Supporting Information

All Chemically Deposited, Annealing and Mesoporous Metal Oxide Free CdSe Solar Cell

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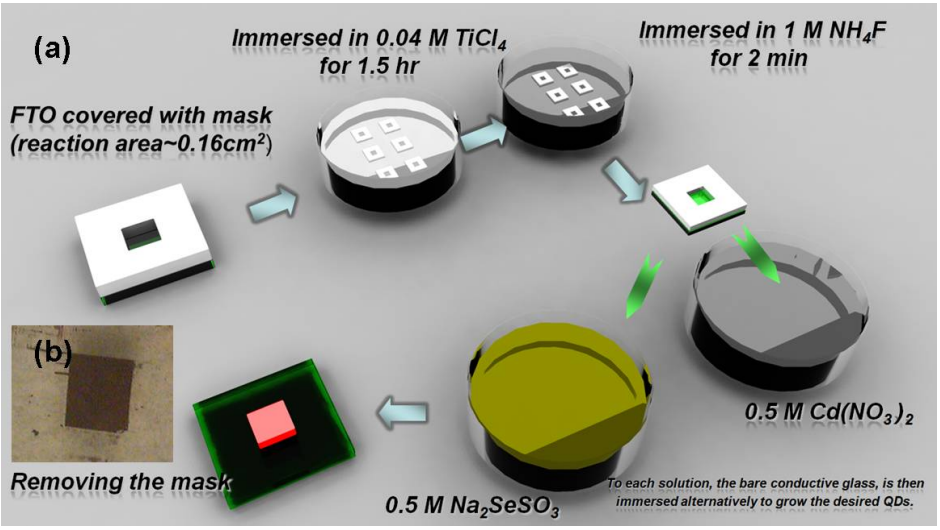
Experimental section

Fabrication of ***FTO/TiO$_2$/F/CdSe*** *device*: As shown in Scheme 1 in the text (also shown below), the FTO substrates were cleaned by sonication sequentially in detergent water, ethanol and acetone. After treatment in a UV-O_3 system for 40 min, the FTO glass plate was immersed in 40 mM aqueous $TiCl_4$ solution for 0.5, 1, 1.5, 2 hrs at 60 ℃ and rinsed with water and ethanol. The substrates were then further immersed in NH_4F aqueous solution for 2 min. For the CBD process, Na_2SeSO_3 aqueous solution was synthesized according to previous report.[1] The pre-treated FTO substrates were then dipped into an ethanol solution containing $Cd(NO_3)_2$ (0.5 M) for 30 min at 40 ℃, rinsed with ethanol, and then dipped for another 7 hrs into the Na_2SeSO_3 (0.5 M) solution at 40 ℃ and rinsed again with ethanol and water. These two-step dipping process is termed as one CBD cycle and the incorporated amount of CdSe can be increased by repeating the assembly cycles. The Pt counter electrode was prepared by spin-coating 50 mM H_2PtCl_6 in isopropyl alcohol on FTO glass, followed by sintering at 385 °C for 15–30 min. The CdSe coated FTO electrode was then incorporated into a sandwich cell structure with a Pt-coated FTO as the counter electrode, and a film (Surlyn 1702, 25 μm) as a spacer between the electrodes. The polysulfide electrolyte solution (water : methanol = 1:1 by volume) was then injected

into the cell through a drilled hole in the back of the counter electrode. Lastly, the hole was sealed using a hot-melt ionomer film and a cover glass. Light-to-electricity conversion efficiency values were measured using a modified light source, 450 W Xe lamp (Oriel, 6266), an Oriel 81088 Air Mass 1.5 Global Filter and a digital source meter purchased from Keithley Instruments Inc. The incident light intensity was calibrated using a standard solar cell composed of a crystalline silicon solar cell and an IR cutoff filter (Schott, KG-5), giving the photoresponse range of amorphous silicon solar cell.



