Electronic Supplementary Material (ESI) for Nanoscale.

Efficient, Flexible and Mechanically Robust Perovskite Solar Cells on Inverted Nanocone Plastic Substrates

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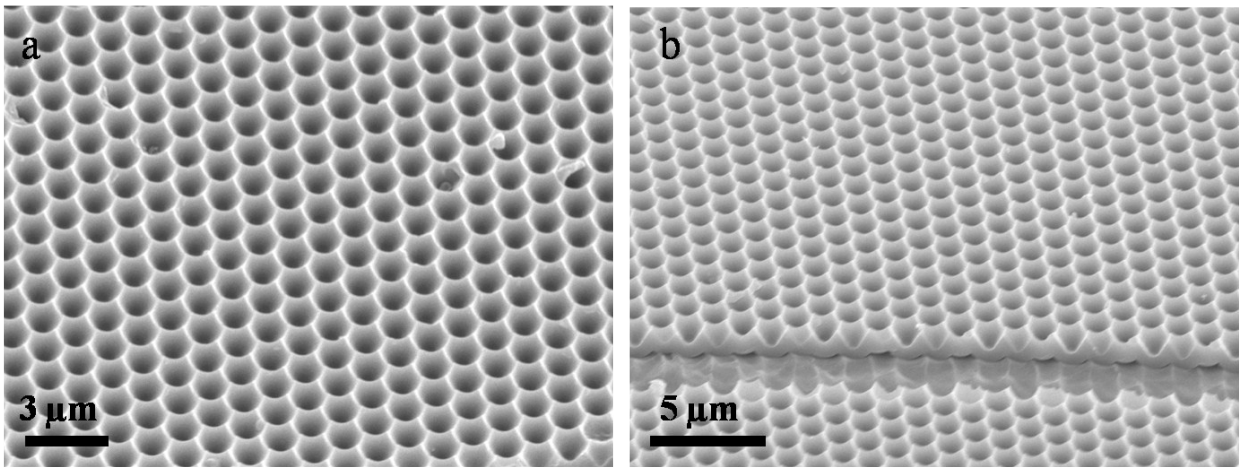

Figure S1. (a)Top and (b) Angular view SEM images of gold-coated nanocone AAO template with 1.2 µm pitch and 1.2 µm depth.

