

Supporting information for Nanoscale

14.7% Efficient Mesoscopic Perovskite Solar Cells Using Single Walled Carbon Nanotubes/Carbon Composite Counter Electrode

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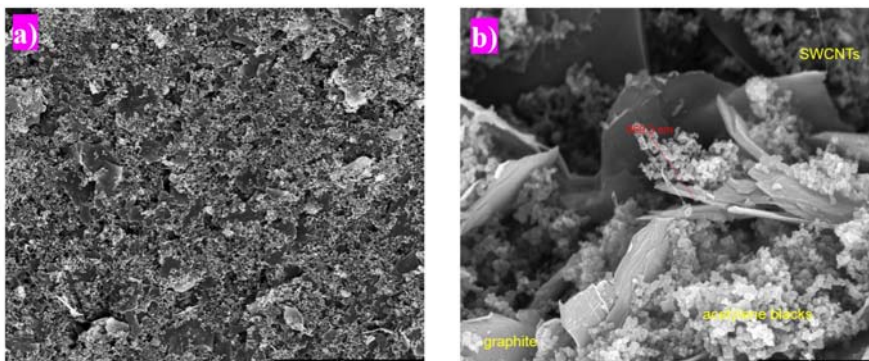


Figure S1. SEM images (a) and (b) of carbon CE with SWCNTs.

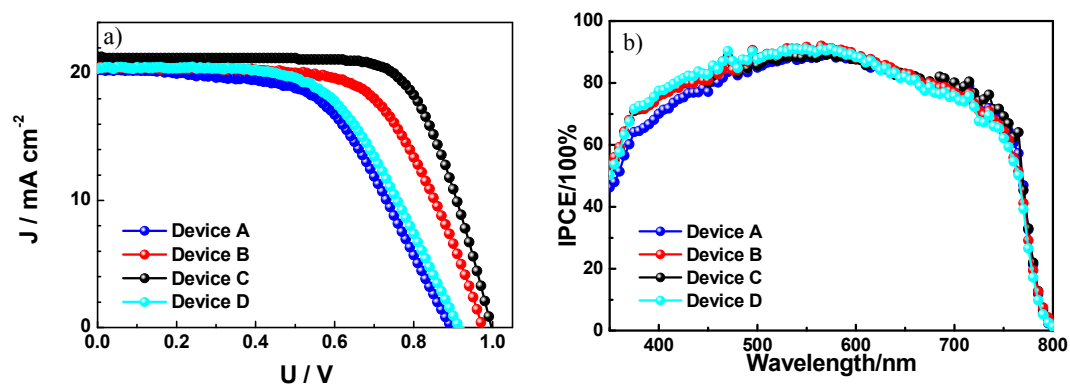


Figure S2. (a) I-V curves for devices A, B, C, and D under standard AM 1.5G illumination at 100 mW cm^{-2} . (b) The corresponding IPCE spectra of devices A, B, C, and D.

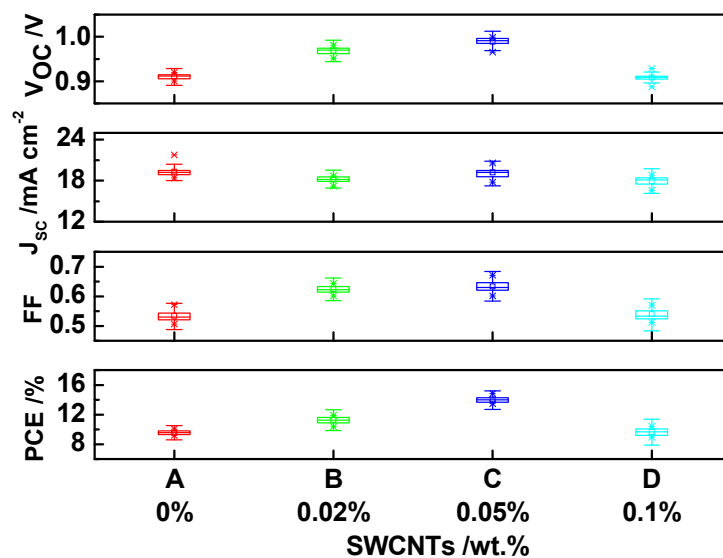


Figure S3. Photovoltaic parameters for perovskite solar cells using carbon counter electrodes when the SWCNTs content varies. Each box presents the parameter distribution of 20 devices under similar working conditions.

