Electronic Supplementary Material (ESI) for Energy & Environmental Science.

Supplementary Information for " Domain Size Control of Perovskite Thin Films via Colloidal Monolayer Lithography "

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Supporting Figures

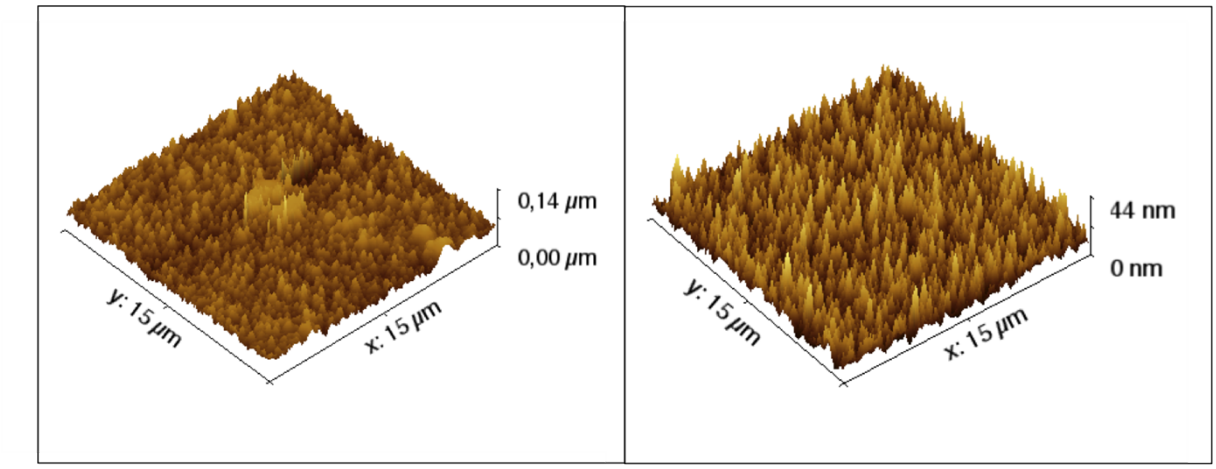

Figure S1. AFM measured 3D profile of 15 Ohm/square FTO glass before (left) and after (right) deposition of c-TiO_2. The root mean square roughness was calculated to be 10.5 and 5.2 nm.

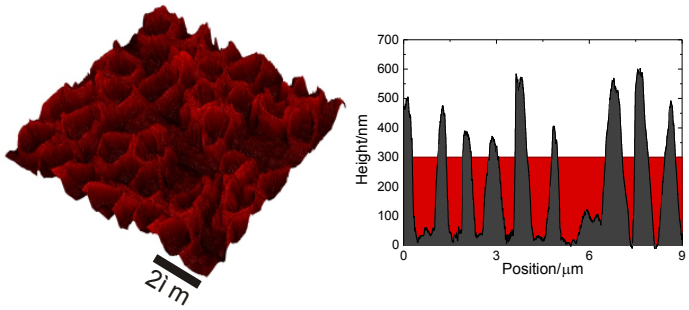

Figure S2. AFM measured 3D profile of TiO_2 honeycomb structure (left). Line profile of TiO_2 honeycomb structure with indicated level of 300 nm thick perovskite filling.

