Supporting Information

The Role of Balanced Dual Charge Generation Pathways in Ternary Organic Solar Cells

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Table S1 Summary of photovoltaic parameters of ternary devices with typical IT-M weight ratios under AM 1.5G illumination at 100 mW/cm^2.

IT-M weight ratio (%)	Number	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE[a)] (%)	$J_{calc.}$[b)] (mA/cm^2)
0%	C29-1	0.833	12.190	67.682	6.875	
	C29-3	0.834	12.200	68.345	6.961	
	C29-4	0.837	11.907	65.662	6.544	
	C33-1	0.836	11.958	69.117	6.911	
	C33-2	0.836	11.987	68.680	6.890	
	C33-3	0.836	11.840	68.331	6.768	
	C33-4	0.837	11.890	64.929	6.459	
	Ave	0.836	11.996	67.535	6.773	11.958
30%	C17-1	0.864	13.926	68.006	8.183	
	C17-3	0.863	14.008	67.025	8.198	
	C28-1	0.863	14.010	66.966	8.198	
	C28-2	0.862	13.963	67.042	8.077	
	Ave	0.863	13.977	67.260	8.164	13.485
50%	C25-1	0.869	15.201	68.292	9.030	
	C25-2	0.871	15.215	68.214	9.047	
	C31-2	0.871	15.373	68.245	9.139	
	C31-3	0.873	15.375	68.400	9.188	
	Ave	0.871	15.291	68.288	9.101	13.791
70%	C32-1	0.902	15.303	68.544	9.467	
	C32-2	0.901	15.238	68.709	9.437	
	C32-3	0.899	15.148	68.693	9.355	
	C32-4	0.896	15.240	67.160	9.176	
	C36-1	0.894	15.450	67.198	9.288	
	C36-2	0.893	15.879	67.806	9.621	

	C36-3	0.894	15.850	67.509	9.573	
	C36-4	0.895	15.961	66.312	9.479	
	Ave	0.897	15.509	67.741	9.425	14.390
80%	C35-2	0.917	15.578	69.836	9.977	
	C35-4	0.918	15.634	68.766	9.877	
	C37-2	0.898	16.627	66.047	9.867	
	C20-1	0.916	16.874	66.885	10.346	
	C20-2	0.921	16.948	67.143	10.484	
	C20-4	0.920	16.989	66.819	10.449	
	Ave	0.915	16.442	67.583	10.167	15.521
90%	C26-1	0.922	15.470	69.007	9.849	
	C26-2	0.924	15.520	68.800	9.873	
	C26-3	0.924	15.567	68.641	9.883	
	C26-4	0.928	15.774	68.165	9.983	
	C27-1	0.929	15.303	69.608	9.904	
	C27-2	0.928	15.320	69.674	9.907	
	C27-3	0.926	15.237	69.879	9.860	
	C27-4	0.926	15.286	68.758	9.736	
	Ave	0.926	15.435	69.067	9.874	15.492
100%	C30-1	0.929	14.377	66.223	8.803	
	C30-3	0.927	14.507	66.833	8.986	
	C16-1	0.930	14.850	64.503	8.901	
	C16-2	0.932	14.626	65.251	8.841	
	Ave	0.930	14.590	65.703	8.883	14.377

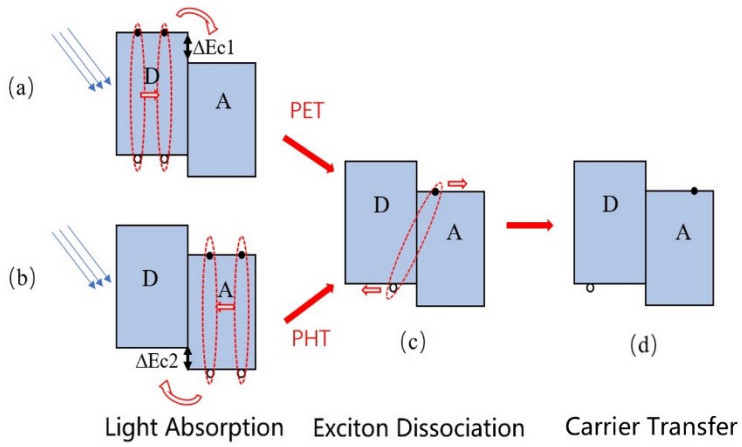

Figure S1. A simplified energy diagram of a donor−acceptor interface. (a)PET and (b)PHT process. Ground state electrons absorb energy and are excited to an excited state to form hole-electron pair. Exciton diffusion to the interface of D/A materials and then occur (c)exciton dissociation, as the two-charge transfer from the same CT state, the process of dissociation behaves identically. The CT state dissociate and (d)exciton transfer carry out to electrodes at both ends.