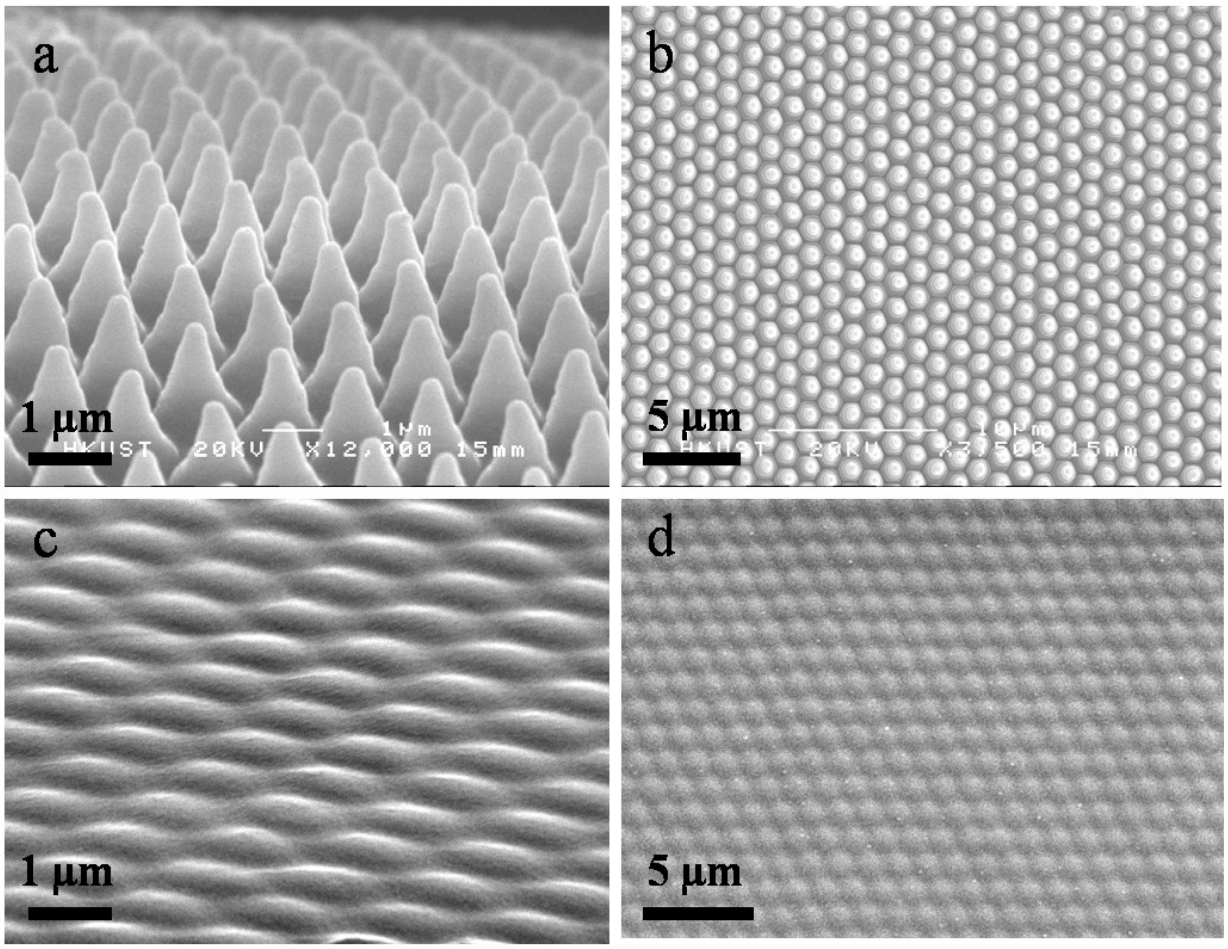

Figure S2. (a,c) Angular and (b,d) Top view of nanocone PDMS template with aspect ratio of 1.0 (a,b) and 0.25 (c,d).

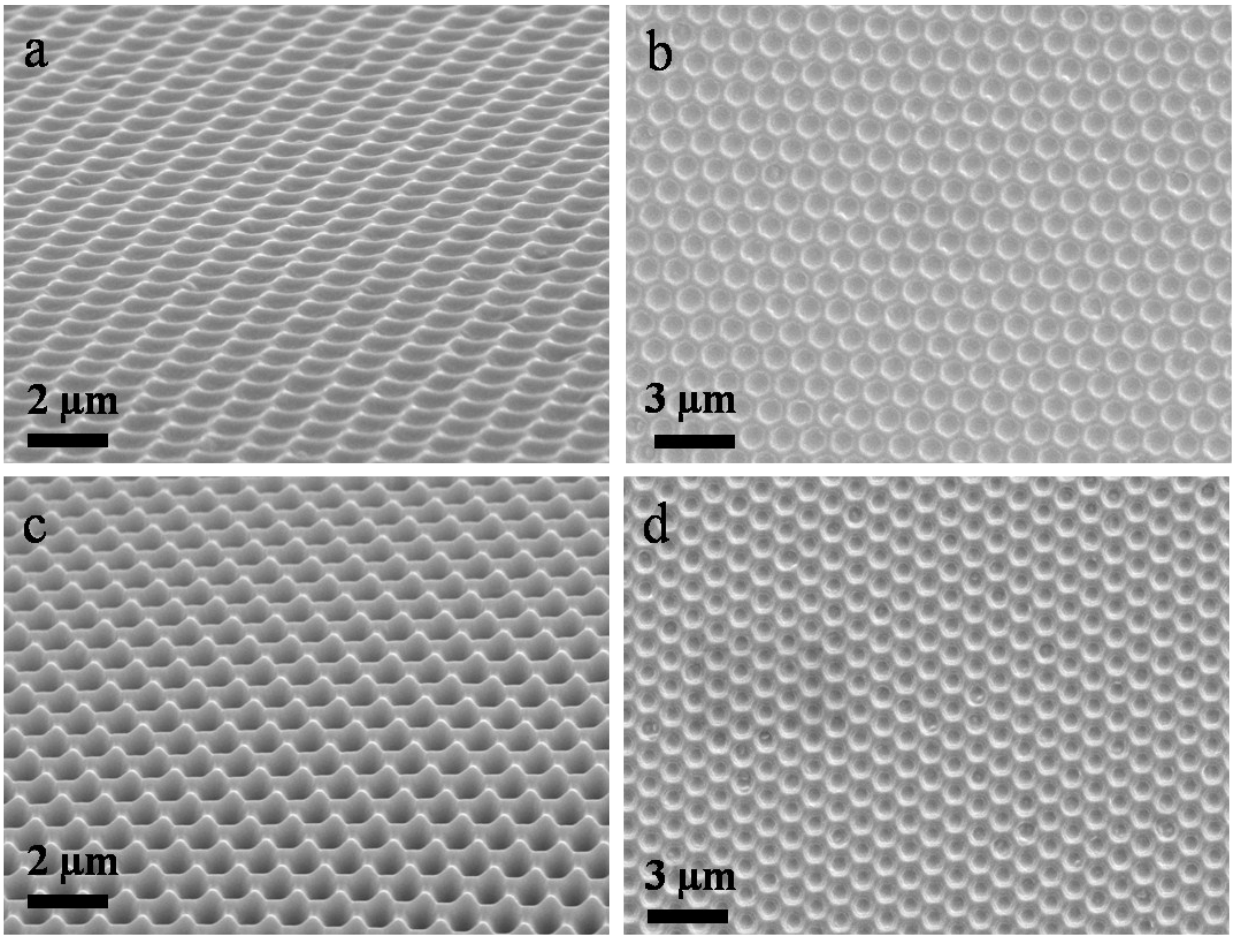

Figure S3. (a,c) Angular and (b,d) Top view of inverted nanoconeepoxysubstrate with aspect ratio of 0.25 (a,b) and 1 (c,d).

