

Electronic Supplementary Information (ESI) for
Grain growth study of perovskite thin films prepared by flash
evaporation and its effect on the solar cell performance

Haitao Xu^a, Yanglin Wu^a, Fuzong Xu^a, Jiabin Zhu^a, Chaowei Ni^a, Wenzhen Wang^a,
Feng Hong^b, Run Xu^{*a}, Fei Xu^{*b,c}, Jian Huang^a and Linjun Wang^{*a}

^a School of Materials Science and Engineering, Shanghai University, 99 Shangda
Road, Shanghai 200444, China

^b SHU-Solar E R&D Lab, Department of Physics, Shanghai Key Laboratory of High
Temperature Superconductors, Shanghai University, 99 Shangda Road, Shanghai
200444, China

^c State Key Laboratory of Surface Physics and of Micro and Nano Photonic Structure
(Ministry of Education), Fudan University, 220 Handan Road, Shanghai 200433,
China

* Corresponding Authors; Email: runxu@staff.shu.edu.cn; feixu@staff.shu.edu.cn;
ljwang@staff.shu.edu.cn

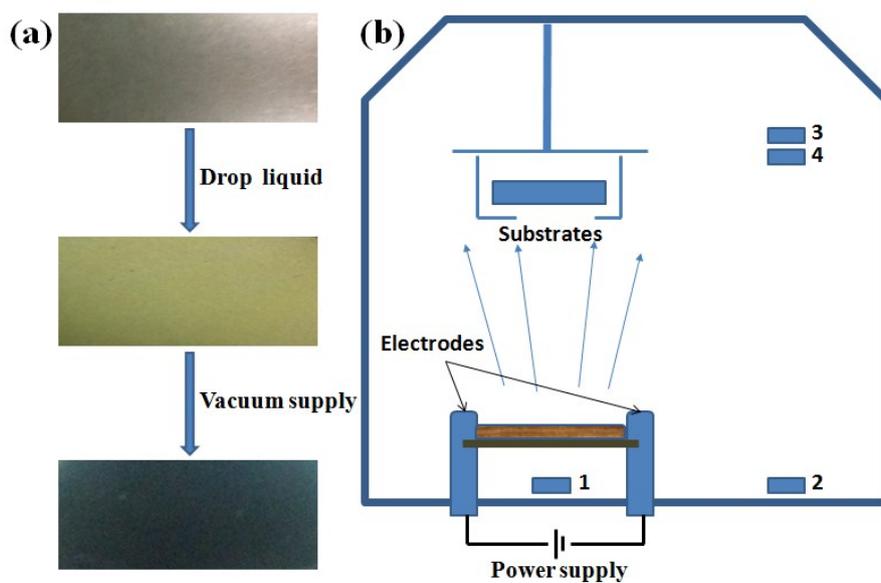


Fig. S1 Process flow for the deposition of perovskite thin films by flash evaporation. (a) The precursor solution is spread onto a molybdenum foil by dropping equally-distributed liquid and then a polycrystalline film is obtained by solvent evaporation after pumping down the growth chamber. (b) Where the hybrid perovskite is evaporated onto the desired substrates with four pieces. Control Sample 1 is placed by 5 cm right under the molybdenum foil and Control Sample 2 is placed parallel to Control Sample 1 but 20 cm far away from source. Both Control Sample 3 and 4 are placed back to back by 20 cm far away from substrates. Among them, Control Sample 3 faces up and Control Sample 4 faces down.