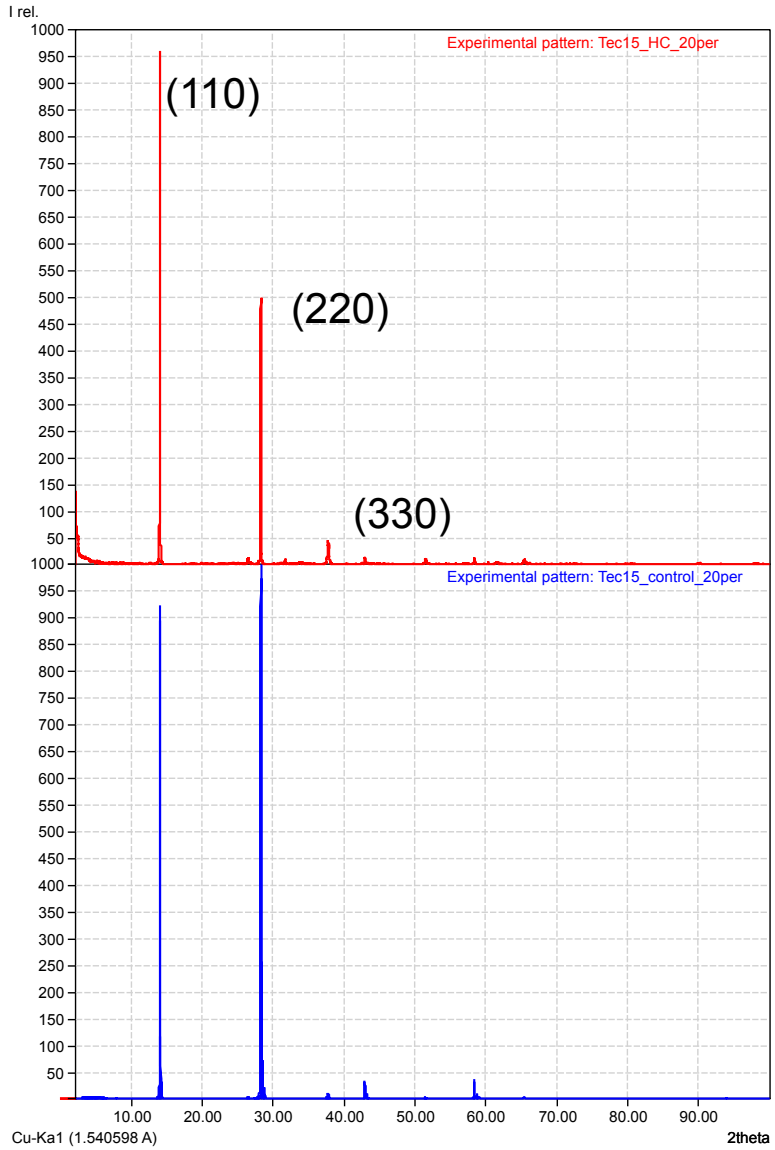

Figure S3. XRD patterns of perovskite films within SiO_2 honeycombs (top) or on top of FTO/c-TiO_2 substrates (bottom) deposited from 20 wt% precursor solution. The patterns are showing good similarity with the typical tetragonal $CH_3NH_3PbI_3$ patterns and lattice parameters (a=8.884, c=12.61 and a=8.874, c=12.62) were determined via a Rietveld refinement with χ^2=4.7 and χ^2=9.8). By Scherrer equation, crystallite sizes were estimated to be equal to around 110-120 nm (top) and 150-190 nm (bottom), respectively. Therefore we see a slight increase in crystallite size for the unconfined perovskite films deposited on FTO/c-TiO_2 substrates but the difference is not significant.

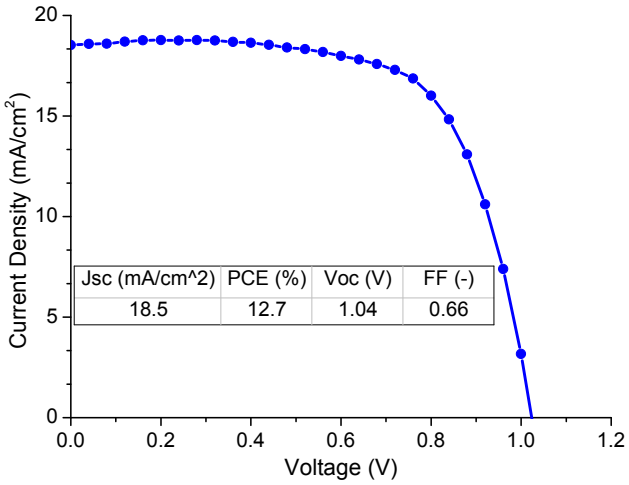

Figure S4. J-V characteristic curve for a SiO_2 honeycomb structured perovskite solar cell fabricated with 30 wt% precursor solution, scanning from forward bias to short circuit direction with a scan rate of 0.15 V/s.