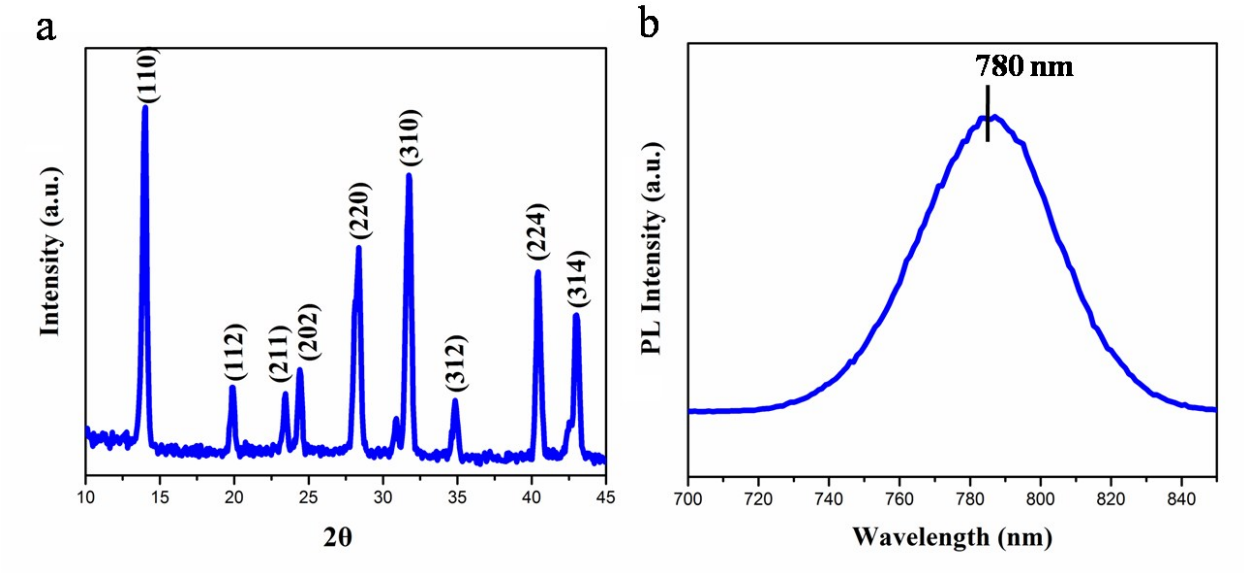

Figure S4. (a) XRD pattern and (b) photoluminescence spectrum of perovskite thin film.

