Supplementary information for

Elimination of the light-soaking effect and performance enhancement in perovskite solar cells using a high dielectric constant fullerene derivative as electron extraction material

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Table S1 Variation in time of the fitting parameters for devices using [60]PCBM as EEL under continuous illumination.

Time (min)	Rs (Ohm)	R1 (Ohm)	C1 (F)	Rμ (Ohm)	Q2	α	f_p	Cμ (F)
0	46.0	54.4	1.92E-08	138.5	3.3E-07	0.77	59951	1.7E-08
10	44.8	54.4	1.92E-08	78.3	2.8E-07	0.77	85566	1.3E-08
20	45.5	54.4	1.93E-08	60.0	2.1E-07	0.77	100146	1.0E-08
50	45.1	54.0	1.86E-08	16.7	1.0E-07	0.77	136016	4.3E-09
70	44.8	52.0	1.88E-08	14.1	9.0E-08	0.77	163721	3.7E-09
80	45.0	52.0	1.94E-08	13.8	8.2E-08	0.77	179619	3.30E-09
90	45.02	52.01	1.94E-08	13.83	8.2E-08	0.77	179619	3.3E-09

Table S2 Variation in time of the fitting parameters for devices using PTEG-1 as EEL under continuous illumination.

Time (min)	Rs	R1	C1 (F)
0	43.7	53.6	2.43E-08
10	41.8	53.4	2.40E-08
20	41.4	53.3	2.37E-08
30	41.6	53.5	2.36E-08
40	41.5	52.0	2.43E-08
50	41.4	52.0	2.29E-08
60	41.3	52.1	2.27E-08

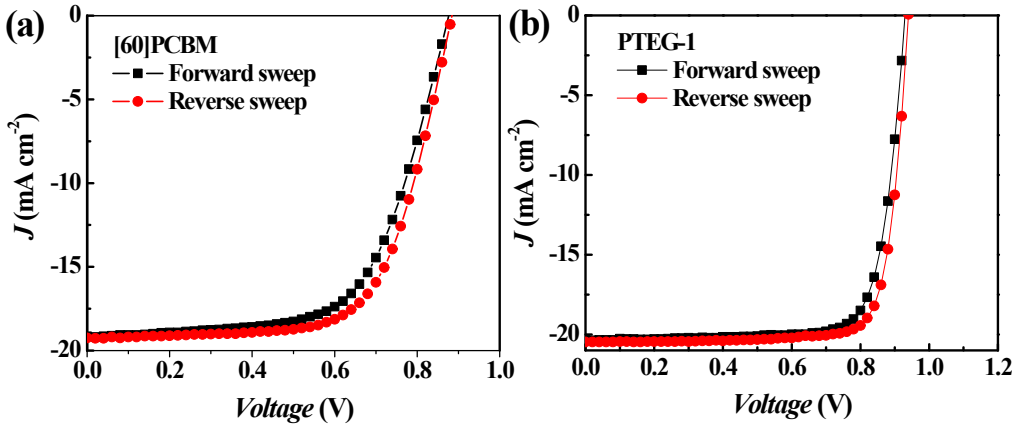

Fig. S1 J-V characteristics under forward and reverse sweep for devices using (a) [60]PCBM and (b) PTEG-1 as EEL.

