Supporting Information

Uniform, Stable and Efficient Planar-Heterojunction Perovskite Solar Cells by a Facile Low-Pressure Chemical Vapor Deposition under Fully Open-Air Condition

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Figure S1. The photograph of the white CH₃NH₃I powder, which is loaded in the quartz boat placed in the tubular furnace.



Figure S2. The XRD of CH_3NH_3I powder, and the it gives peaks at 19.66°, 19.93°, and 24.55°, assigned as the (002), (101) and (110) planes, which is well accord with the pattern of CAS#:14965-49-2.



Figure S3. The DSC of CH_3NH_3I powder and it has two endothermic peaks at 145 °C and 275 °C. The line of disorder after 300 °C is caused by the fast decomposition of CH_3NH_3I powder.



Figure S4. The photographs of different reaction time at (a) 0min, (b) 20min and (c) 100min. Figure S4(a) shows the photograph of PbI₂ film just placed in the tubular furnace. Figure S4(b) shows the photograph of PbI₂ film reacted for 20 min. Figure S4(c) shows the photograph of PbI₂ film reacted for 100 min.



Figure S5. The 3-D height image $(2 \times 2\mu m)$ of AFM of CH₃NH₃PbI₃ absorbers, and its bearing depth over $2 \times 2 \mu m$ 3-D AFM graph is only just 78 nm.



Figure S6. The EDS of CH₃NH₃PbI₃ absorbers, and the Pb/I ratio is highly close to the desired stoichiometry.



Figure S7. The photo pictures of $CH_3NH_3PbI_3/TiO_2/FTO/Glass at 145 °C with (a) 0min, (b) 30min, (c) 60min and (d) 120min, and (e) the photograph of annealing process. The experiments were carried out under a fully open-air condition with humidity of 61% at 25.5°C.$



Figure S8. The J-V curves of the best PSCs annealing 30 min with reverse and forward scan mode. Forward scan from -0.1V to 1.2V and reverse scan from 1.2V to -0.1V. The step voltage was fixed at 10mV. PSCs of annealing for 30 min give the efficiency of 11.10% by the forward scan and 12.73% by the reverse scan.



Figure S9. The J-V curves of the PSCs annealing (a) 0 min and (b) 60 min with reverse and forward scan mod. Forward scan from -0.1V to 1.2V and reverse scan from 1.2V to -0.1V. The step voltage was fixed at 10mV. In Figure S9 (a), PSCs of annealing for 0 min give the efficiency of 1.10% by the forward scan and 3.40% by the reverse scan. In Figure S9 (b), PSCs of annealing for 60 min show the efficiency of 8.67% by the forward scan and 9.79% by the reverse scan.