Supporting Information

Incorporation of Two Electron Acceptors to Improve Electron Mobility and Stability of Perovskite Solar Cells

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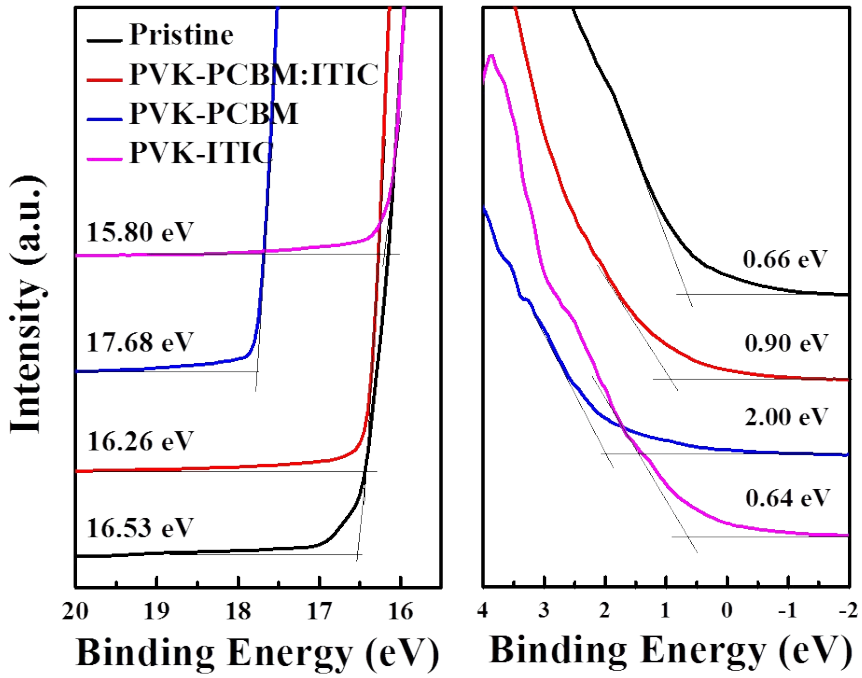

Figure S1. Ultraviolet photoelectron spectroscopy (UPS) of secondary electron cutoff and valence band of the pristine (black), PCBM:ITIC treated (red), PCBM treated (blue) and ITIC treated (purple) perovskite films.

Table S1. The energy level of pristine, PCBM:ITIC, PCBM and ITIC treated perovskite films.

Devices	E_{cutoff} (eV)	E_{oneset} (eV)	HOMO (eV)	LUMO (eV)
Pristine	16.53	0.66	-5.35	-3.81
PVK-PCBM:ITIC	16.26	0.90	-5.86	-4.26
PVK-PCBM	17.68	2.00	-5.54	-3.96
PVK-ITIC	15.80	0.64	-6.06	-4.47

Table S2. Photovoltaic parameters of the devices based on the pristine and treated films fabricated via solution mixture strategy.

Devices	J_{SC} (mA cm^{-2})	V_{OC} (V)	FF (%)	PCE (%)	Average PCE (%)
Pristine	19.11	1.01	72.23	14.00	13.56±0.44
PVK-PCBM:ITIC=1:0	19.81	1.02	76.16	15.51	15.12±0.39
PVK-PCBM:ITIC=0.6:0.4	20.67	1.05	78.98	16.99	16.65±0.34
PVK-PCBM:ITIC=0.5:0.5	20.14	1.04	77.45	16.36	15.90±0.46
PVK-PCBM:ITIC=0.4:0.6	20.25	1.04	76.13	16.09	15.45±0.64
PVK-PCBM:ITIC=0:1	20.59	1.03	74.24	15.91	15.40±0.51

The average and standard deviation values were calculated from 50 cells.

