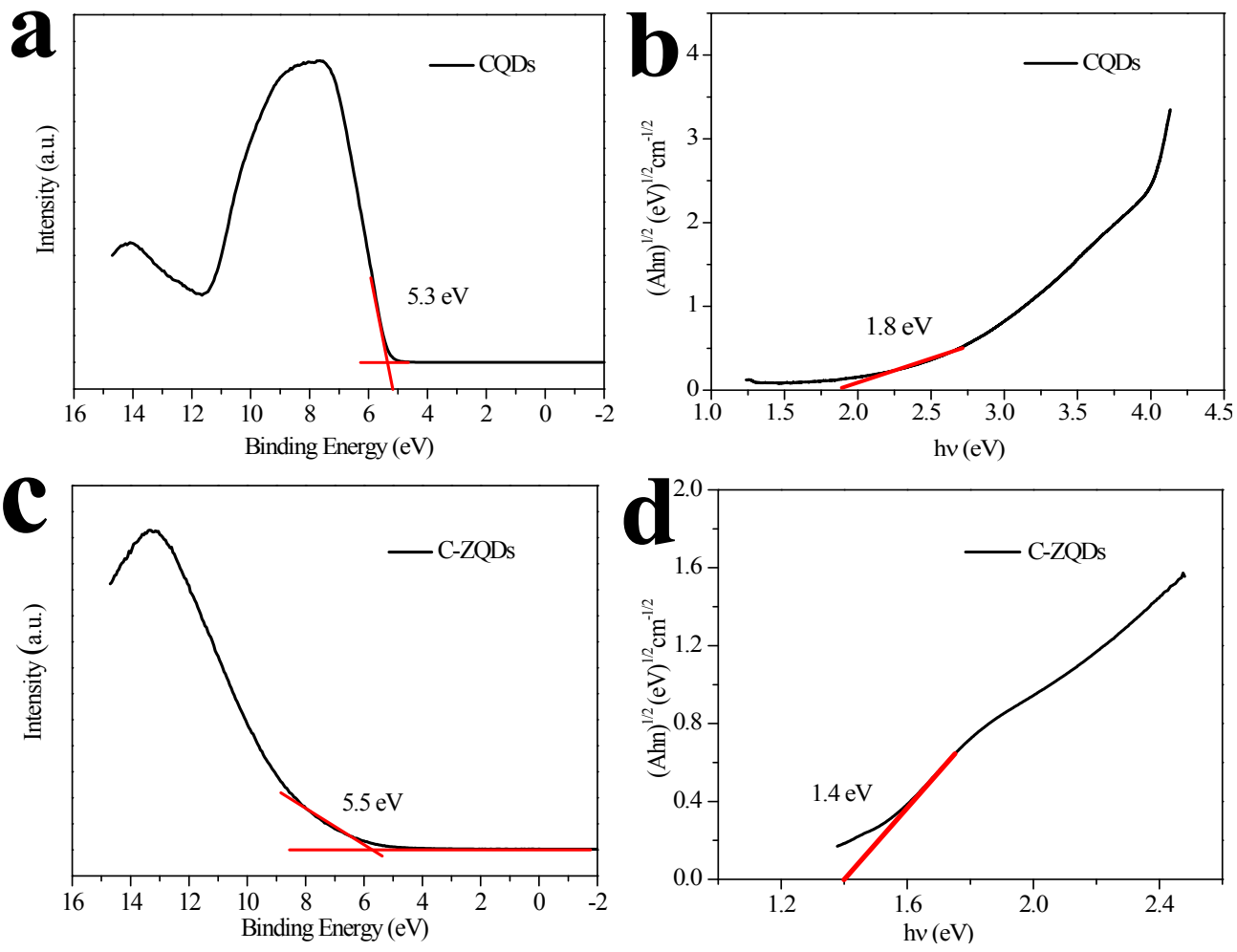

Fig. S9 (a) High-resolution UPS analysis and b) $(Ahv)^2$ vs energy (hv) curve for CQDs. (c) High-resolution UPS analysis and (d) $(Ahv)^2$ vs energy (hv) curve for C-ZQDs.

