
Supporting Information

Alkenyl Carboxylic Acid: Engineering the Nanomorphology in Polymer-Polymer Solar Cells as Solvent Additive

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1. General methods

The charge carrier mobility was measured by the space charge limited current (SCLC) method with a device structure of ITO/ PEDOT:PSS (40 nm)/ Blend (120~150 nm)/ Au (50 nm) (hole-only device) for the hole mobility measurement and with a structure of ITO/ ZnO (40 nm)/ Blend(120~150 nm)/ LiF (0.6 nm)/ Al (80 nm) (electron-only device) for the electron mobility measurement. The mobility was determined by fitting the dark current to the model of a single carrier SCLC, described by the equation:

$$J = 9\epsilon_r\epsilon_0\mu V^2/8L^3$$

where J is the current density, L is the thickness of active layer blend, ϵ_r is the dielectric constant of the polymer, ϵ_0 is the permittivity of the vacuum, μ is the mobility under zero-field, $V = V_{app} - V_{bi}$, V_{app} is the applied potential, and V_{bi} is the built-in potential from the difference in the work functions of the anode and the cathode.

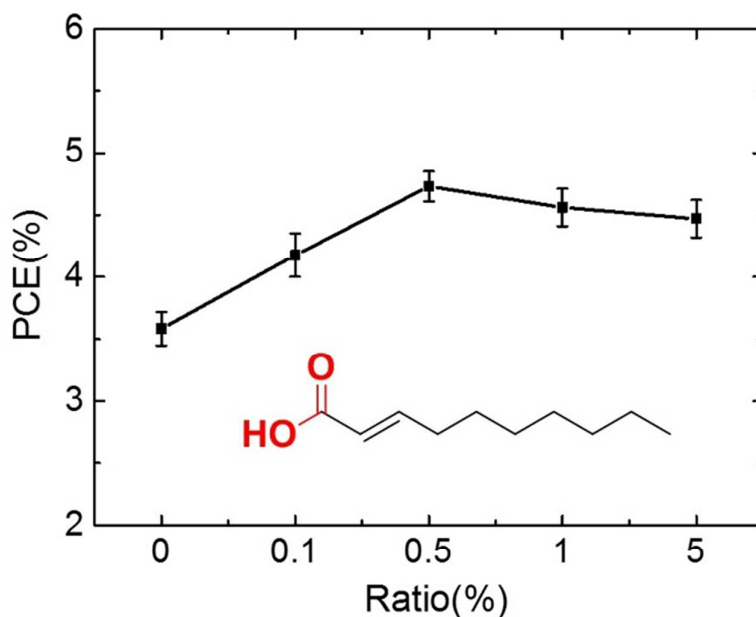


Figure S1. The PCEs of all-polymer solar cells cast from chloroform with different CA-10 concentration.

