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Electronic Supporting Information

The synergistic effect of H₂O and DMF towards stable and 20% efficiency inverted perovskite solar cells

Chien-Hung Chiang^a, Md. Khaja Nazeeruddin^b, Michael Grätzel^b, Chun-Guey Wu^{a,c,*}

^a Research Center for New Generation Photovoltaics, National Central University,

^b Laboratory of Photonics and Interfaces, Swiss Federal Institute of Technology (EPFL), Station 6, Lausanne, CH 1015, Switzerland,

^c Department of Chemistry, National Central University, Jhong-Li, 32001, Taiwan, ROC.

Sample	Crystalline domain	Crystallinity (^a CPS)	
	size (Å)		
PSK-0	197	12	
PSK-0.1	250	31	
PSK-0.5	262	42	
PSK-1.0	243	50	
VPSK-0	254	29	
VPSK-0.1	269	32	
VPSK-0.5	280	55	
VPSK-1	277	55	

Table S1: The crystallinity domain size and crystallinity of thevarious perovskite films

a. CPS: count per second, used to represent the crystallinity of the perovskite film.

Jsc (mA/cm ²)	Voc (V)	FF	Max. PCE (%)	PCE (%) (Avg± SD)
23.51	1.03	0.83	20.1	19.1±0.63
22.51	0.99	0.75	16.7	
4.25	4.69	0.77	15.4	14.96 ± 0.29
		·		
2.58	3.78	0.62	6.11	
	Jsc (mA/cm ²) 23.51 22.51 4.25 2.58	Jsc (mA/cm²) Voc (V) 23.51 1.03 22.51 0.99 4.25 4.69 2.58 3.78	Jsc (mA/cm²) Voc (V) FF 23.51 1.03 0.83 22.51 0.99 0.75 4.25 4.69 0.77 2.58 3.78 0.62	Jsc (mA/cm ²) Voc (V) FF Max. PCE (%) 23.51 1.03 0.83 20.1 22.51 0.99 0.75 16.7 4.25 4.69 0.77 15.4 2.58 3.78 0.62 6.11

Table S2: The photovoltaic parameters of the cells and modules based VPsk-0.5 films.

a: da = a:designated illumination area.

b: Module based on Psk-0 film prepared without H₂O additive or DMF vapor treatment also listed for comparison.



Figure S1. GIWXRD patterns of Psk-X films prepared with various amounts of H₂O in MAI/IPA solution.



Figure S2. The Uv/vis absorption spectra of Psk-x and VPsk-0.5 films



Figure S3. The I-V curves of the inverted (D-X) cells based on Psk-X films.



Figure S4. The I-V curves of D-0.1 and D-1.0 under dark



Figure S5. GIWXRD patterns of VPsk-X films prepared with various amounts of H_2O in MAI/IPA solution and treated with DMF vapor..



Figure S6. The I-V curves of the inverted VD-X cells (cells based on VPsk-X films).



Figure S7. The histograms of the PCE based on 35 cells using VPsk-0.5 film as an absorber.



Figure S8. The I-V curves of VD-0.5 cell scanned at different directions (left) and with various delay times (scan rates, right)



Figure S9: The degrading of VD-0.5 cell under 85oC, 85% relative hunidity.



Figure S10: The IPCE curves of a large-area (1.3 cm²) cell measured at 5 poistions



Figure S11: (a) Schematic representation of the designed circuit for perovskite minimodule. (b) the real picture of the perovskite minimodule (left-hand side: front view; right-hand side: back view)..



Figure S12. The histograms of the PCE based on 60 inverted solar mini-modules using VPsk-0.5 films as an absorber.



Figure S13. TR-PL spectra of Psk-0, Psk-0.5 and VPsk-0.5 films (on glass)



Figure S14. The packing of the p-i-n cell for stability test in ambient atmosphere