Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Perovskite based Plug and Play AC Photovoltaic Device with Ionic Liquid Induced Transient Opto-electronic Conversion

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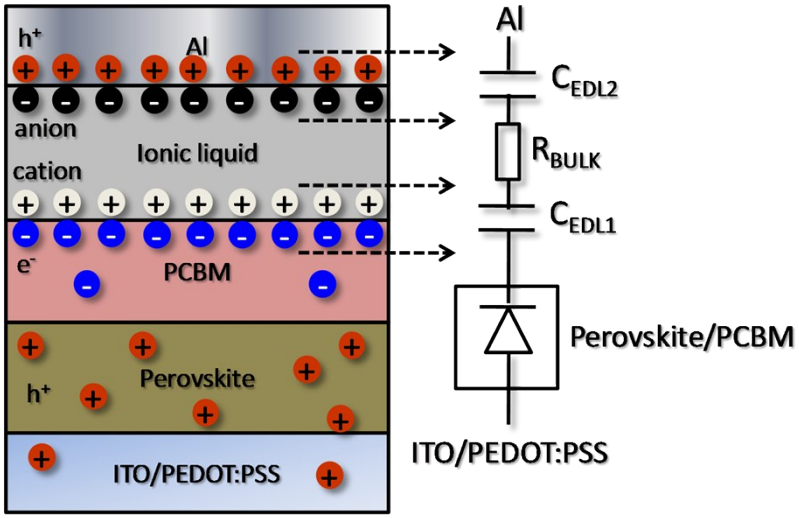

Figure S1. The device architecture of ITO/PEDOT:PSS/$CH_3NH_3PbI_3$/PCBM/Et2PrNMe-CF3BF3(IL)/Al and the equivalent circuit: C_{EDL1} and C_{EDL2} are the two capacitor formed the PCBM/ionic liquid and ionic liquid/Al interfaces and the R_{BULK} is the bulk resistance of the ionic liquid.

