

Supporting Information

Enhance organic thin-film transistor performance of polymer semiconductors via the modification of both conjugated backbone and side chain of diketopyrrolopyrrole-benzodithiophene copolymers

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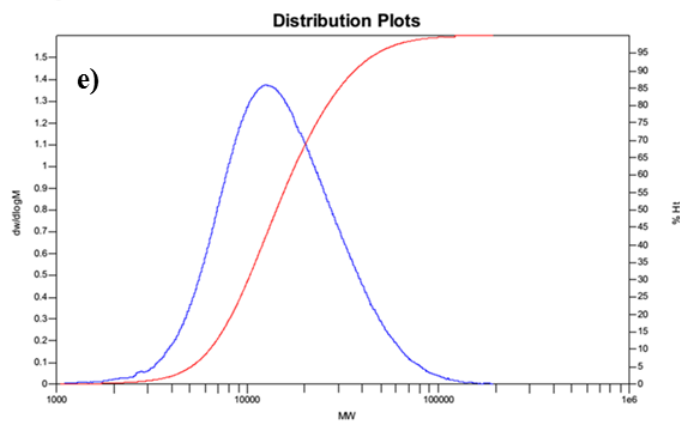
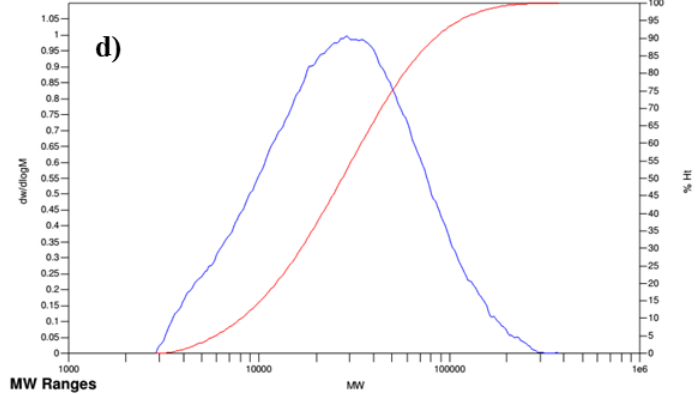
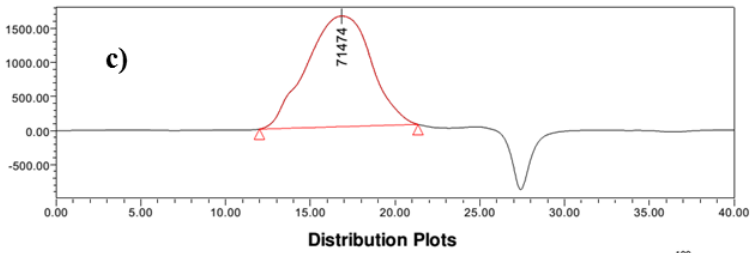
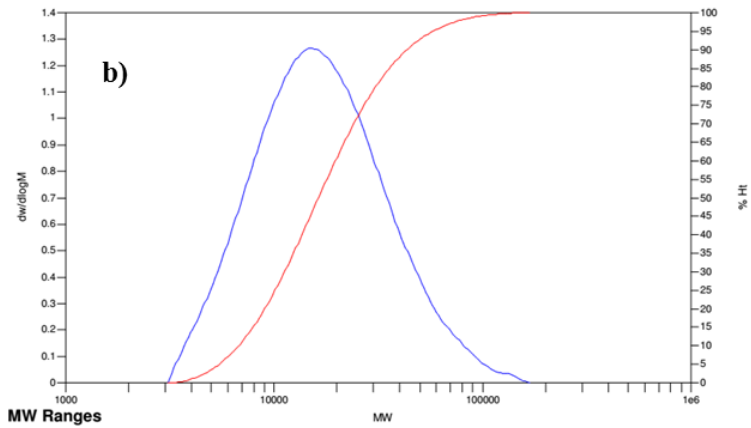
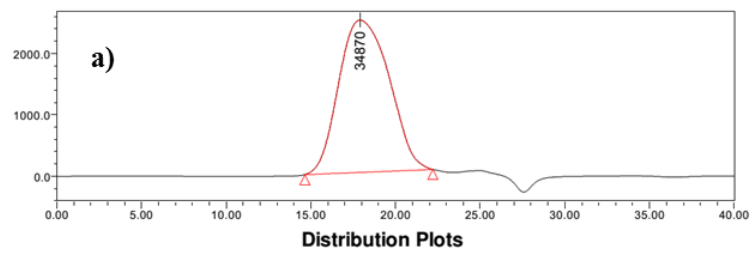
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Additional data



Polymers	M _n	M _w	M _p	Polydispersity
P1 (RT)	19500	40300	34900	2.07
P1 (High-T)	13100	21577	14900	1.64
P2 (RT)	45600	189000	71500	4.13
P2 (High-T)	18000	38300	28900	2.12
P3(High-T)	11800	18900	12600	1.60

Figure S1. GPC chromatogram of polymers using THF as an eluent at a column temperature of 25 °C for P1 (a) and P2 (c), and using 1,2,4-trichlorobenzene as an eluent at a column temperature of 150 °C for P1 (b), P2 (d), and P3 (e).

