Supporting Information

Conjugated polymers with deep LUMO levels for field-effect transistors and polymer-polymer solar cells

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The supporting information contains GPC curves of DPP polymers (Fig. S1),absorption spectra of the polymers in chloroform (Fig. S2), cyclic voltammograms of DPP polymers and PCBM (Fig. S3), Output curves of the OFET devices (Fig. S4), Field-effect hole and electron mobility of the DPP polymers thin films without thermal annealing (Table S1), AFM height image of the polymer thin films on Si substrate withoutand with thermal annealing (Fig. S5), and characteristics of PDPP5T:DPP-polymer solar cells fabricated from chloroform with different additives (Table S2).

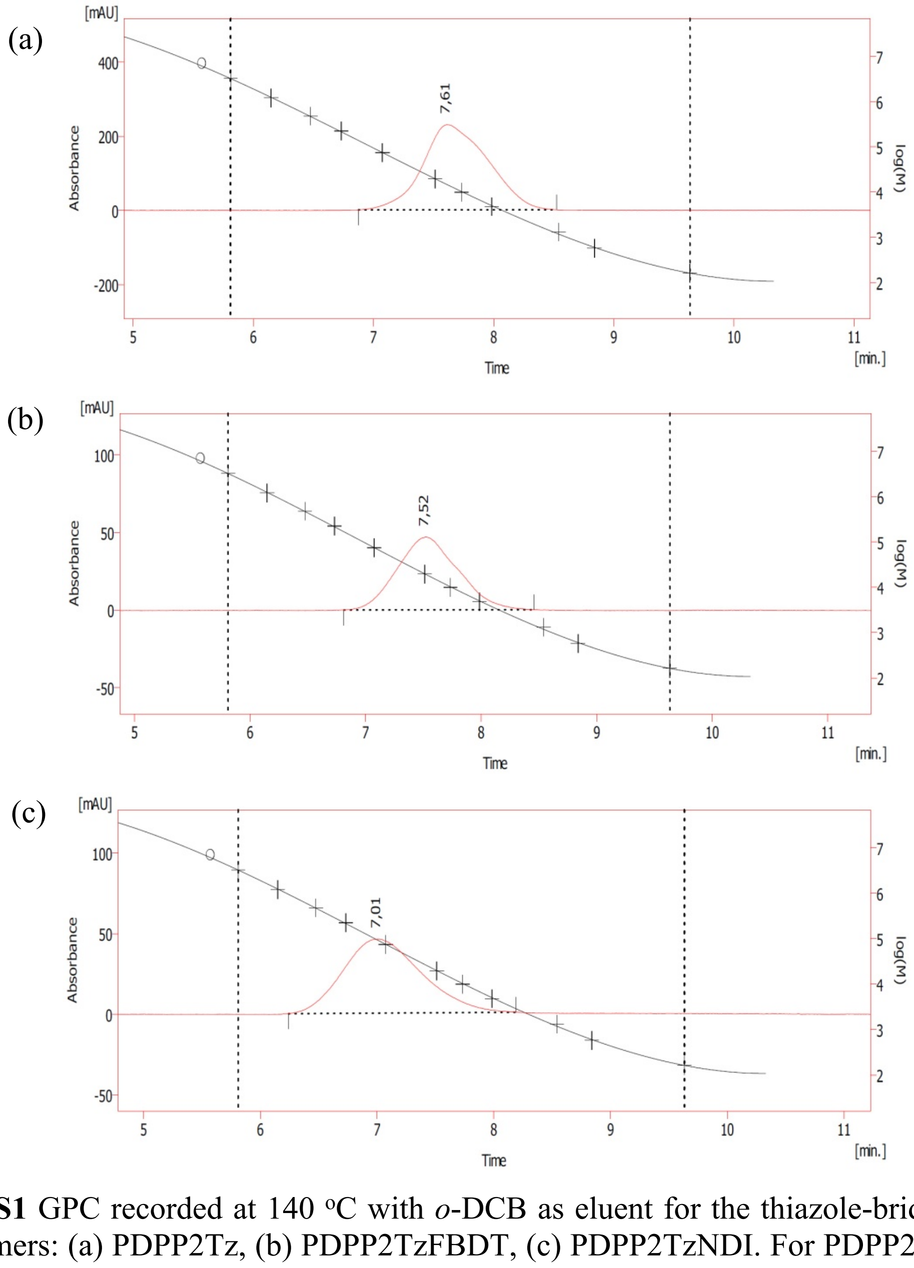

Fig. S1 GPC recorded at 140 ^{o}C with *o*-DCB as eluent for the thiazole-bridged DPP polymers: (a) PDPP2Tz, (b) PDPP2TzFBDT, (c) PDPP2TzNDI. For PDPP2TzFBDT, only small molecular weight polymer can go through the 0.45 μm filter for measurement.