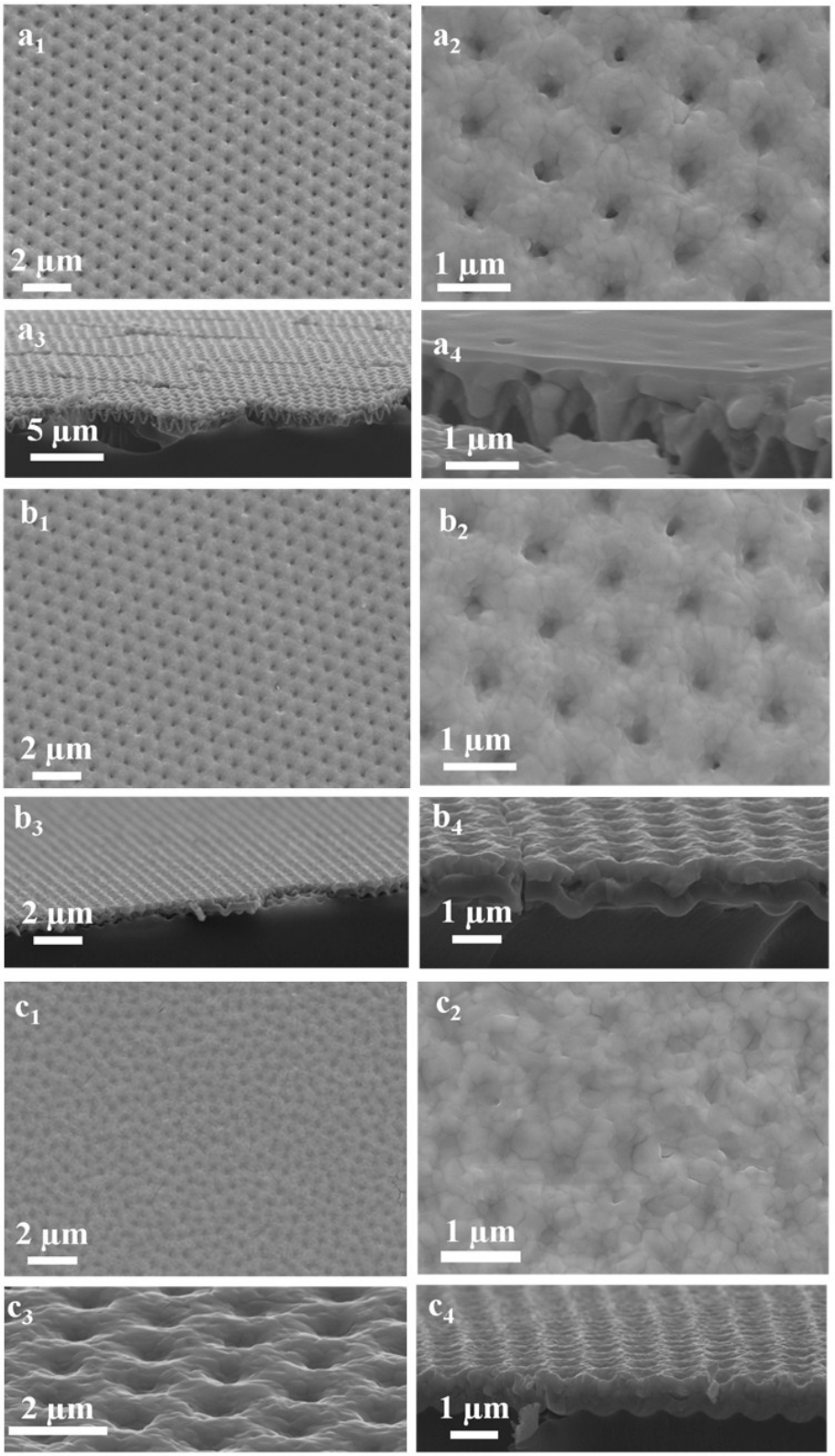

Figure S5. The top and cross sectional view SEM images of perovskite layer based on i-cone substrates with different aspect ratios,(a_1-a_4) 1, (b_1-b_4) 0.5, (c_1-c_4) 0.25.