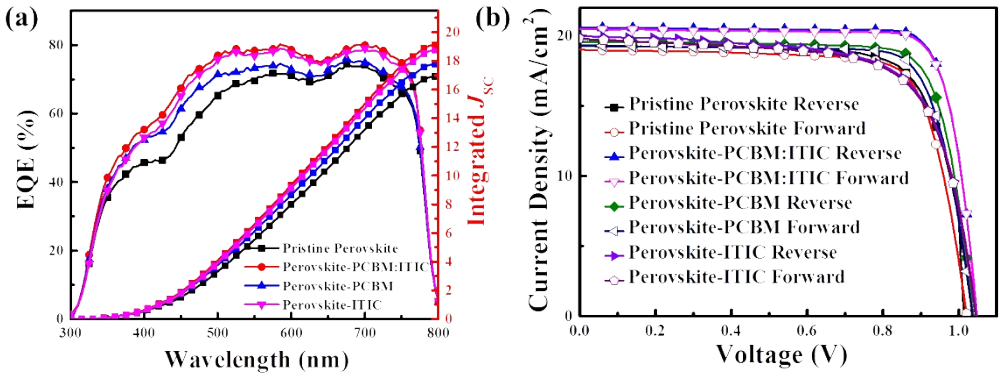

Figure S2 (a) EQE of the devices based on the pristine and treated perovskite films. (b) *J*-V curves for devises measured by forward and reverse scans.

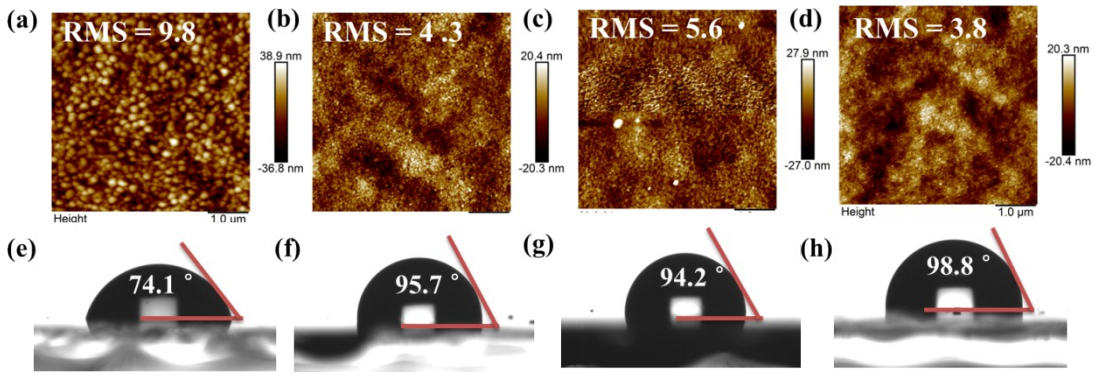

Figure S3. Atomic force microscopy (AFM) images for surface topography and the contact angles of water on the pristine (a, e), PCBM:ITIC (b, f), PCBM (c, g) and ITIC (d, h) treated perovskite films.

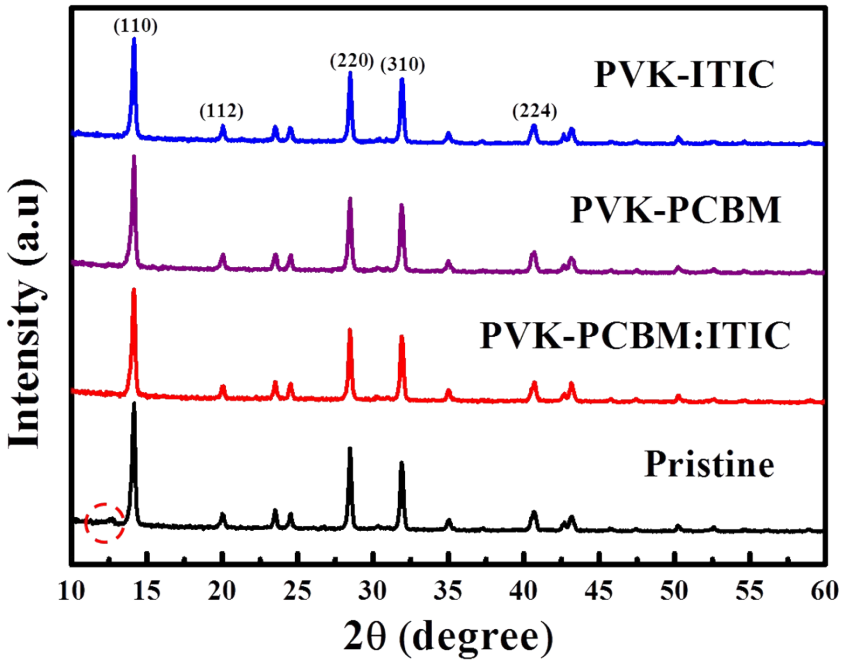

Figure S4. GIXRD profile of pristine and treated perovskite films.

