Supporting Information

for

Rational Design of Ternary-phase Polymer Solar Cells by Controlling Polymer Phase Separation

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1. Absorption Spectroscopy

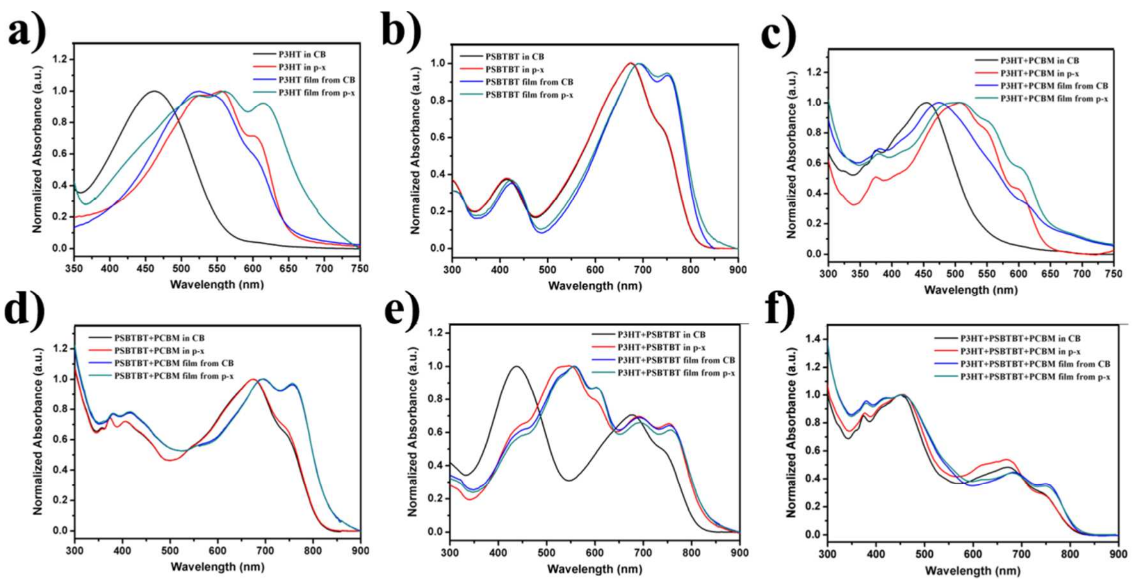

Figure S1. UV-vis absorption spectroscopy of the solutions in CB and p-x and films fabricated from them: a) P3HT; b) PSBTBT; c) P3HT+$PC_{71}BM$ (1:1); d) PSBTBT+$PC_{71}BM$ (1:1); e) P3HT+PSBTBT (1:1); f) P3HT+PSBTBT+$PC_{71}BM$ (1:1:2).