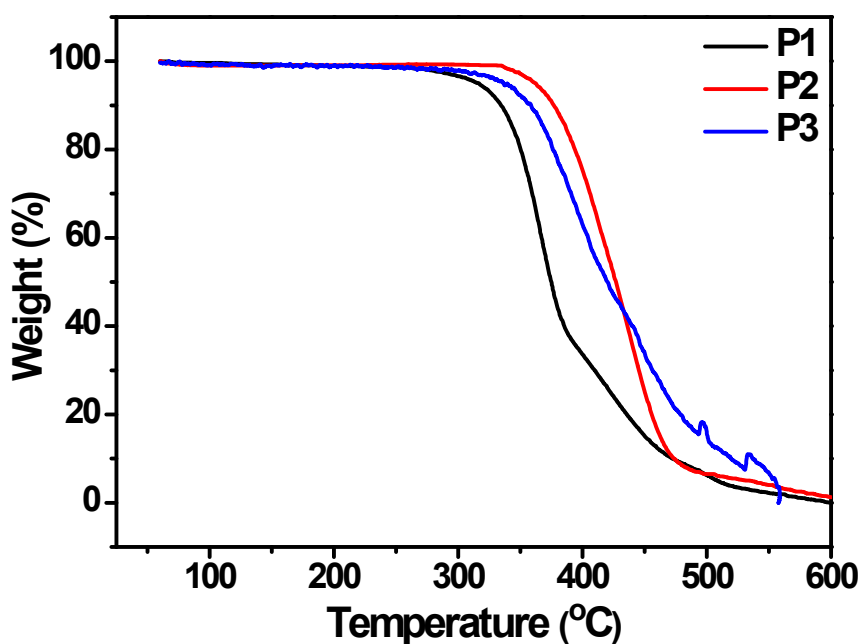


Figure S2. TGA plot of polymers (scan rate: 10 °C/min)