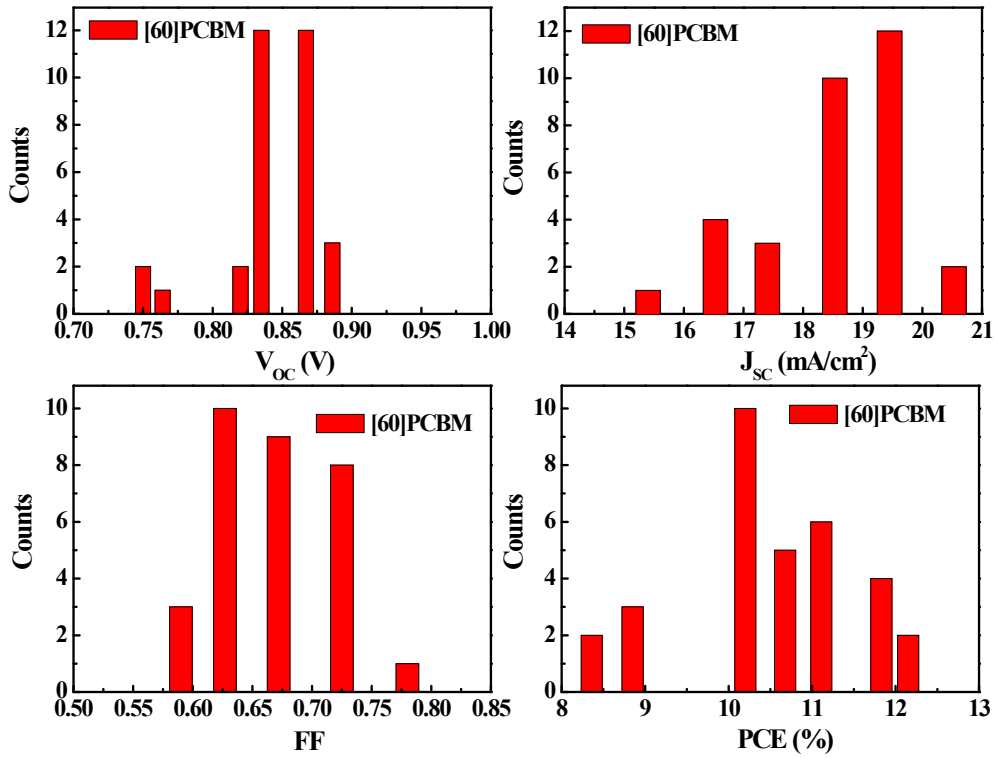

Fig. S2 Statistics of the device parameters for devices using [60]PCBM as EEL.

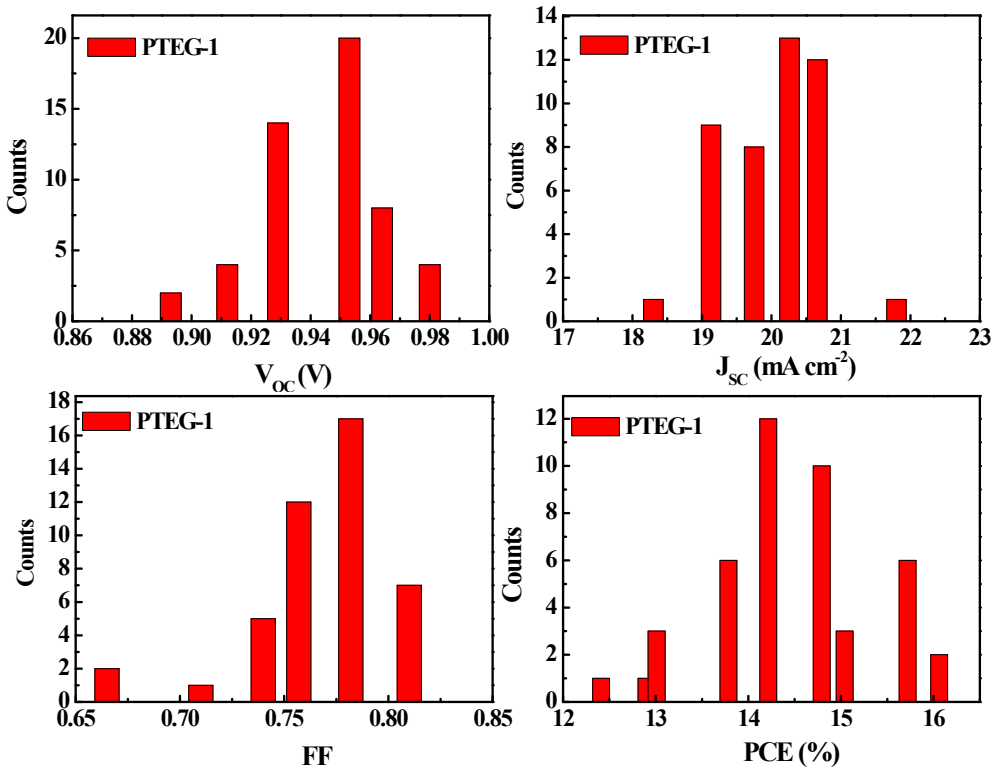

Fig. S3 Statistics of the device parameters for the devices using PTEG-1 as EEL.