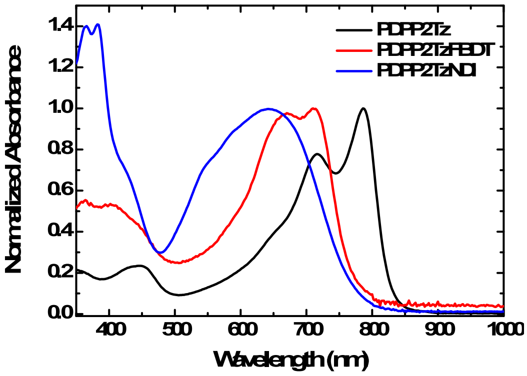

Fig. S2 Optical absorption spectra of the thiazole-bridged DPP polymers in chloroform solution.

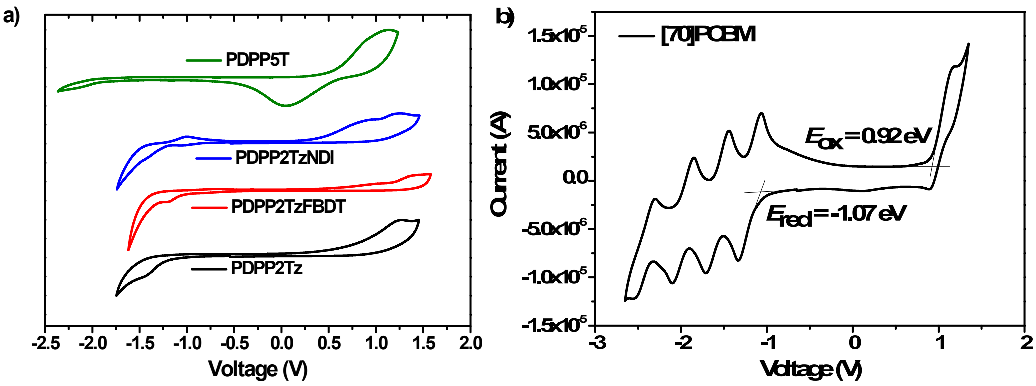

Fig. S3 Cyclic voltammograms of (a) the thiazole-bridged DPP polymers and PDPP5T thin films and (b) [70]PCBM in *o*-DCB. Potential vs. Fc/Fc^{+}. LUMO and HOMO of [70]PCBM can be calculated as -4.16 eV and -6.15 eV.

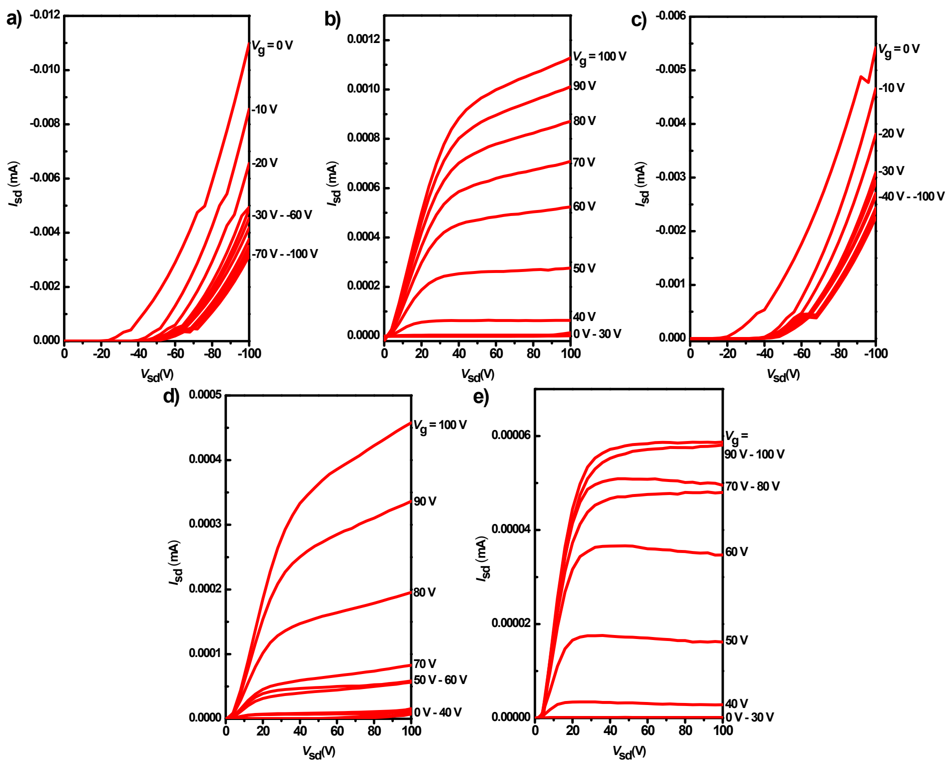

Fig. S4. Output curves of the OFET devices fabricated from the polymer thin films under optimized thermal annealing temperature. (a) and (b) PDPP2Tz. (c) and (d) PDPP2TzFBDT. (e) PDPP2TzNDI. (a), (c) for p type, and (b), (d) and (e) for n type.