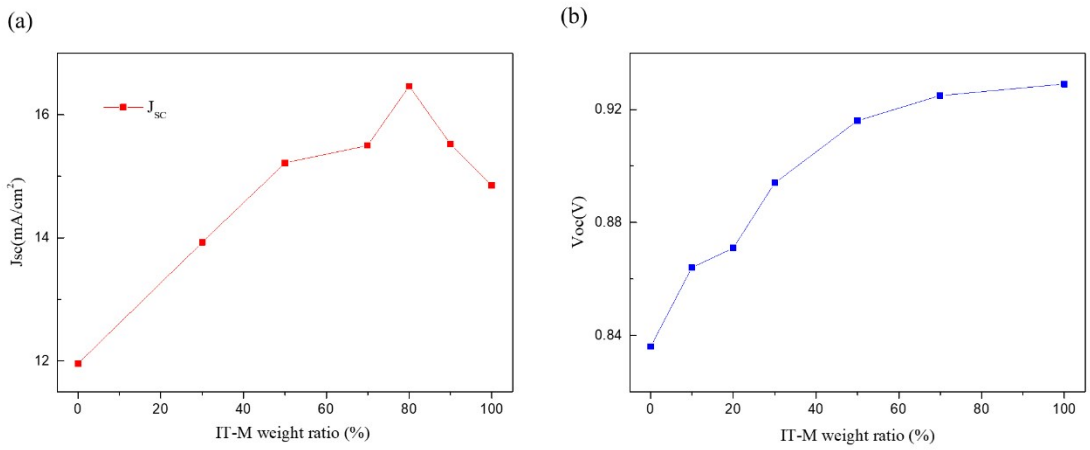

Figure S2. The changes of (a) V_{OC} and (b) J_{SC} of PBDB-T: $PC_{71}BM$:IT-M ternary devices which has varying the weight ratio of IT-M.

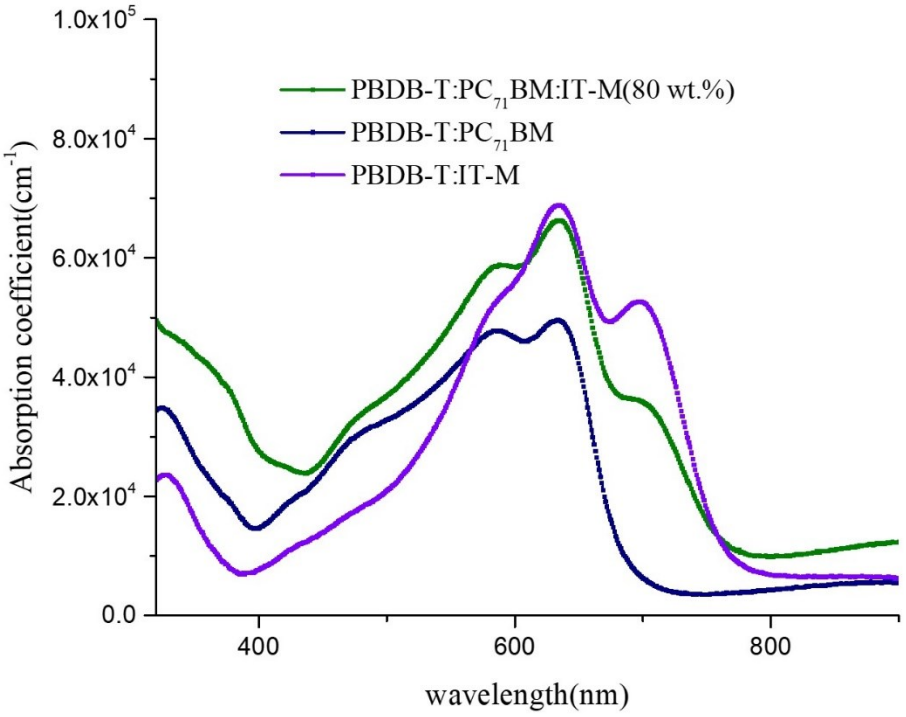

Figure S3. The absorption spectrum of absorption coefficient of ternary and binary devices. The absorption coefficient is calculated by dividing the absorbance by the film thickness.