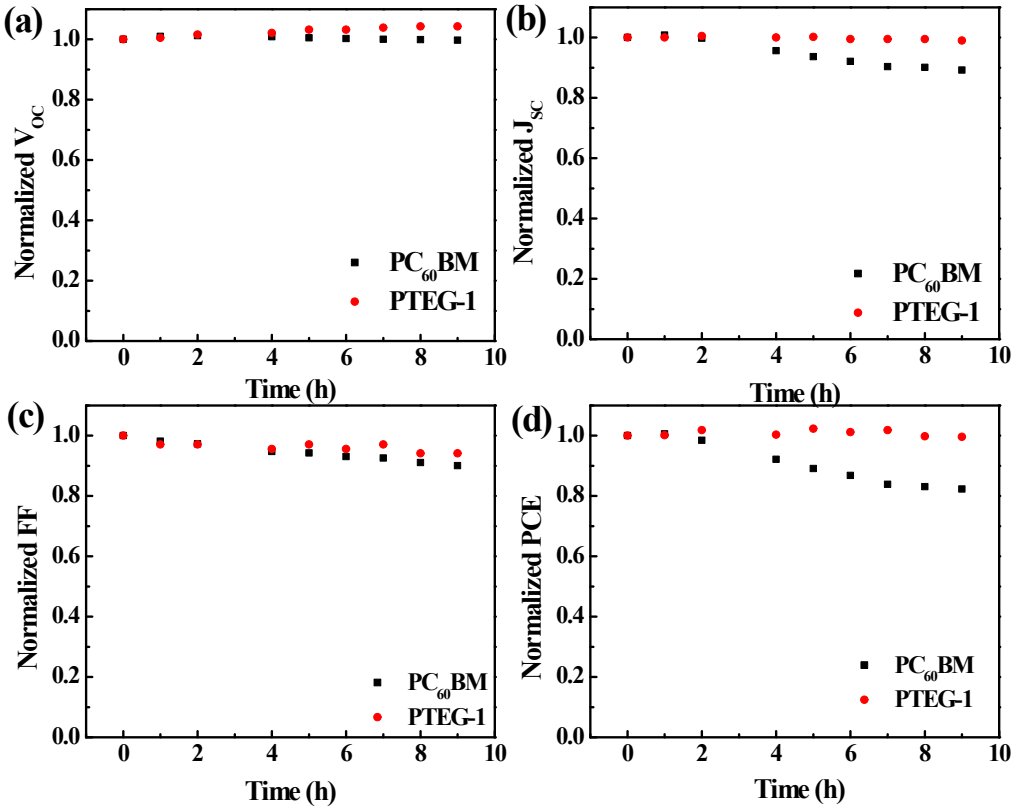

Fig. S4 Variation of the device parameters under prolonged illumination. The device parameters after 1.5 h light soaking are taken as initial value (0 h).

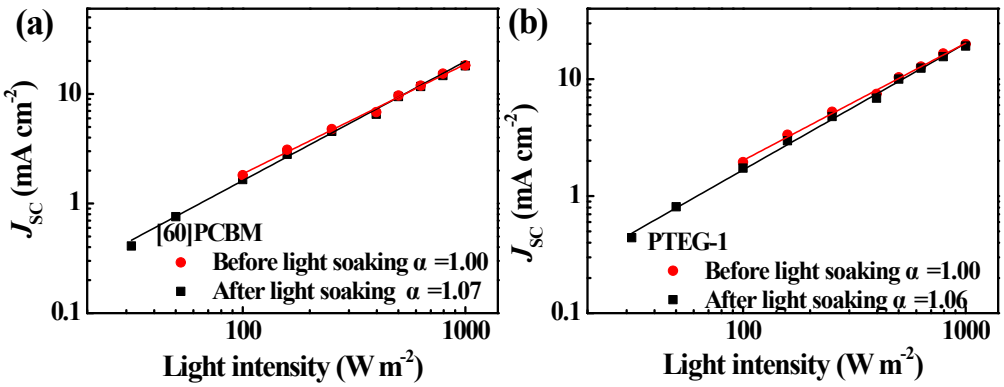

Fig. S5 Light intensity dependence of the J_{SC} measured before and after light soaking for devices using (a) [60]PCBM and (b) PTEG-1 as EEL.