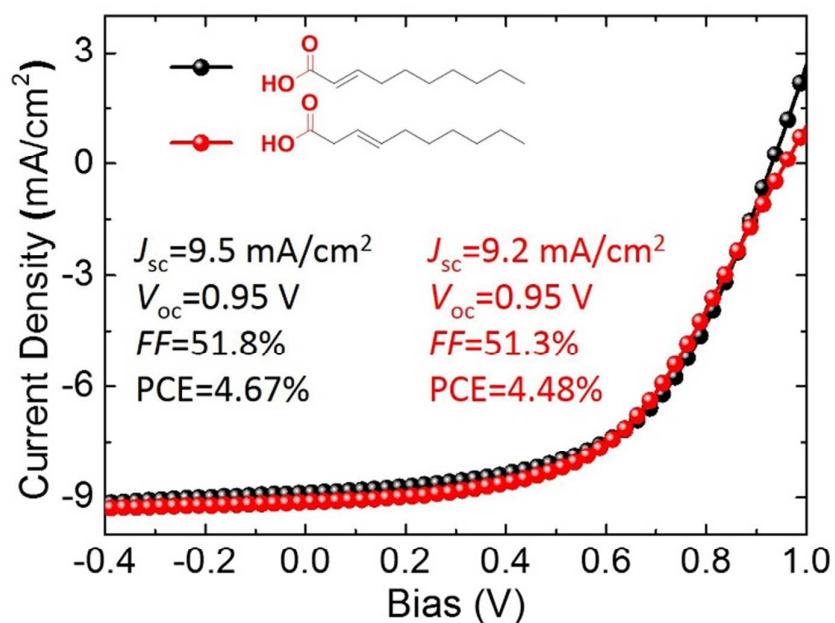


Figure S2. The J - V curves of PTP8/P(NDI2HD-T) solar cell devices cast from chloroform with trans-2-Decenoic Acid and 3-Decenoic Acid as additives.

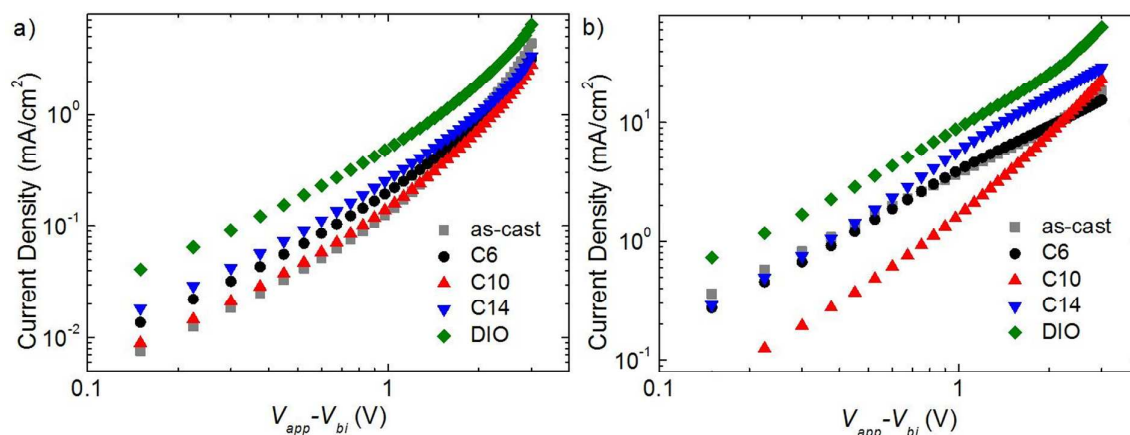


Figure S3. J - V characteristics of the hole-only (a), electron-only (b) devices based on PTP8/P(NDI2HD-T) blends.

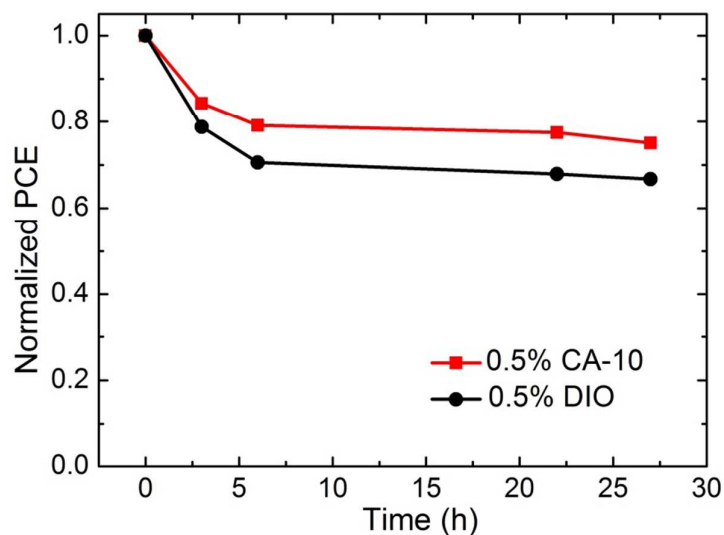


Figure S4. Degradation of PTP8/P(NDI2HD-T) solar cells to show the effect of additive on device stability. Devices were tested with a conventional structure of ITO/PEDOT:PSS/Blend/Al and stored under dark in N_2 .