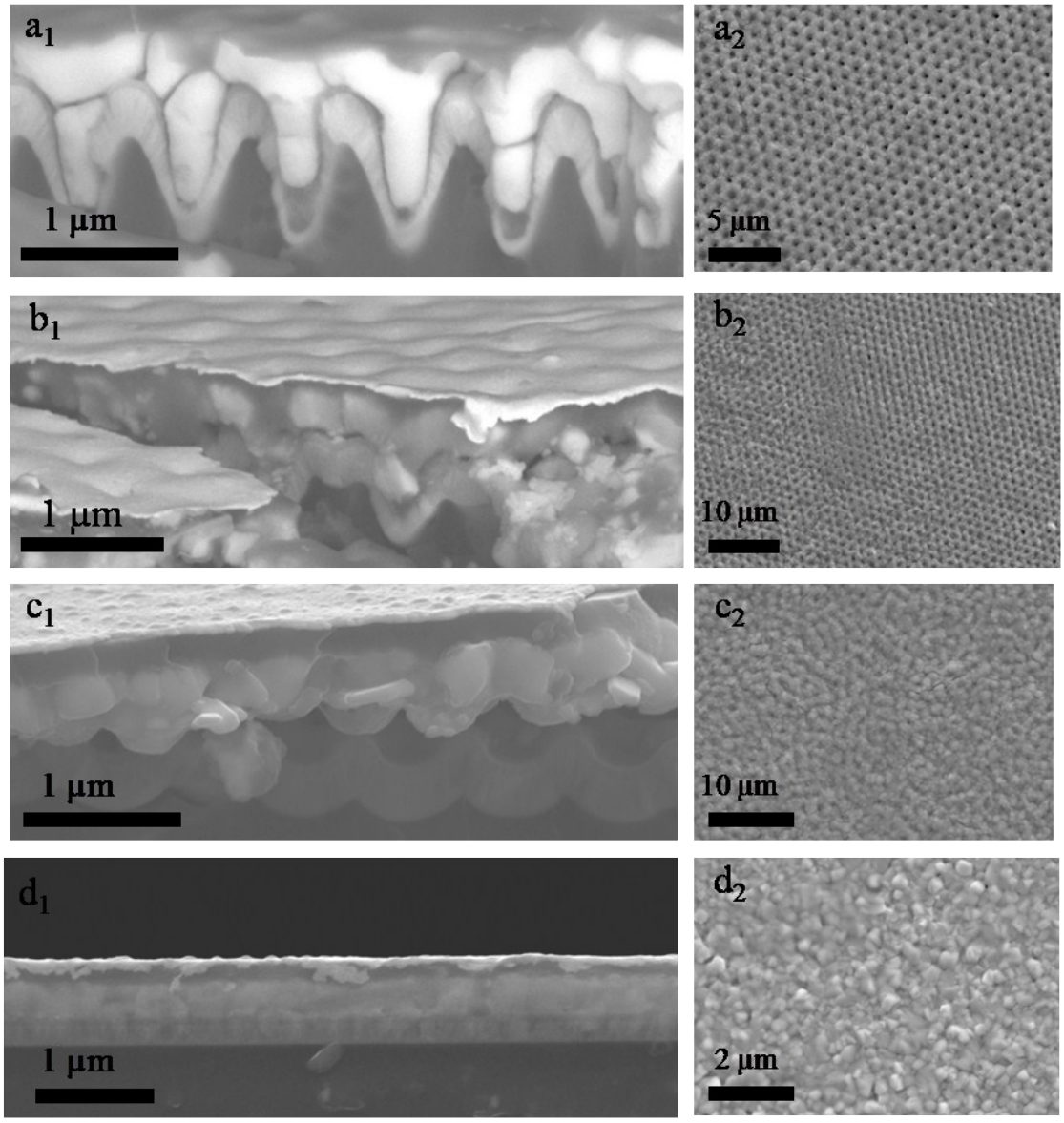

Figure S6. The cross section and top view SEM images of perovskite solar cell based on i-cone substrates with different aspect ratios,(a_1,a_2) 1, (b_1,b_2) 0.5, (c_1,c_2) 0.25, and (d_1,d_2) flat substrate.

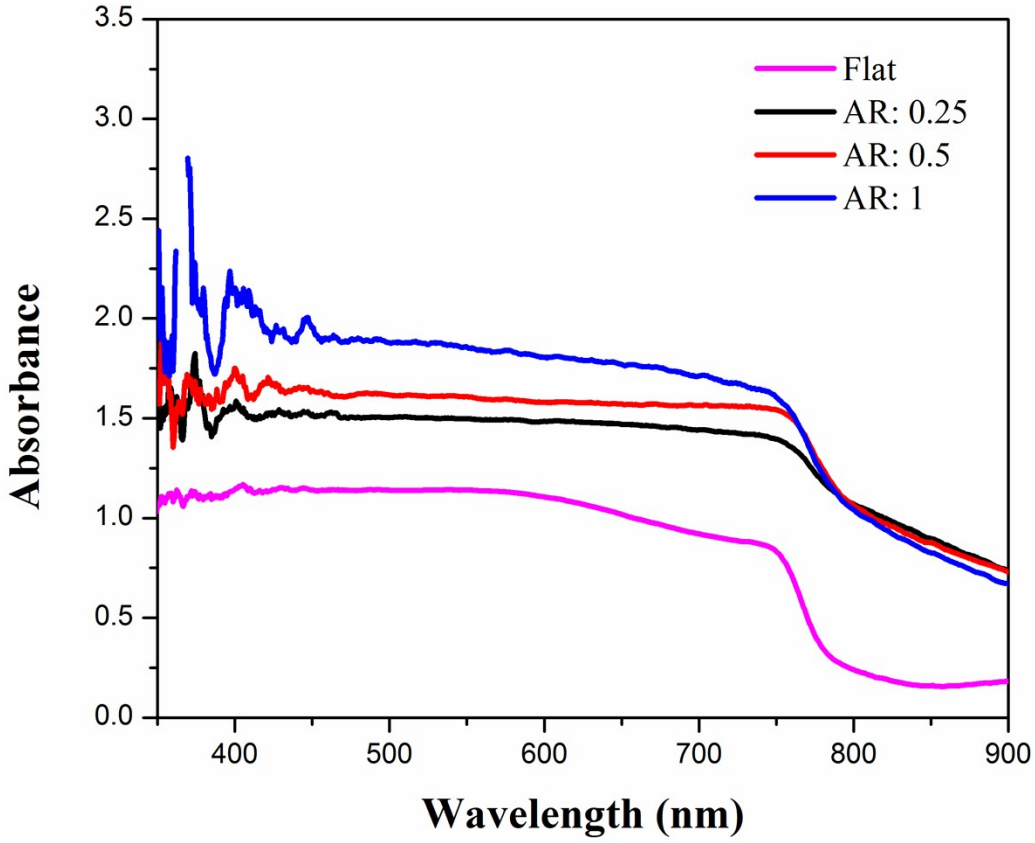

Figure S7: The absorbance spectra of perovskite films deposited on i-cone substrates with different aspect ratios.

