

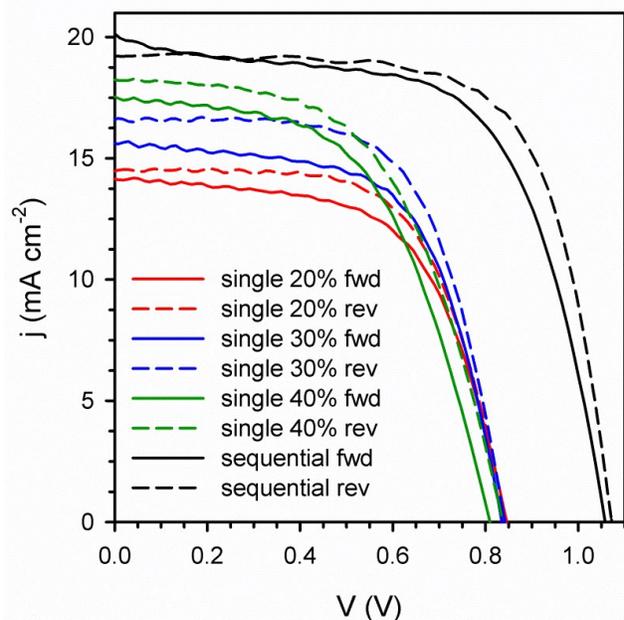
## Loading of Mesoporous Titania films by CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> Perovskite, Single step vs Sequential deposition

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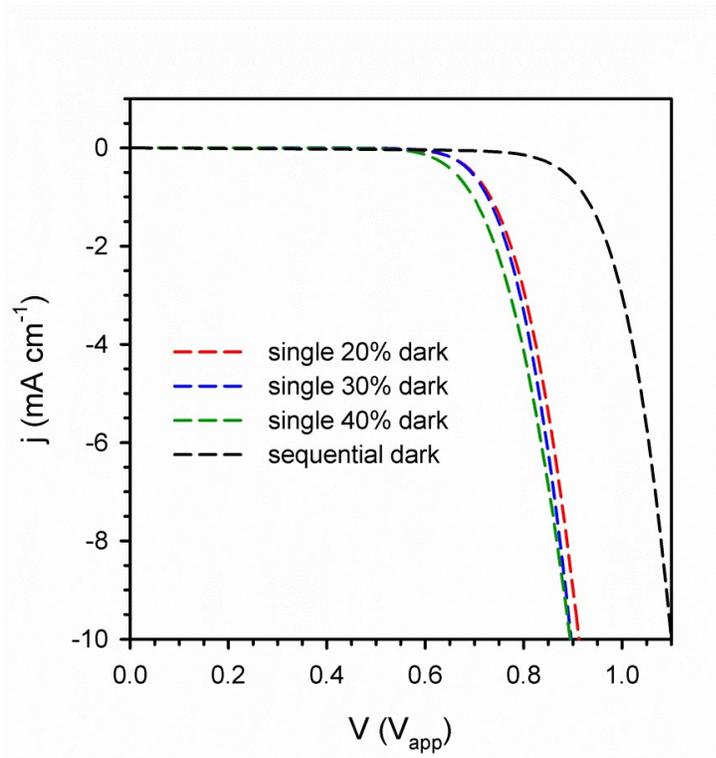
**TiO<sub>2</sub> blocking layer and mesoporous film preparation:** Fluorine doped tin oxide glass substrates (Tec15, <14 ohm/square, 2.2 mm thick, Pilkington) were patterned by laser etching and were subsequently cleaned by ultrasonication in decon soap solution followed by rinsing with deionized water and ethanol. They were further ultrasonicated in ethanol and were dried with clean dry air. TiO<sub>2</sub> compact layers were formed by spray pyrolysis at 450°C. A mesoporous TiO<sub>2</sub> film was then spincoated at 4000 rpm for 30 s, dried at 120.5 °C for 10 min and sintered at 500 °C for 15 min. For mesoporous TiO<sub>2</sub> films (300-400 nm), Dyesol 30 NRD was used in absolute ethanol in the ratio 2:7 by volume. The films were then subjected to 20 mM TiCl<sub>4</sub> treatment at 70 °C for 30 mins followed by sintering at 500 °C in air for 15 min.

**HTM and contact deposition:** The HTM formulation was comprised of 100 mg of spiro-OMeTAD, 28.8 μL of 4-tert-butylpyridine, 17.5 μL of a stock solution of lithium bis(trifluoromethylsulfonyl) imide (520 mg/mL in acetonitrile (ACN)) and FK102 dopant (12 mg in 40 μL of ACN) in 1 mL of chlorobenzene. This HTM was spincoated at 4000 rpm for 30 s. All of these process steps were carried out inside a dry box with humidity less than 15 %. A back contact of gold (90-100 nm thick) was deposited by thermal evaporation. The active area of the cell was measured to be 0.2 cm<sup>2</sup> which was masked by a black tape during the testing of the cells.

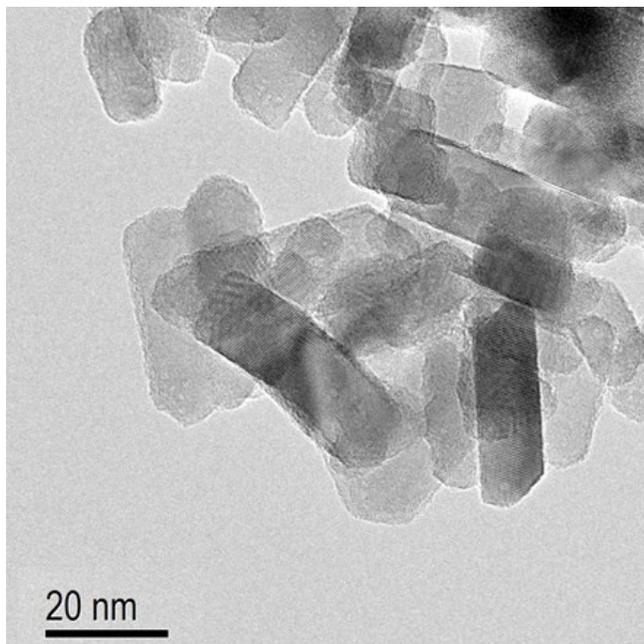
**TEM:** The samples for the TEM measurements were prepared by scraping the as-prepared films with a razor blade, without any supplementary solvent. The stability of the TEM results was checked by repeating the analysis in a time lapse of 3 hours.



**Figure S1** Hysteresis behavior: current-voltage characteristics measured under 1 sun illumination intensity at forward (from Jsc to Voc) and reverse (from Voc to Jsc) bias.



**Figure S2** Current-voltage characteristics measured in dark conditions.



**Figure S3** TEM image of bare TiO<sub>2</sub> film.