Table S1. The molecular formula, structure and boiling point of acids and solvent we adopted.

Name	MF	Structure	bp
trans-2-Hexenoic Acid	$C_6H_{10}O_2$		217 °C (lit.)
trans-2-Decenoic Acid	$C_{10}H_{18}O_2$		135-121 °C 2.5 mmHg
3-Decenoic Acid	$C_{10}H_{18}O_2$		120 °C 1.5mmHg
9-Tetradecenoic Acid	$C_{14}H_{26}O_2$		144 °C 0.6 mm Hg (lit.)
Chloroform	$CHCl_3$		61 °C

Table S2. Effect of blend ratios on the performance of as-cast devices based on PTP8/P(NDI2HD-T) using chloroform as the processing solvent.

PTP8/P(NDI2HD-T)	V_{oc} (V)	J_{sc} (mA/cm ²)	FF	PCE (%)
70:30	0.976	7.05	0.54	3.77
65:35	0.976	7.10	0.57	3.92
60:40	0.975	7.96	0.60	4.66
55:45	0.963	7.40	0.62	4.43
50:50	0.948	7.22	0.57	3.89

Table S3. Effect of thickness on the performance of as-cast devices based on PTP8/P(NDI2HD-T) using chloroform as the processing solvent.

Device	V_{oc} (V)	J_{sc} (mA/cm ²)	FF (%)	PCE (%)
PTP8:P(NDI2HD-T), 20mg/ml, 1000rpm, 1.5:1	0.66	2.80	17.2	0.32
PTP8:P(NDI2HD-T), 20mg/ml, 1500rpm, 1.5:1	0.73	4.70	24.4	0.83
PTP8:P(NDI2HD-T), 20mg/ml, 2000rpm, 1.5:1	0.70	5.11	30.6	1.10
PTP8:P(NDI2HD-T), 20mg/ml, 2500rpm, 1.5:1	0.69	5.63	35.2	1.36
PTP8:P(NDI2HD-T), 18mg/ml, 1000rpm, 1.5:1	0.65	4.66	25.0	0.76
PTP8:P(NDI2HD-T), 18mg/ml, 1500rpm, 1.5:1	0.59	4.78	30.6	0.86
PTP8:P(NDI2HD-T), 18mg/ml, 2000rpm, 1.5:1	0.74	5.33	36.4	1.43
PTP8:P(NDI2HD-T), 18mg/ml, 2500rpm, 1.5:1	0.69	4.94	39.6	1.34
PTP8:P(NDI2HD-T), 15mg/ml, 1000rpm, 1.5:1	0.64	5.09	34.0	1.10
PTP8:P(NDI2HD-T), 15mg/ml, 1500rpm, 1.5:1	0.73	4.70	38.8	1.32
PTP8:P(NDI2HD-T), 15mg/ml, 2000rpm, 1.5:1	0.76	4.48	42.3	1.44
PTP8:P(NDI2HD-T), 15mg/ml, 2500rpm, 1.5:1	0.79	4.15	42.3	1.38
PTP8:P(NDI2HD-T), 13mg/ml, 1000rpm, 1.5:1	0.68	4.87	39.3	1.29
PTP8:P(NDI2HD-T), 13mg/ml, 1500rpm, 1.5:1	0.63	3.59	34.2	0.77
PTP8:P(NDI2HD-T), 13mg/ml, 2000rpm, 1.5:1	0.64	3.39	32.9	0.71
PTP8:P(NDI2HD-T), 13mg/ml, 2500rpm, 1.5:1	0.61	2.94	32.5	0.58