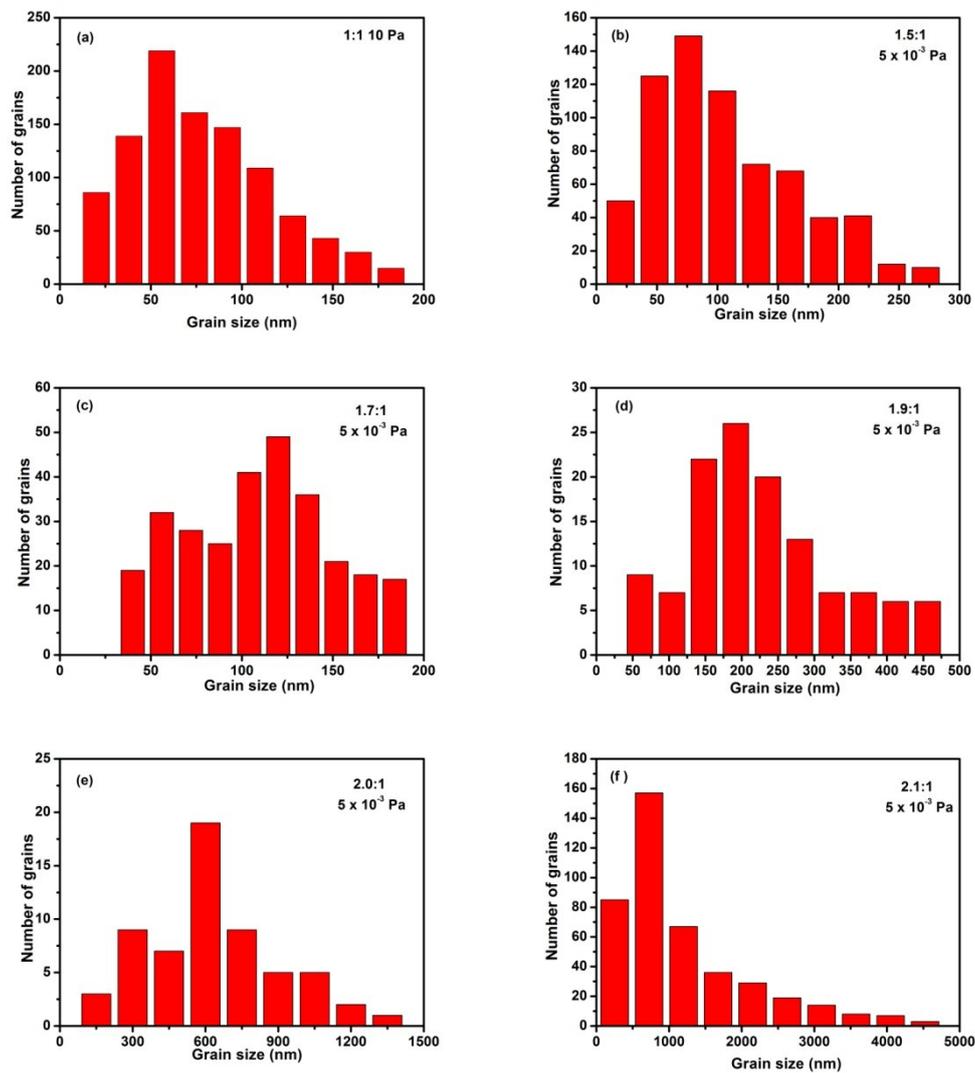


Fig. S2 (a) A histogram of average MAPbI₃ grain size at a high pressure of 10 Pa. (b) - (f) histograms of average MAPbI₃ grain size at a low pressure of 5×10^{-3} Pa with different molar ratios between MAI and PbI₂. The ratios are 1.5, 1.7, 1.9, 2.0, 2.1, respectively.

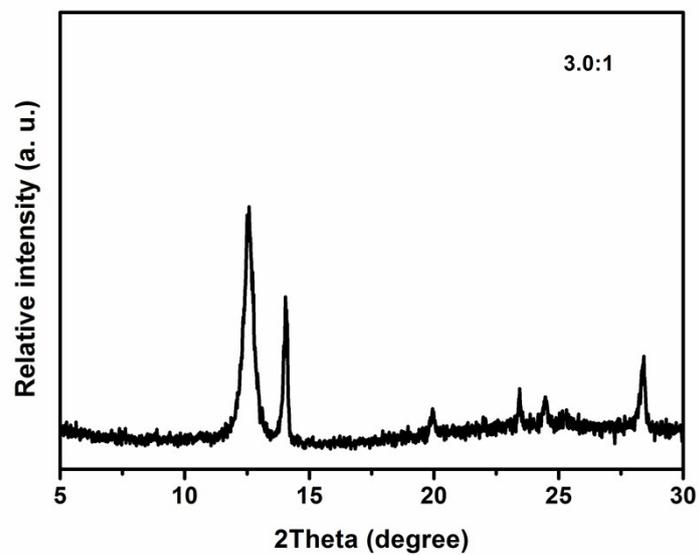


Fig. S3 X-ray diffraction spectra of films at a low pressure of 5×10^{-3} Pa with increasing current in three minutes.