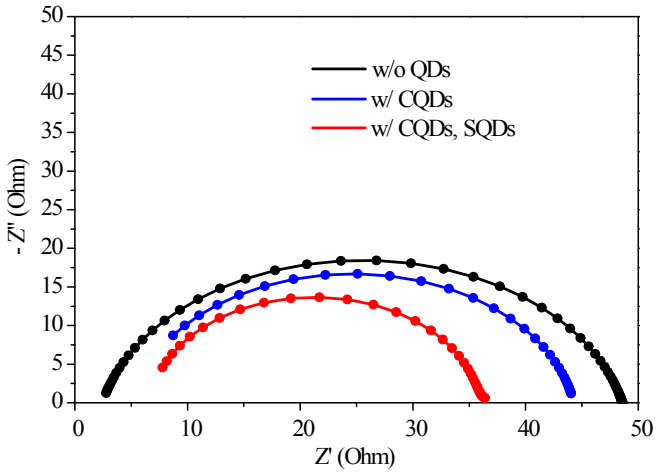

Fig. S10 EIS Nyquist plots of three bifacial PSCs measured at open circuit in the dark.

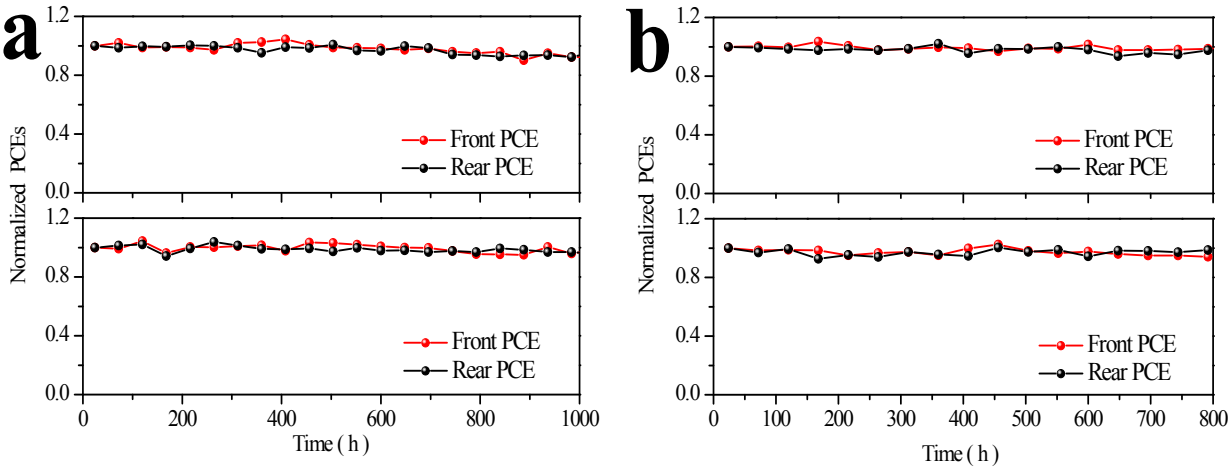

Fig.S11 Normalized PCEs of bifacial $CsPbBr_3$ solar cells without QDs (above) and modified by CQDs/C-ZQDs (below) at (a) 60% RH/25 °C and (b) 80°C/0% RH. All the devices are measured without encapsulation.