Reference:

1. Y. L. Lee and Y. S. Lo, *Adv. Funct. Mater*. 2009, **19**, 1

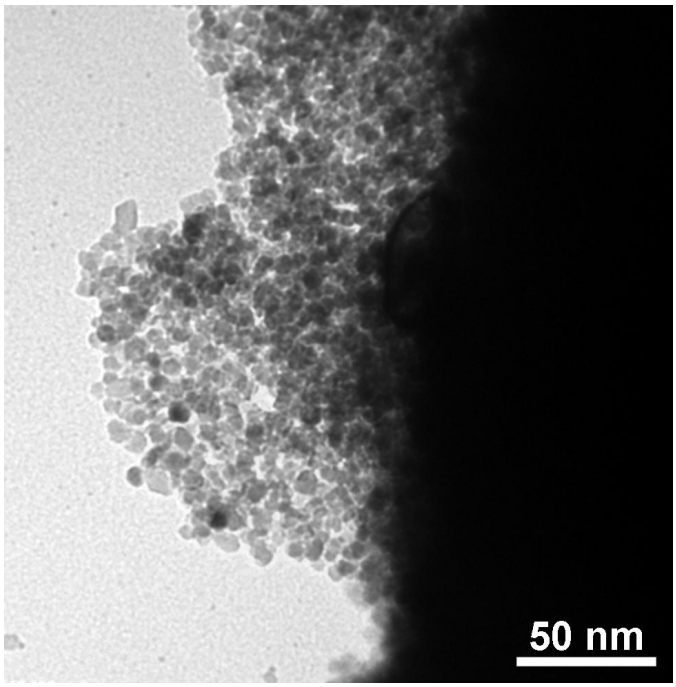


Figure S1. The TEM image of as-prepared CdSe film.

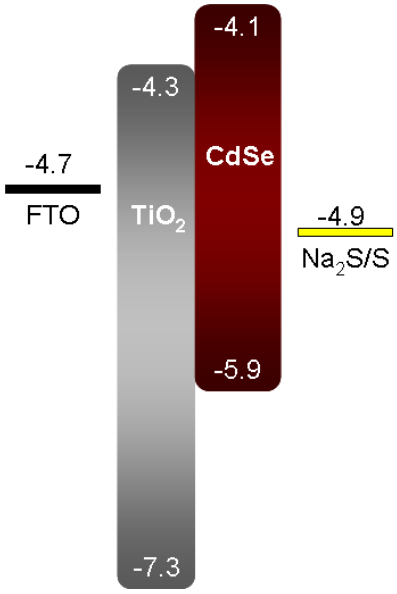


Figure S2. The corresponding energy diagram of device **FTO/TiO_2/CdSe**.

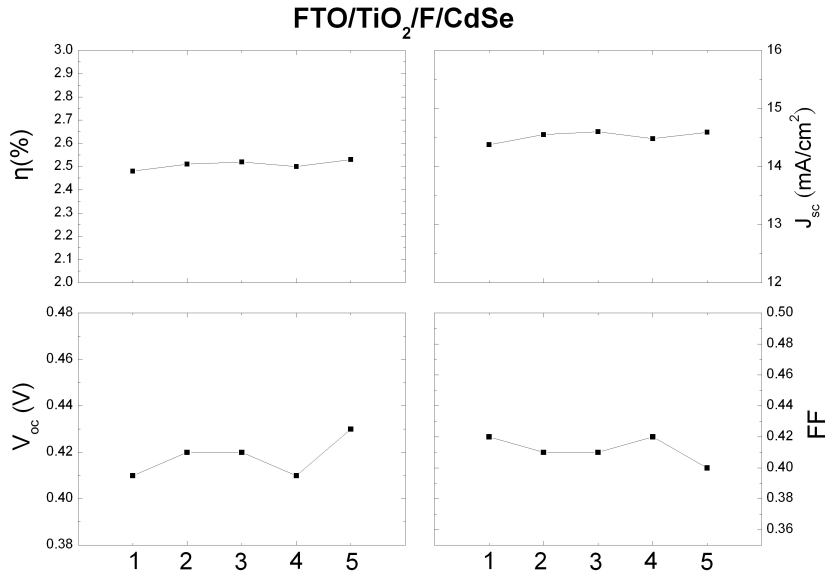


Figure S3. The cell performance parameters of five **FTO/TiO_2/F/CdSe** devices under the same experimental conditions.

Table S1. The cell performance parameters of various types of CBD cells as a function of immersing time of NH_4F

Immersing time of NH_4F(min)	J_{sc} (mA/cm^2)	V_{oc} (V)	FF	η(%)
0	13.67	0.42	0.35	2.01
1	13.77	0.41	0.39	2.20
2	14.55	0.42	0.41	2.51
5	14.44	0.43	0.4	2.48
30	14.28	0.42	0.41	2.46