2. AFM Characterization

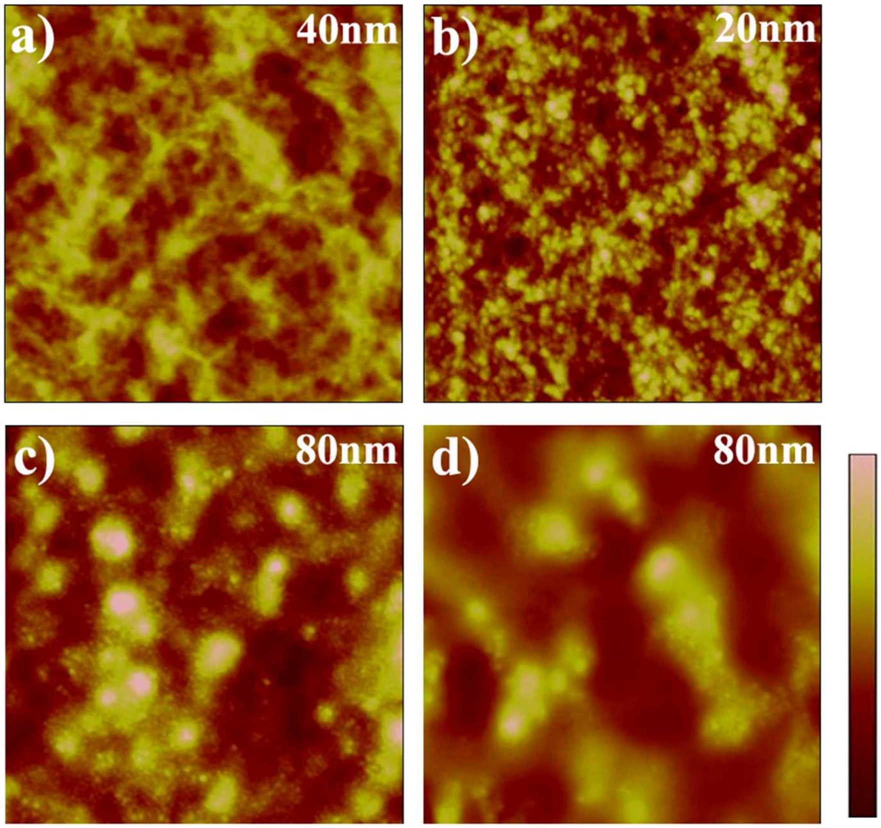

Figure S2. Tapping-mode AFM (2 μm×2 μm) phase images: a) Pure P3HT film prepared from CB; b) Pure PSBTBT film prepared from p-x; c) Ternary-phase blend film prepared from CB (1:1:2) ; d) Ternary-phase blend film prepared from p-x (1:1:2).

3. XRD Characterization

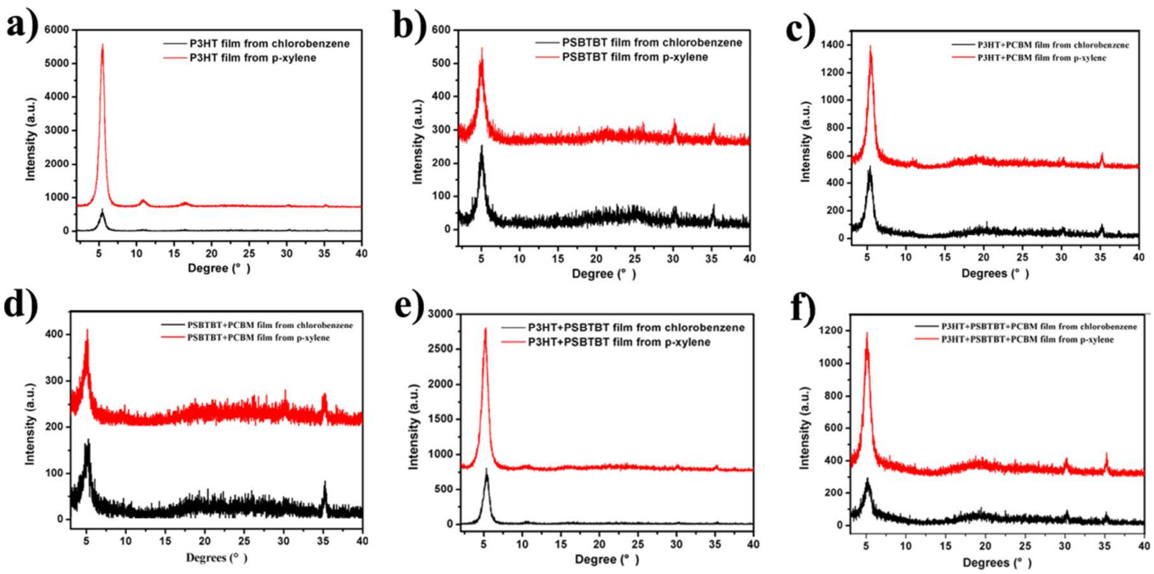

Figure S3. XRD patterns of films prepared from CB and p-x: a) P3HT; b) PSBTBT; c) P3HT+PC$_{71}$BM (1:1); d) PSBTBT+PC$_{71}$BM (1:1); e) P3HT+PSBTBT (1:1); f) P3HT+PSBTBT+PC$_{71}$BM (1:1:2).

4. AFM image corresponding to KPFM measurement

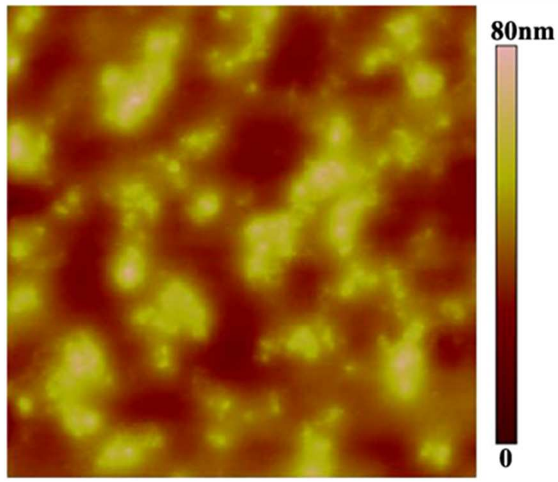

Figure S4. AFM height images (2μm×2μm) of ternary-phase prepared from p-x (1:1:2).