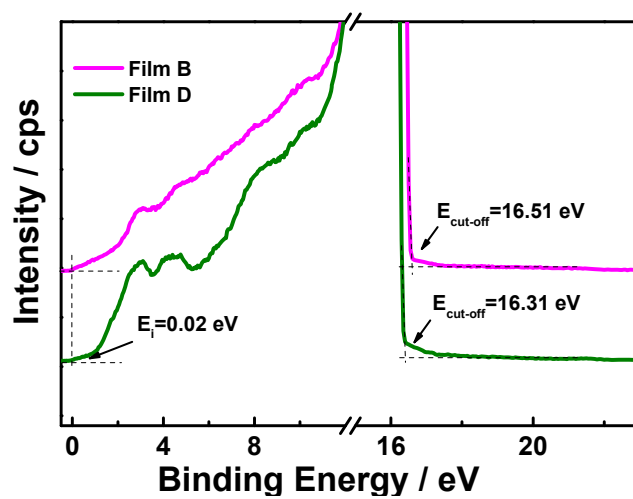


Figure S4. UPS in the onset (E_i) and the cutoff ($E_{\text{cut-off}}$) energy regions of the surface measurement for the carbon CE with 0.02 % SWCNTs (Film B) and 0.1 % (Film D).

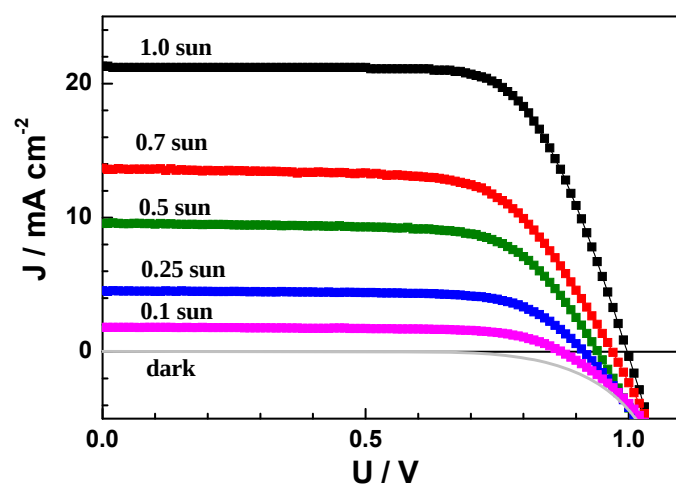


Figure S5. IV curve of device C under different light intensities.

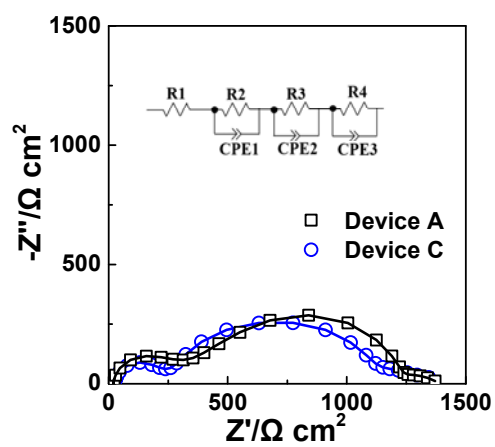


Figure S6. Nyquist plot obtained under 10 mW cm^{-2} illumination at a bias of -0.7 V . The inset shows the equivalent circuit for data fitting.

Table S1. Square resistance of $\sim 10 \mu\text{m}$ thick carbon CE employing SWCNTs with different values.

SWCNT content (wt.%)	0	0.02	0.05	0.1
Sheet resistance (Ω)	75.4	73.5	72.4	71