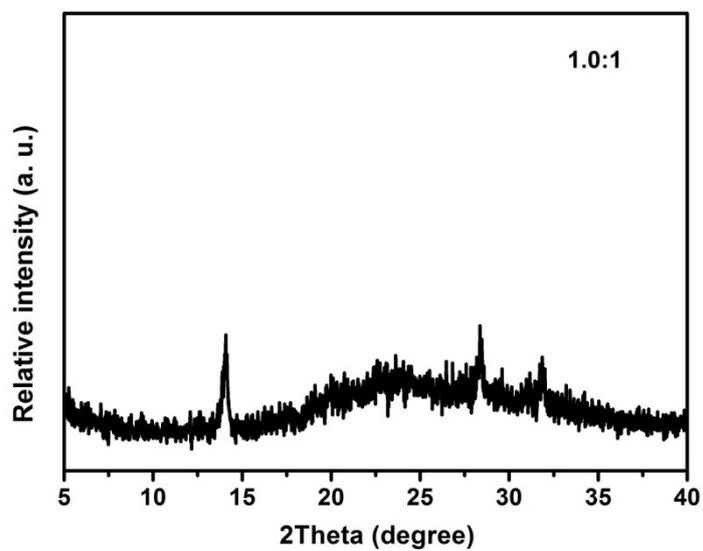


Fig. S4 X-ray diffraction spectra of the Control Sample 1 of glass which evaporated at a low pressure of 10 Pa.

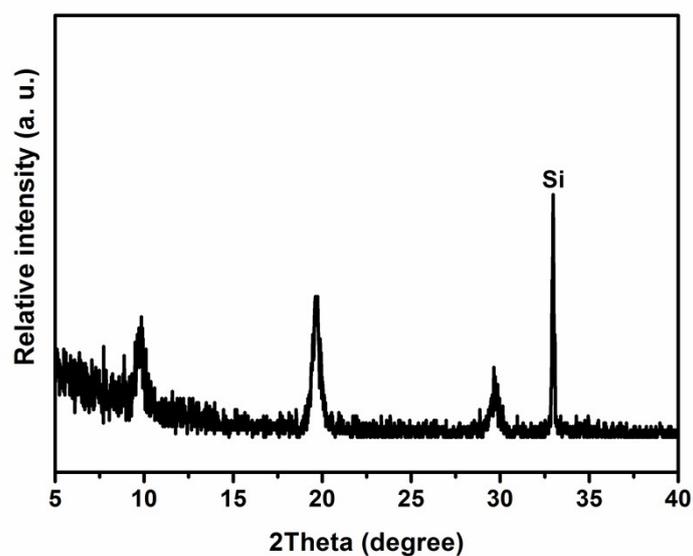


Fig. S5 X-ray diffraction spectra of a control sample of Si which evaporated at a low pressure of 5×10^{-3} Pa.