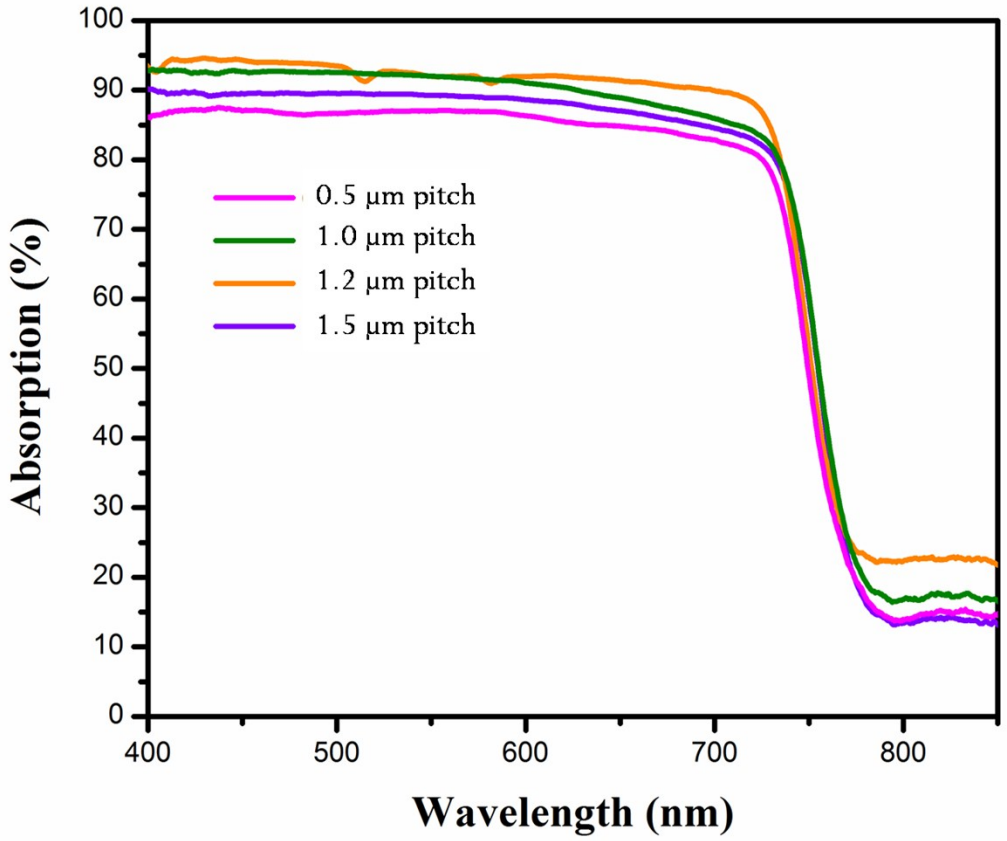

Figure S8: The light harvesting efficiency of perovskite thin film on the i-cone substrates with different pitch sizes of 0.5, 1.0, 1.2, and 1.5 µm.