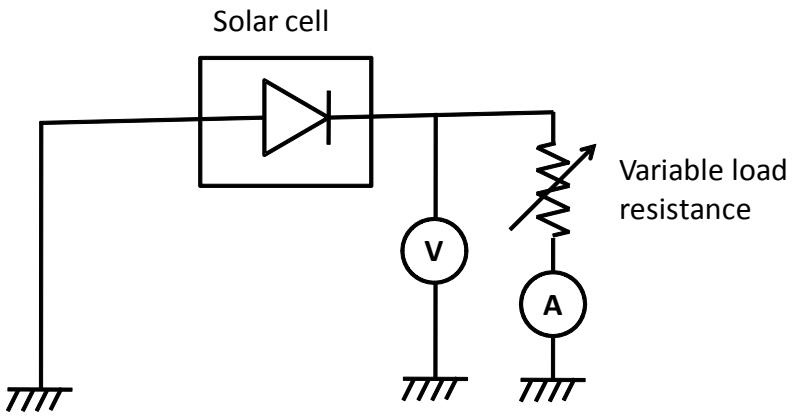

Figure S2. Schematic circuit diagram of the measurement unit

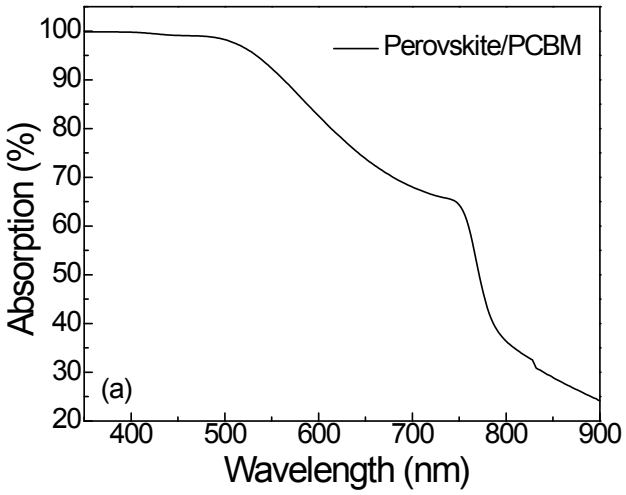

Figure S3. Absorption spectra of the perovskite/PCBM film

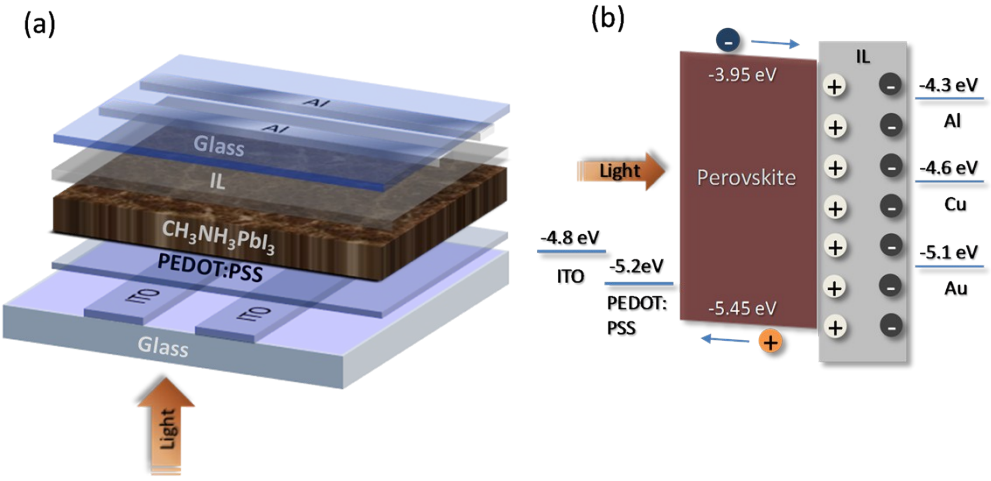

Figure S4. (a) Schematic diagram of the device configuration. (b) Schematic illustration of energy level diagram and charge transport of ITO (UV-Ozone treated)/PEDOT:PSS/perovskite ($CH_3NH_3PbI_3$)/IL (BMIM-OTF)/Al, Cu, Au photo-cell.

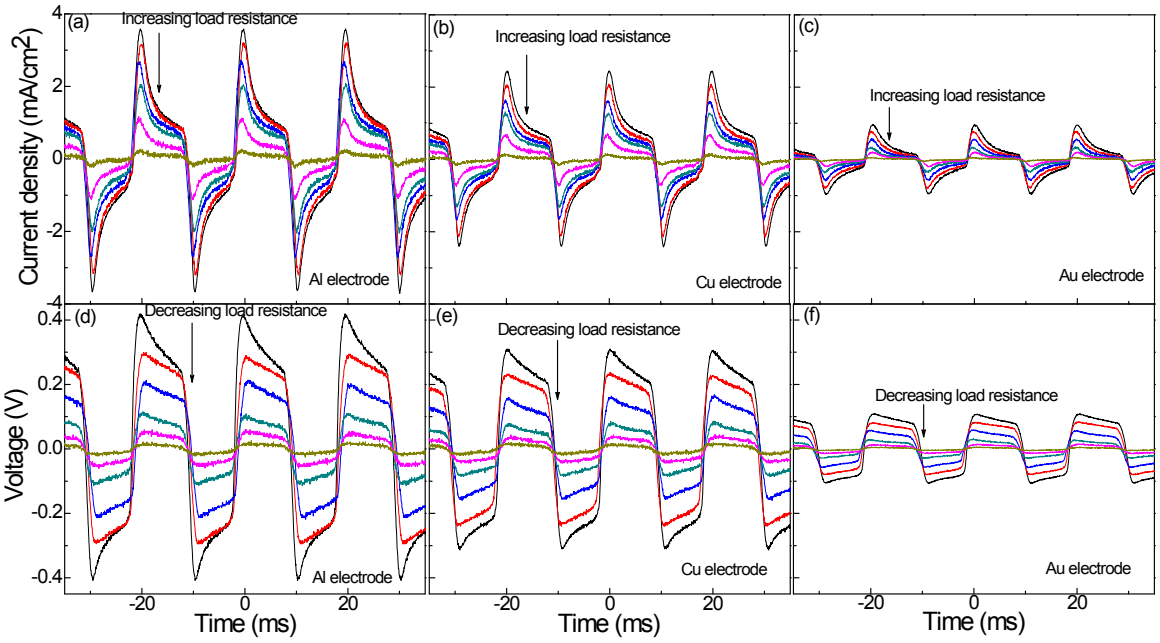

Figure S5. Transient photo-current response of the AC solar cell at 50 Hz for (a) Al, (b) Cu and (c) Au electrode. Transient photo-voltage response of the AC solar cell for (d) Al, (e) Cu and (f) Au electrode.