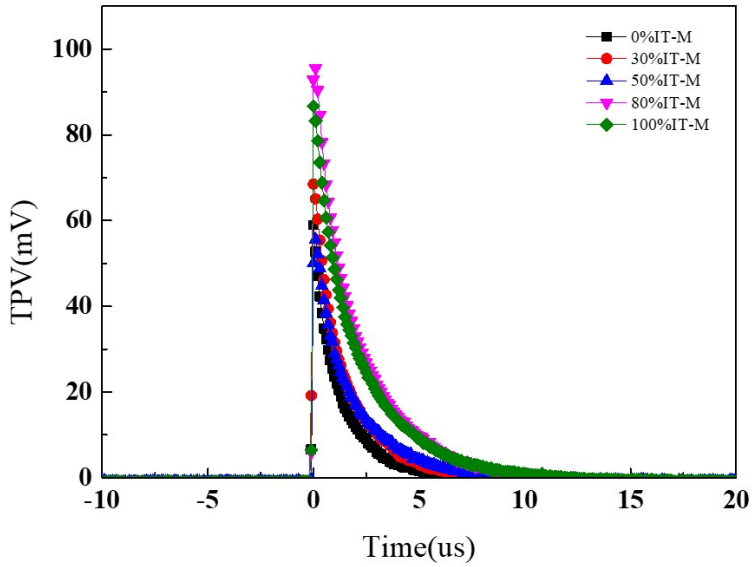

Figure S4. Transient photovoltage (TPV) analysis. The charge density (n) in the device as a function of V_{OC} are obtained from small perturbation lifetime via photovoltage (TPV) technique.

Table S2. The detail dates of lifetime from TPV measurement.

IT-M Content (%)	Lifetime (us)
0	1.432
30	1.689
50	2.004
80	2.257
100	2.342

Table S3. The root-mean-square (RMS) of ternary blends with different IT-M contents.

IT-M weight ratio (%)	Ra (nm)
0	1.80
30	2.18
50	2.32
80	2.58
100	2.95

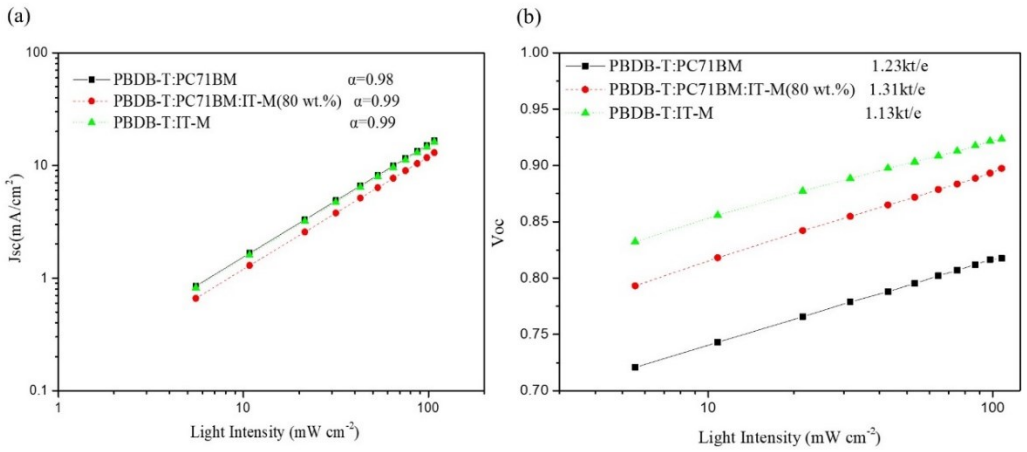

Figure S5. Dependence of (a) J_{SC} and (b) V_{OC} on light intensity (Plight) of two binary devices and the optimal ternary device.

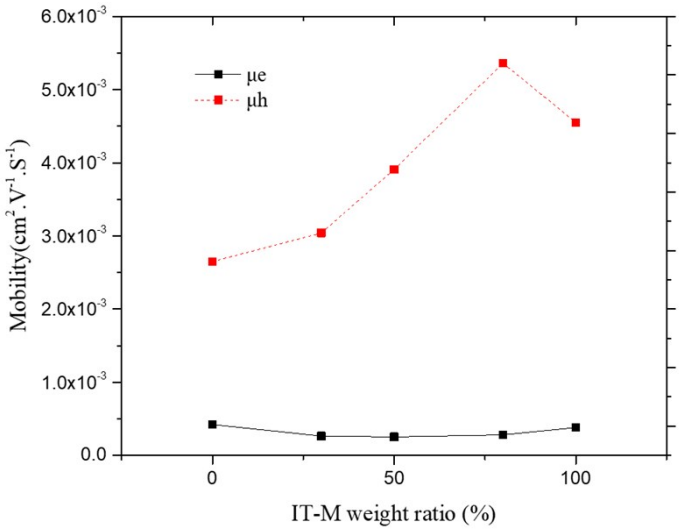

Figure S6. Electron and hole mobility of devices with different IT-M content.

Table S4. Summary of the charge carrier mobility in the PBDB-T: $PC_{71}BM$:IT-M doping different amount of IT-M.

IT-M weight ratio (%)	μe ($cm^2.V^{-1}.S^{-1}$)	μh ($cm^2.V^{-1}.S^{-1}$)
0	4.22×10^{-4}	2.65×10^{-3}
30	2.64×10^{-4}	3.04×10^{-3}
50	2.52×10^{-4}	3.91×10^{-3}
80	2.81×10^{-4}	5.36×10^{-3}
100	3.82×10^{-4}	4.55×10^{-3}