5. KPFM images under illumination

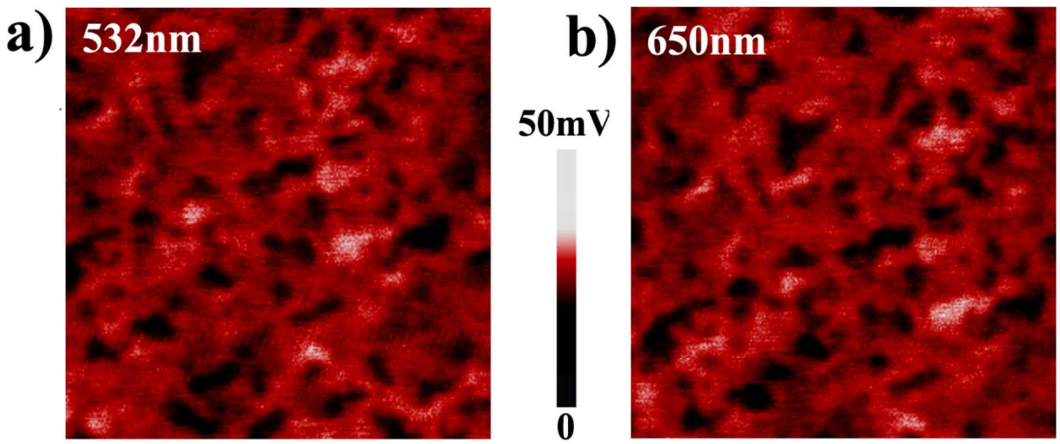

Figure S5. KPFM images (2 μm×2 μm) of the ternary-phase sample prepared from p-x: a) surface potential image under illumination at 532 nm; b) surface potential image under illumination at 650 nm.

6. Device optimization

Table S1. Performance of P3HT/$PC_{71}BM$ PSCs fabricated from p-x.

Temperature /Anealing time	V_{oc} (V)	J_{sc} (mA/cm^2)	*FF* (%)	*PCE* (%)
110^{o}C/15min	0.63	5.1	51	1.9
110^{o}C/30min	0.64	5.2	60	2.3
110^{o}C/60min	0.63	5.0	54	2.0
150^{o}C/15min	0.63	5.8	60	2.6
150^{o}C/30min	0.64	5.7	62	2.6
150^{o}C/60min	0.63	5.4	59	2.4
190^{o}C/15min	0.66	4.8	57	2.1
190^{o}C/30min	0.65	4.6	56	2.0
190^{o}C/60min	0.67	4.3	56	1.9

Table S2. Performance of PSBTBT/$PC_{71}BM$ PSCs fabricated from p-x.

Temperature /Anealing time	V_{oc} (V)	J_{sc} (mA/cm^2)	*FF* (%)	*PCE* (%)
110^{o}C/15min	0.65	2.8	31	0.69
110^{o}C/30min	0.65	3.3	32	0.82
110^{o}C/60min	0.66	3.5	31	0.86
150^{o}C/15min	0.63	3.9	32	0.93
150^{o}C/30min	0.66	4.1	34	1.1
150^{o}C/60min	0.65	3.7	34	0.96
190^{o}C/15min	0.65	3.8	32	0.94
190^{o}C/30min	0.66	3.9	32	0.99
190^{o}C/60min	0.65	3.6	32	0.89

Table S3. Performance of ternary-phase PSCs fabricated from p-x.

Temperature /Anealing time	V_{oc} (V)	J_{sc} (mA/cm^2)	*FF* (%)	*PCE* (%)
110^{o}C/15min	0.66	4.0	40	1.2
110^{o}C/30min	0.65	4.9	41	1.6
110^{o}C/60min	0.65	6.2	41	1.9
150^{o}C/15min	0.65	6.0	41	1.8
150^{o}C/30min	0.65	7.2	43	2.4
150^{o}C/60min	0.65	3.6	29	0.79
190^{o}C/15min	0.67	3.3	31	0.82
190^{o}C/30min	0.65	2.0	29	0.46
190^{o}C/60min	0.59	1.2	28	0.24