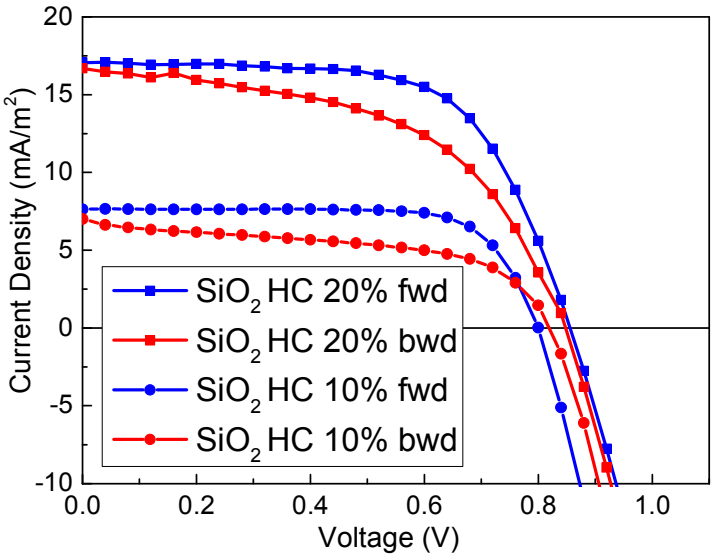

Figure S5. J-V characteristic curves for forward and backward scan of SiO_2 honeycomb structured perovskite solar cell fabricated with 10 and 20 wt% perovskite precursor solution (scan rate 0.15 V/s).

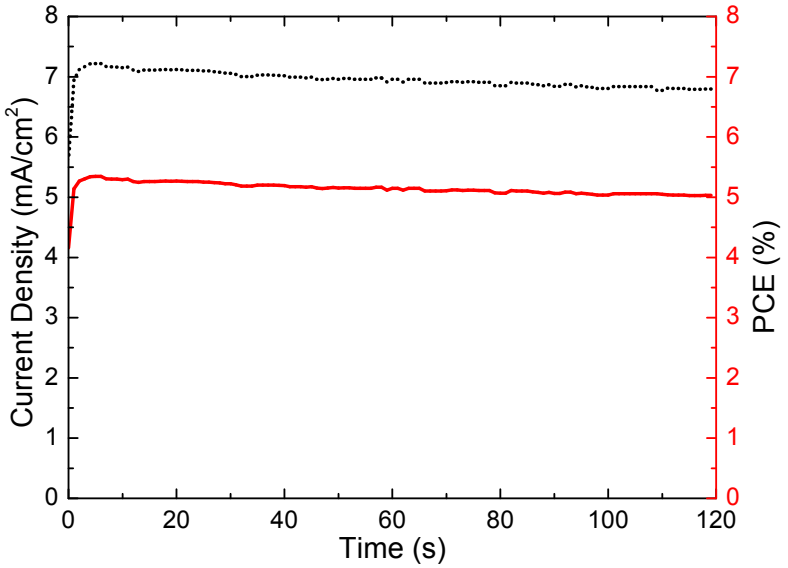

Figure S6. Stabilized current density and PCE of a SiO_2 honeycomb device fabricated from 20 wt% perovskite precursor solution, held at the maximum power voltage of 0.74 V for 120 seconds This device shows a J_{SC} of 10.5 mA/cm^2, a PCE of 7.5%, a FF of 0.77 and a V_{OC} of 0.9 V in the J-V measurement scanning from forward bias to short circuit direction under simulated AM1.5 100 mWcm^{-2} simulated sun light.