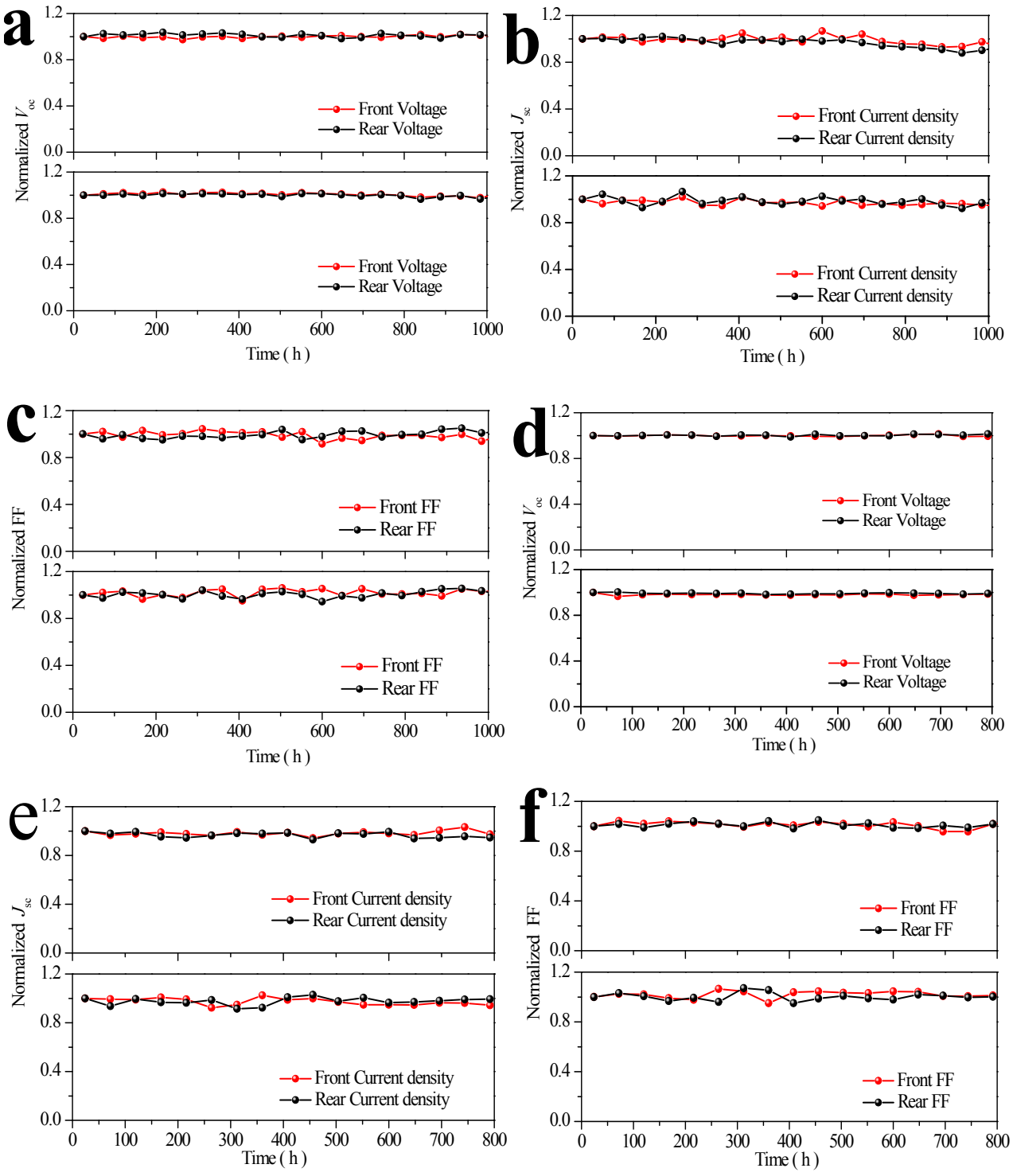

Fig. S12 Normalized photovoltaic parameters for bifacial PSCs including (a) V_{oc}, (b) J_{sc}, (c) *FF* as a function of aging time at 60% RH and 25 °C. Normalized photovoltaic parameters for bifacial devices including (d) V_{oc}, (e) J_{sc}, (f) *FF* as a function of aging time at 80 °C.

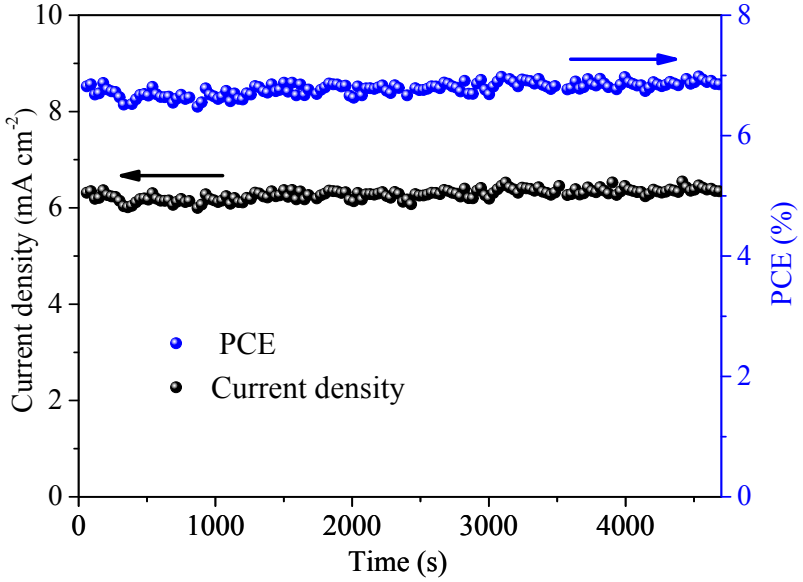

Fig. S13 The continuous photocurrent density (left ordinate) and PCE (right ordinate) for CQDs/C-ZQDs modified bifacial PSCs under 1-sun light soaking.