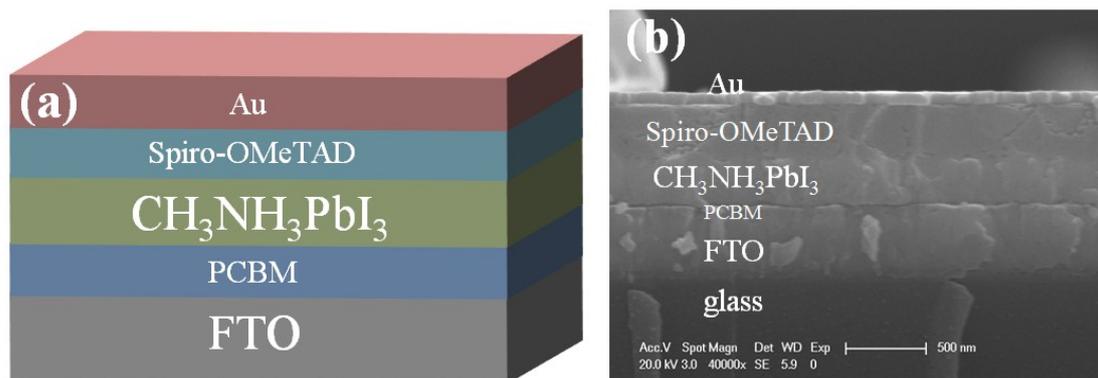


Fig. S6 (a) Layered structure of a complete solar cell fabricated by flash evaporation. The complete solar cell is a FTO-coated glass substrate, followed by an electron transport layer, a perovskite layer, a hole transport layer, and a top metal contact. (b) Cross-sectional SEM image of the perovskite solar cell.

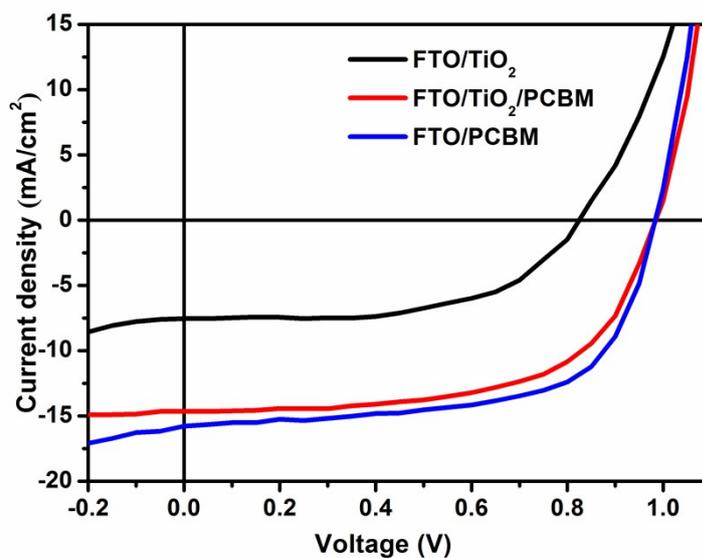


Fig. S7 Current-density/voltage curves for perovskite solar cells with structure of FTO/TiO₂/MAPbI₃/Spiro-OMeTAD/Au, FTO/TiO₂/PCBM/MAPbI₃/Spiro-OMeTAD/Au, and FTO/PCBM/MAPbI₃/Spiro-OMeTAD/Au.

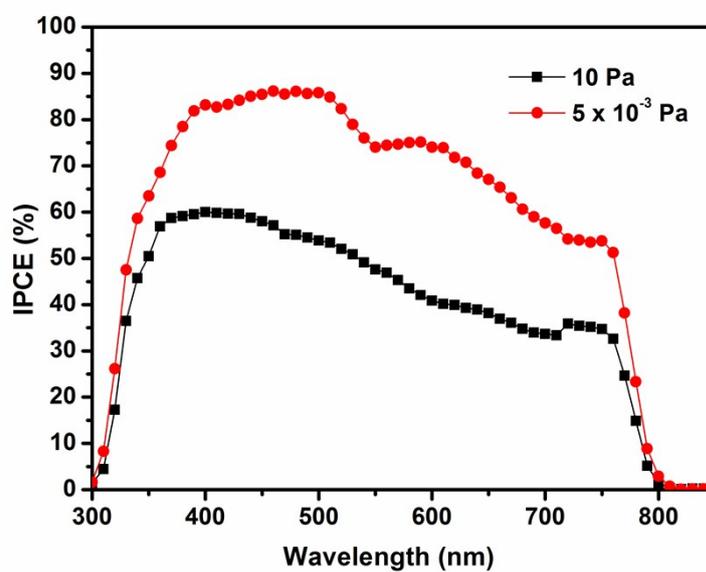


Fig. S8 IPCE in the UV-visible region for the planar perovskite solar cells with perovskite layer deposited at different pressure.