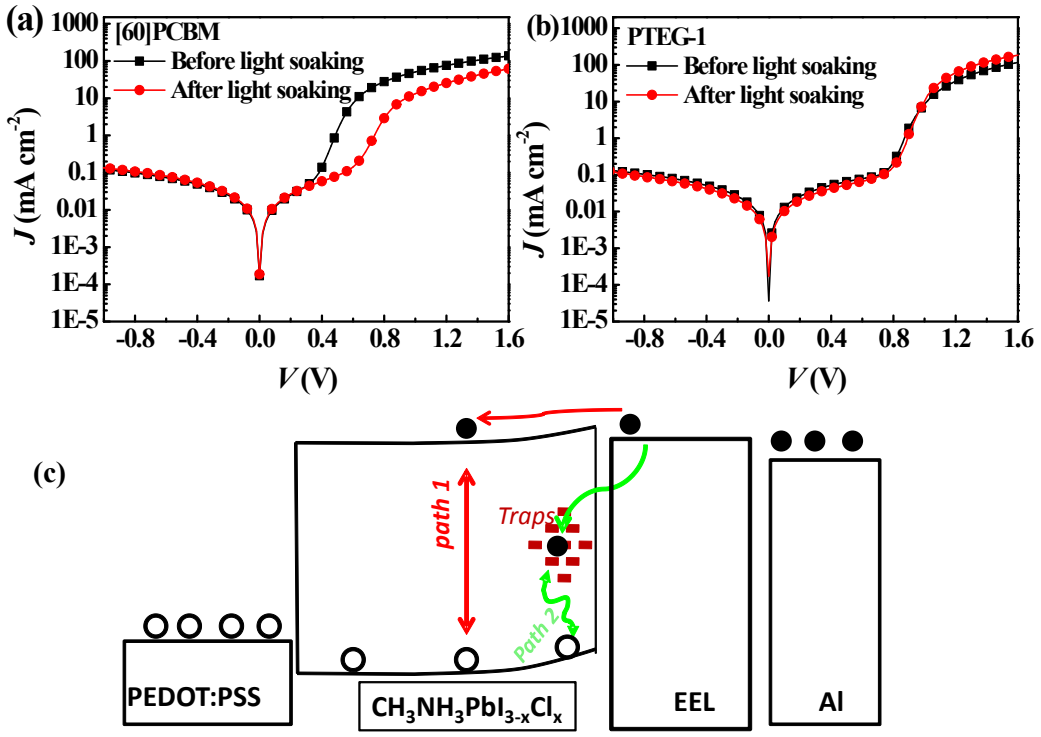

Fig. S6 Dark J-V characteristics measured before and after light soaking for devices using (a) [60]PCBM and (b) PTEG-1 as EEL, and (c) schematic of the recombination process of injected charge carriers in diodes with structure ITO/PEDOT:PSS/$CH_3NH_3PbI_{3-x}Cl_x$/EEL/Al.

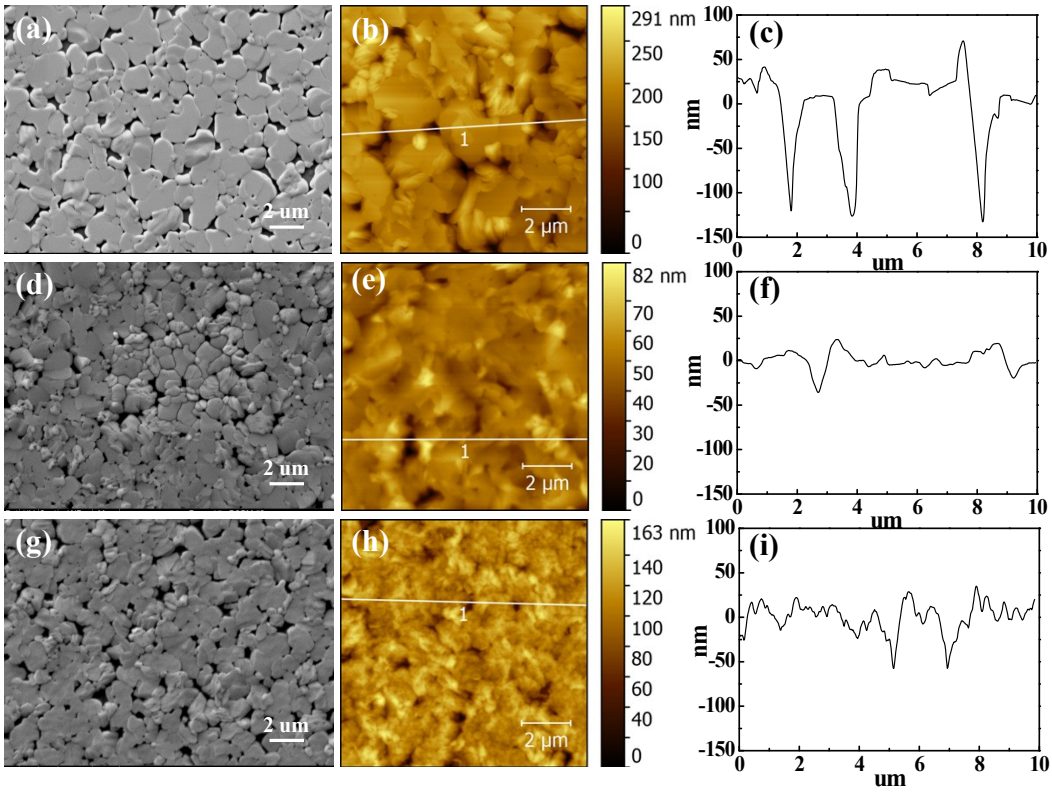

Fig. S7 SEM, AFM and profile micrographs for (a-c) ITO/PEDOT:PSS/pristine perovskite, (d-f) ITO/PEDOT:PSS/HP/[60]PCBM, and (g-i) ITO/PEDOT:PSS/HP/PTEG-1.