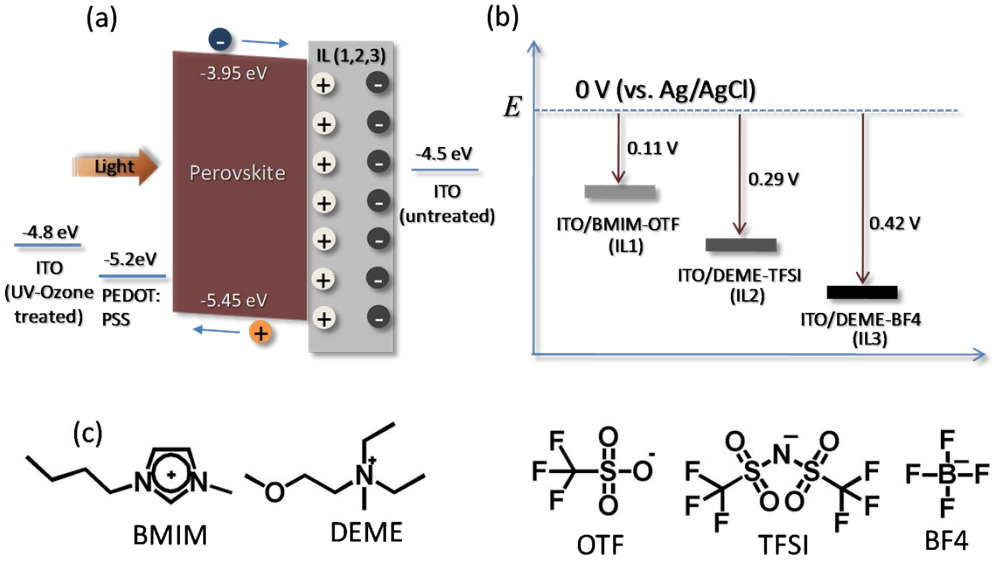

Figure S6. (a) Schematic illustration of energy level diagram of ITO (UV-Ozone treated)/PEDOT:PSS/ perovskite ($CH_3NH_3PbI_3$)/IL (1,2,3)/ITO (untreated) photo-cell. (b) Change in effective electrode potential of ITO with different ionic liquid. (c) Molecular structures and abbreviations of the ionic liquids. IL1 is BMIM-OTF (BMIM: 1-butyl-3-methylimidazolium, OTF: trifluoromethanesulfonate), IL2 is DEME-TFSI (DEME: N,N-diethyl-N-methyl(2-methoxyethyl)ammonium, TFSI: bis(trifluoromethylsulfonyl)imide), and IL3 is DEME-BF4 (BF4: tetrafluoroborate).

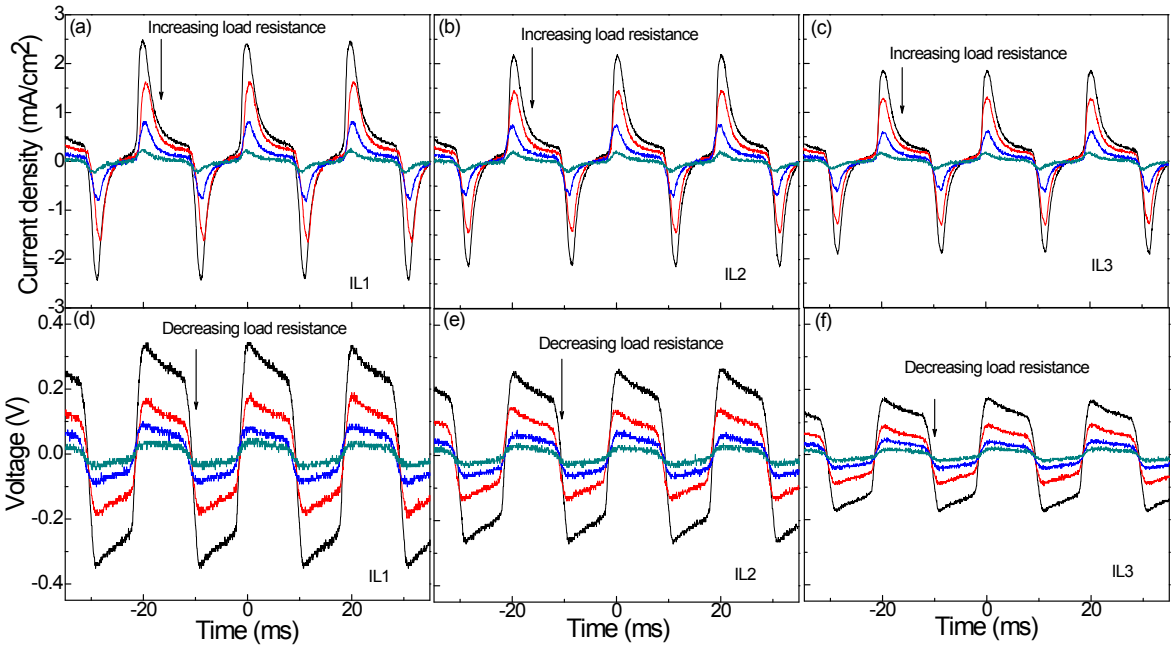

Figure S7. Transient photo-current response of the AC solar cell at 50 Hz for (a) BMIM-OTF (IL1), (b) DEME-TFSI (IL2) and (c) DEME-BF4 (IL3). Transient photo-voltage response of the devices for (d) IL1, (e) IL2 and (f) IL3.

Table S1. Device performance for the AC solar cells with different electrode materials and different ionic liquids

Condition	J_{SC} (mA/cm^2)	V_{OC} (V)	FF (%)	η (%)
Al	3.58	0.42	39.23	0.59
Cu	2.45	0.31	32.91	0.25
Au	0.97	0.11	20.61	0.02
BMIM-OTF (IL1)	2.49	0.34	41.34	0.35
DEME-TFSI (IL2)	2.18	0.27	33.97	0.20
DEME-BF4 (IL3)	1.86	0.17	22.13	0.07