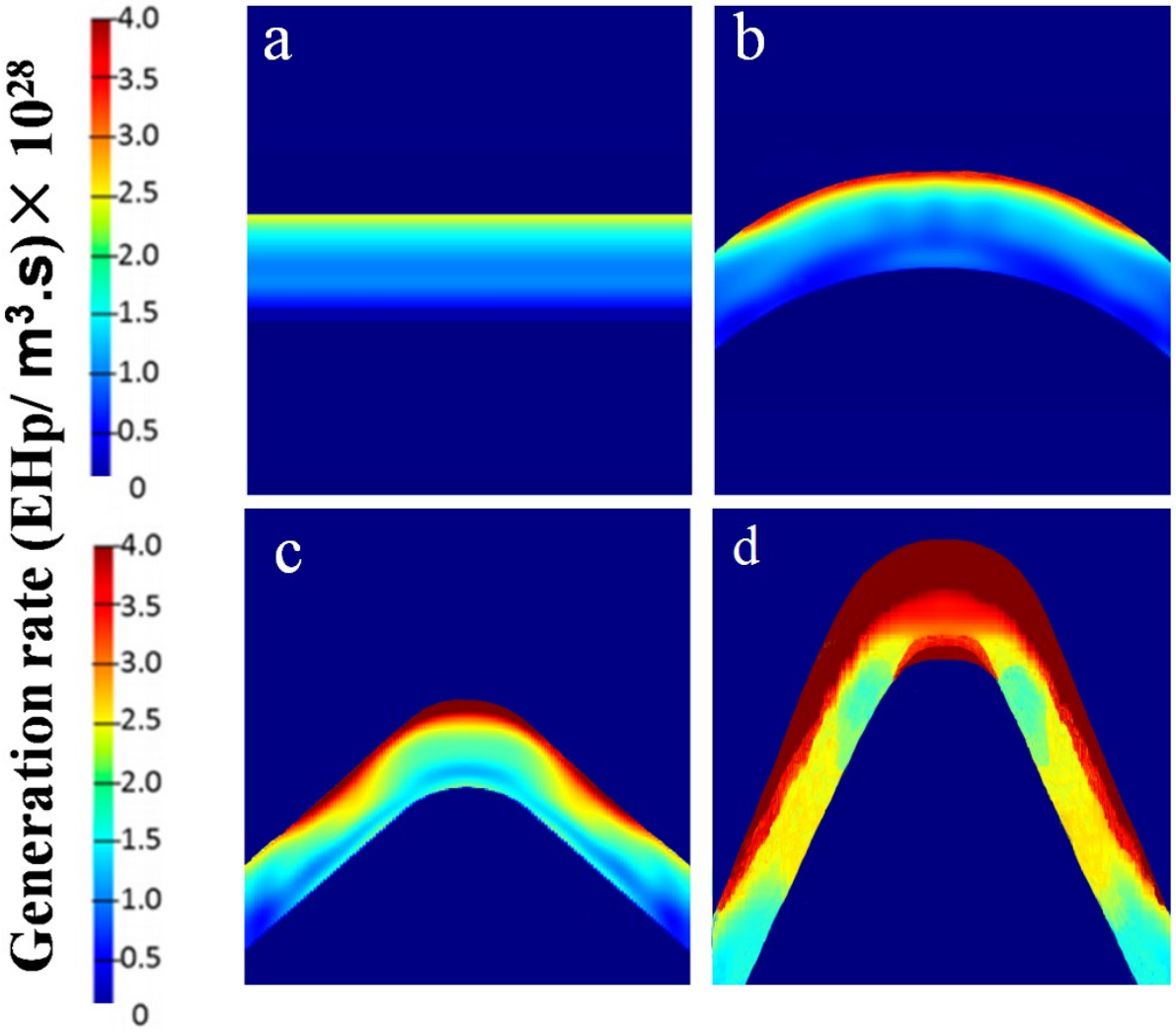

Figure S9. FDTD simulation: The fringe patterns of generation rate (number of absorbed photons/m^3.s) in perovskite layer, flat device (a), and i-cone plastic substrates with different aspect ratios, (b) 0.25,(c) 0.5,(d) 1.0. The thickness of the absorber layer was fixed 300 nm for all devices.

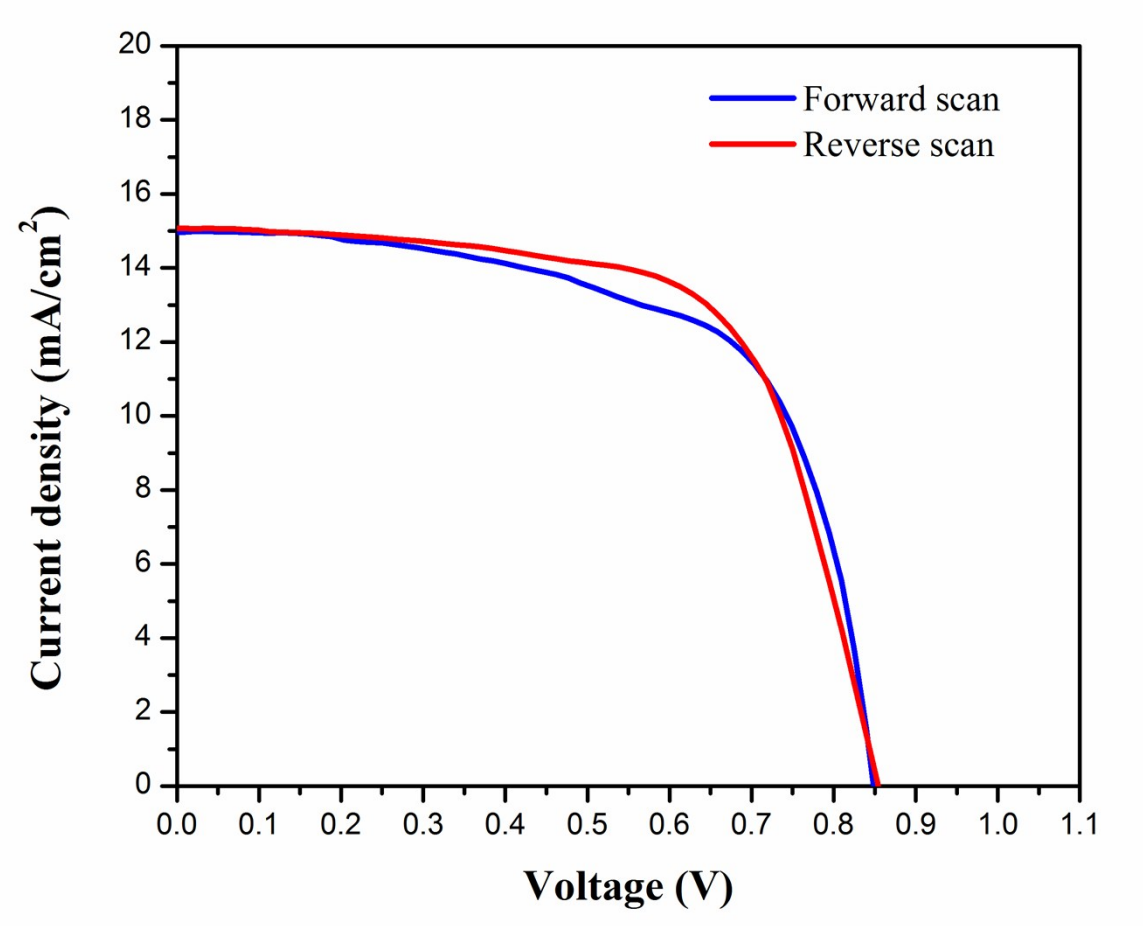

Figure S10. J-V measurement of perovskite solar cell with different scan direction (forward and reverse scan).