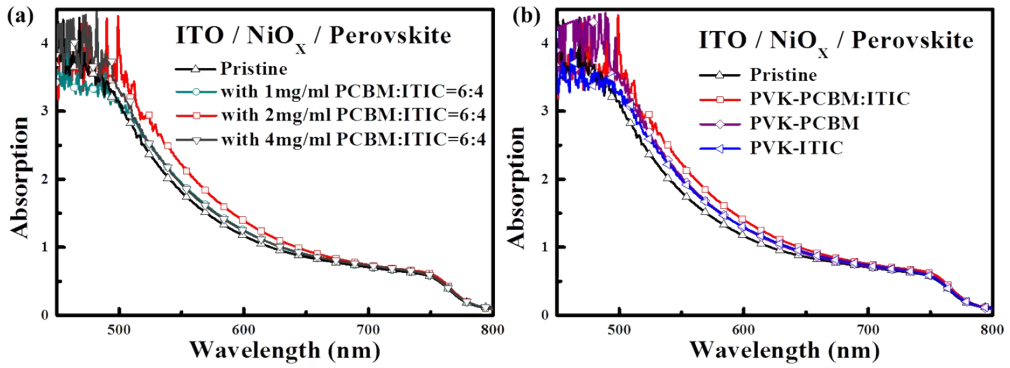

Figure S5. UV-Vis absorption spectra of the pristine and treated perovskite films.

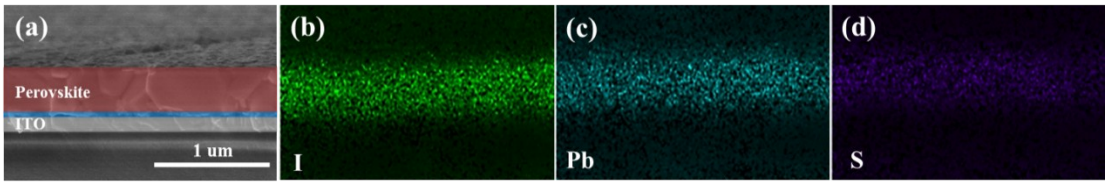

Figure S6 (a) Cross-sectional SEM image of the inverted device structure (glass/ITO/NiO_x/Perovskite (treated with PCBM:ITIC)) and EDS mapping of: **(b)** I, **(c)** Pb, **(d)** S elements.

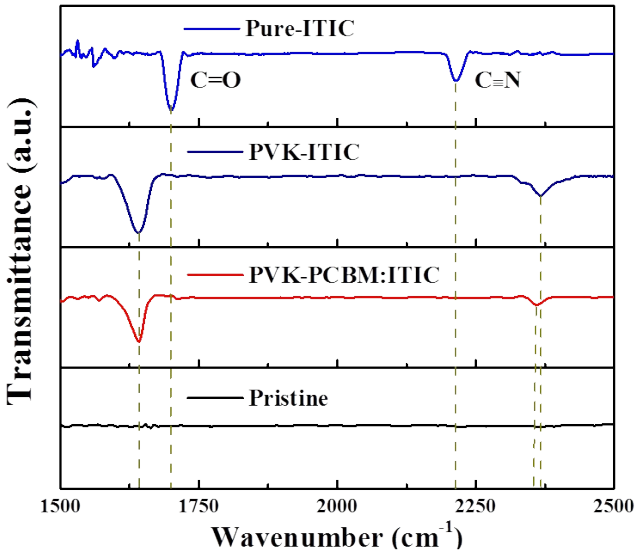

Figure S7 FTIR spectra of the powder of ITIC, PVK-ITIC, PVK-PCBM:ITIC and pristine perovskite blend.