Table S1. Field-effect hole and electron mobility of the DPP polymers thin films without thermal annealing.

Polymer	μ_h (cm^2 V^{-1} s^{-1})	μ_e (cm^2 V^{-1} s^{-1})
PDPP2Tz	2.44×10^{-5}	2.69×10^{-3}
PDPP2TzFBDT	-	8.39×10^{-4}
PDPP2TzNDI	-	5.68×10^{-4}

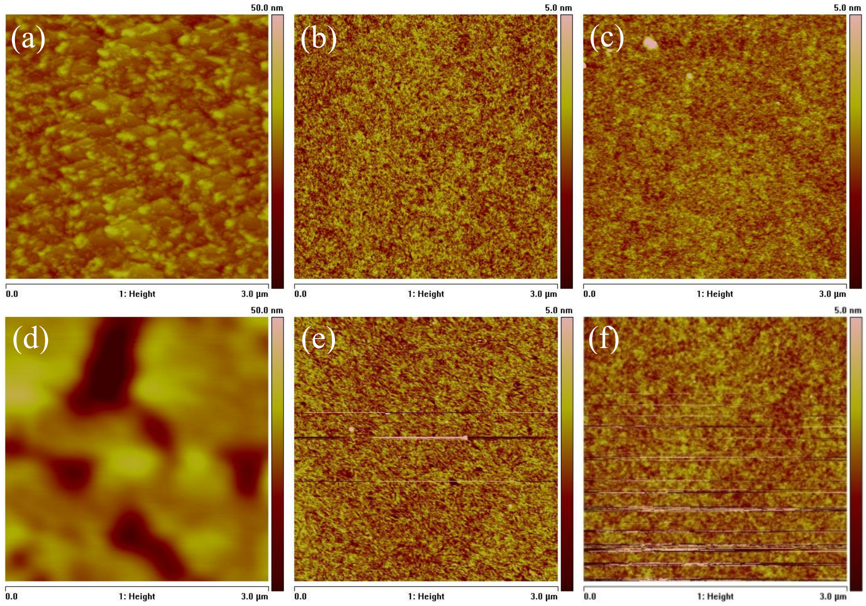

Fig. S5 AFM height image of the polymer thin films on Si substrate without (a, b and c) and with thermal annealing (d, e and f). (a) and (d) PDPP2Tz; (b) and (e) PDPP2TzFBDT; (c) and (f) PDPP2TzNDI. The thermal annealing temperature is 150 °C for PDPP2Tz, 140 °C for PDPP2TzFBDT and 160 °C for PDPP2TzNDI. Root mean square (RMS) surface roughness is 3.13 nm, 0.494 nm, 0.350 nm, 5.04 nm, 0.540 nm and 0.397 nm.

Table S2. Characteristics of PDPP5T:DPP-polymer solar cells fabricated from chloroform with different additives. The thickness of active layers is around 70 - 90 nm.

Acceptor	Solvent	J_{sc} (mA/cm^2)	V_{oc} (V)	FF	PCE (%)
PDPP2Tz	$CHCl_3$	0.97	0.61	0.35	0.21
	$CHCl_3$:DIO 2.5%	0.56	0.57	0.40	0.12
	$CHCl_3$:1-CN 3%	1.6	0.57	0.4	0.37
	$CHCl_3$: *o*-DCB 10%	1.39	0.53	0.37	0.27
PDPP2TzFBDT	$CHCl_3$	0.51	0.63	0.36	0.12
	$CHCl_3$:DIO 2.5%	0.35	0.61	0.41	0.09
	$CHCl_3$:1-CN 3%	0.77	0.61	0.39	0.19

	$CHCl_3$:*o*-DCB 10%	0.51	0.60	0.43	0.13
PDPP2TzNDI	$CHCl_3$	0.94	0.54	0.29	0.14
	$CHCl_3$:DIO 2.5%	1.87	0.53	0.29	0.29
	$CHCl_3$:1-CN 3%	2.2	0.53	0.36	0.42
	$CHCl_3$:*o*-DCB 10%	1.43	0.52	0.31	0.23