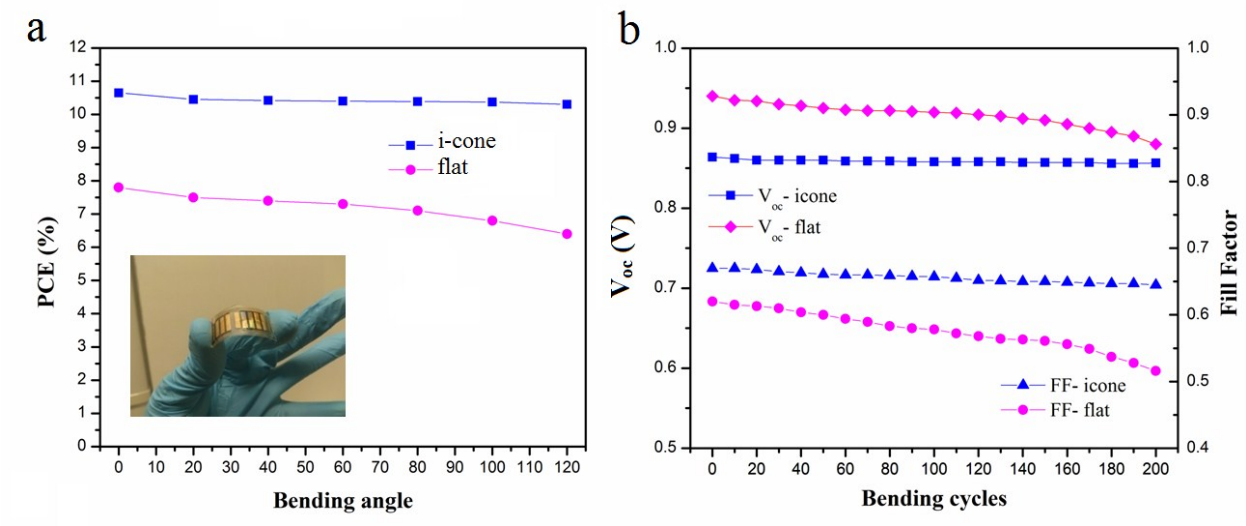

Figure S11. (a)Efficiency stability depending on bending angle in perovskite solar cells based on flat and 0.5-aspect ratio-i-cone-epoxy substrates. (b)The stability of V_{oc} and Fill factor depending on bending cycles in perovskite solar cells based on i-cone epoxy substrate.

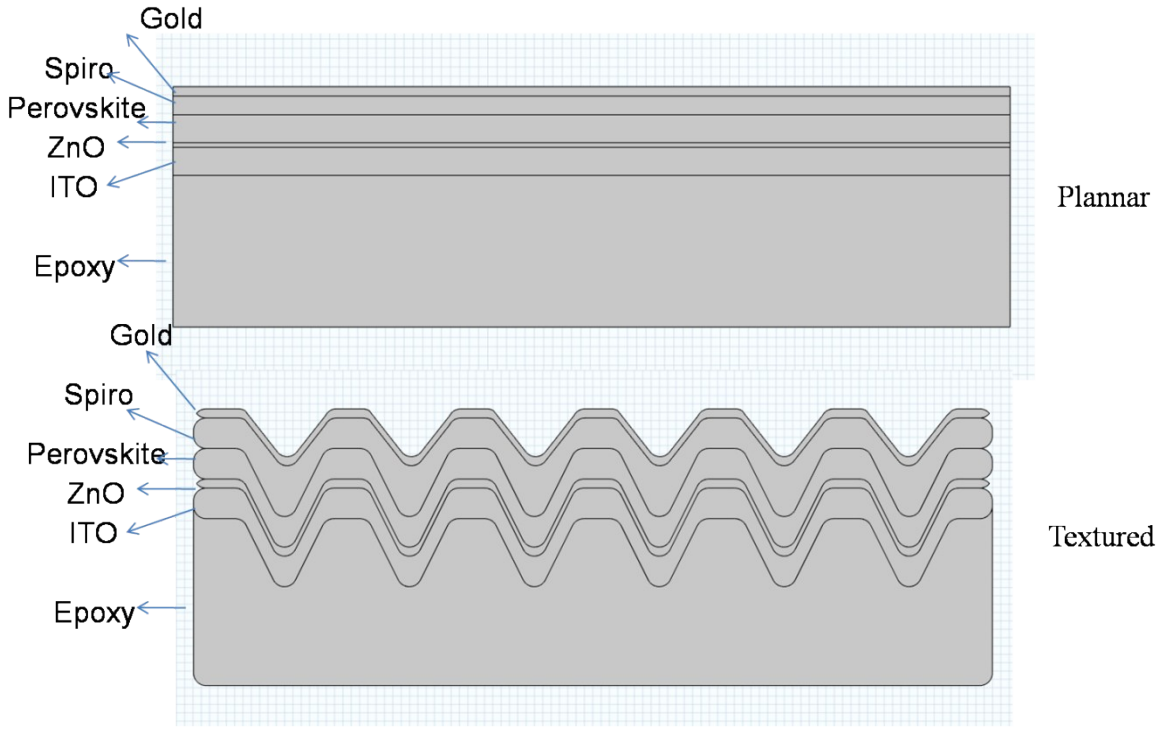

Figure S12. The modeling of flat and i-cone perovskite solar cell for mechanical simulation. The size of the model is $10 \times 3\ \mu m^2$.