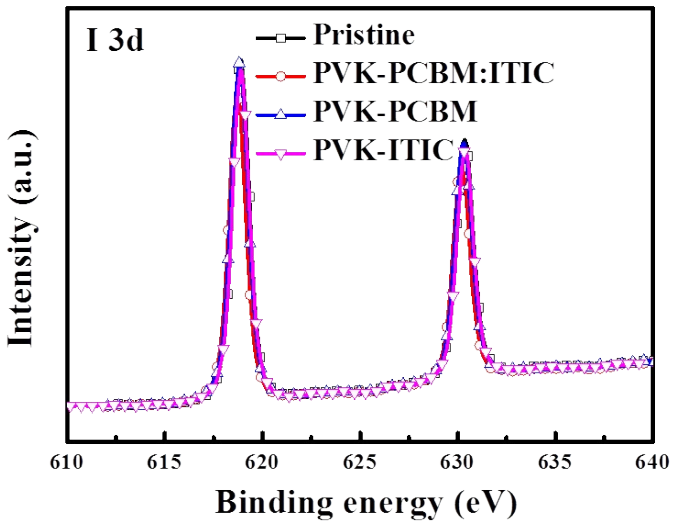

Figure S8. XPS spectra in I 3d region for perovskite films made from fresh precursor solutions without and with treatment.

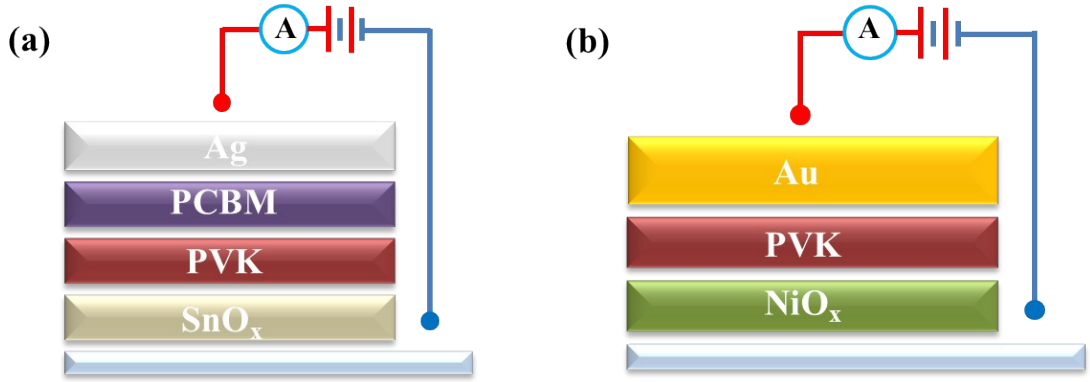

Figure S9. The electron-only (a) and hole-only (b) device structures.

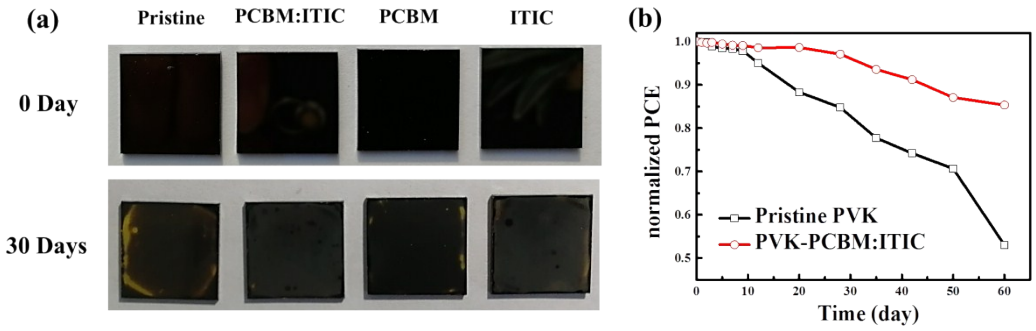

Figure S10. (a) A series of photographs of perovskite films without and with treated before and after 30 days in the ambient condition of 60% relative humidity. (b) The corresponding efficiency as a function of the device aging time.