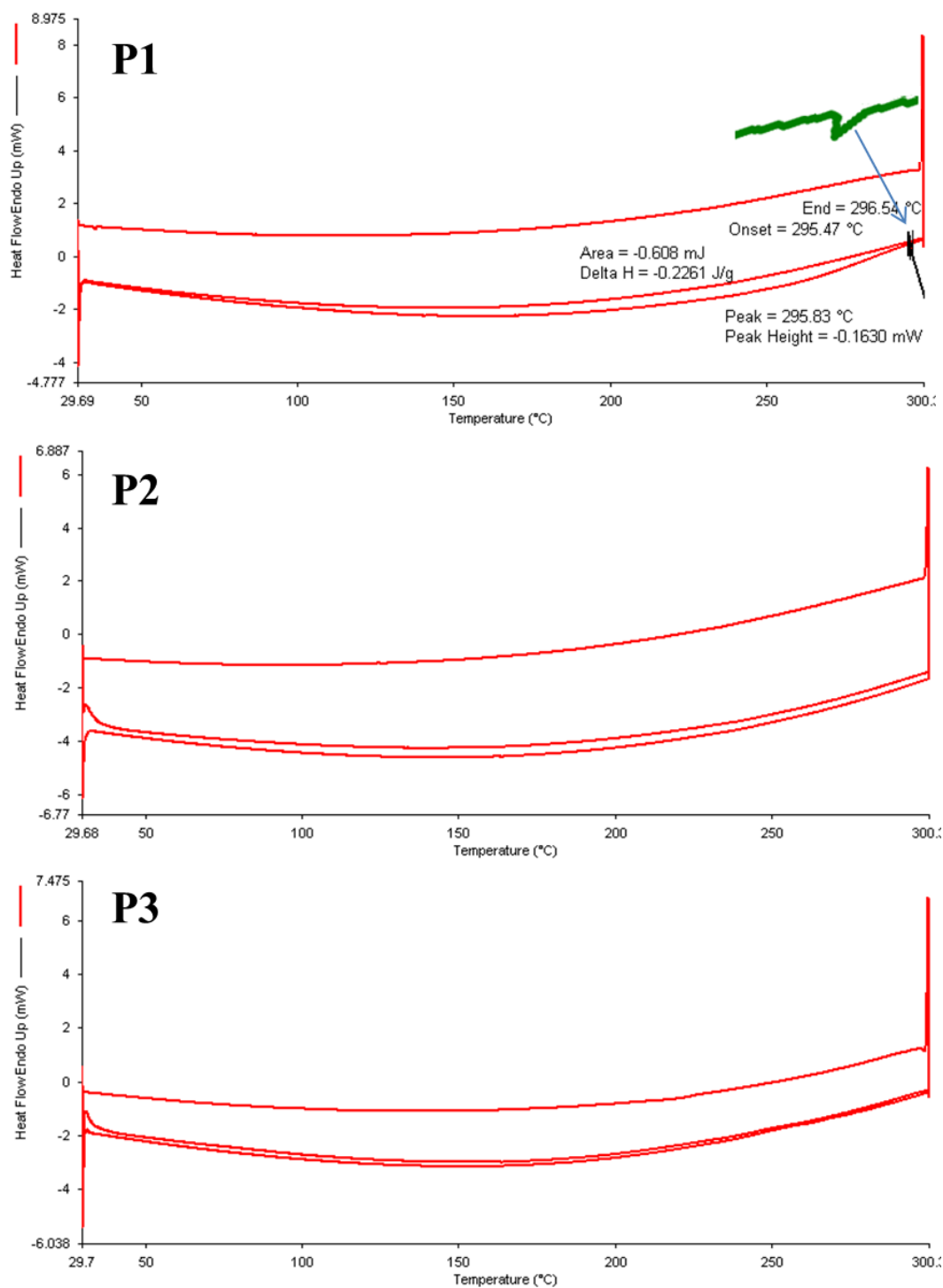


Figure S3. DSC curves of polymers (scan rate: 10 °C/min)

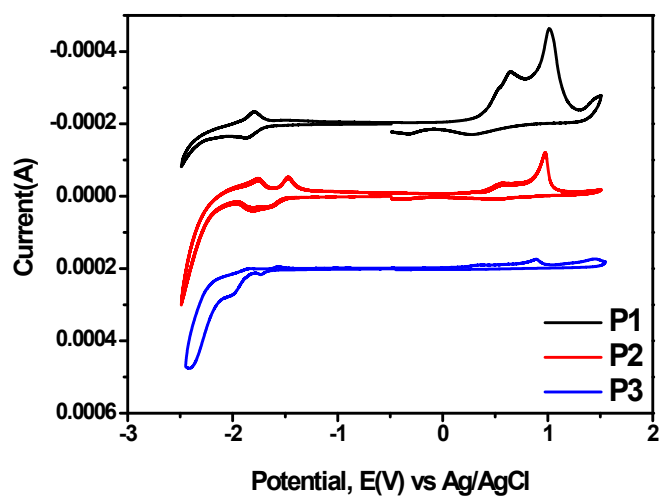


Figure S4. Cyclic voltammogram of polymers in thin film on a platinum electrode and tested in $\text{Bu}_4\text{NPF}_6/\text{CH}_3\text{CN}$ solution (scan rate, 100 mV s^{-1}).

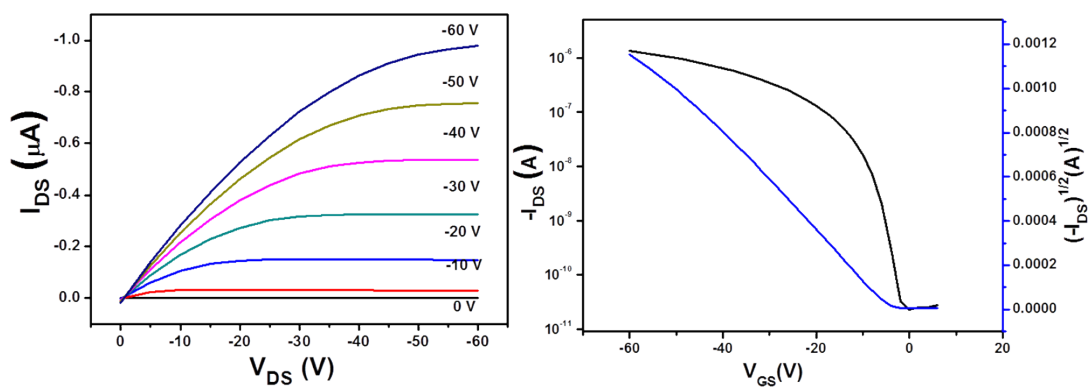


Figure S5. Output and transfer characteristics of OTFTs with a P1 thin film annealed at the optimum annealing temperature.

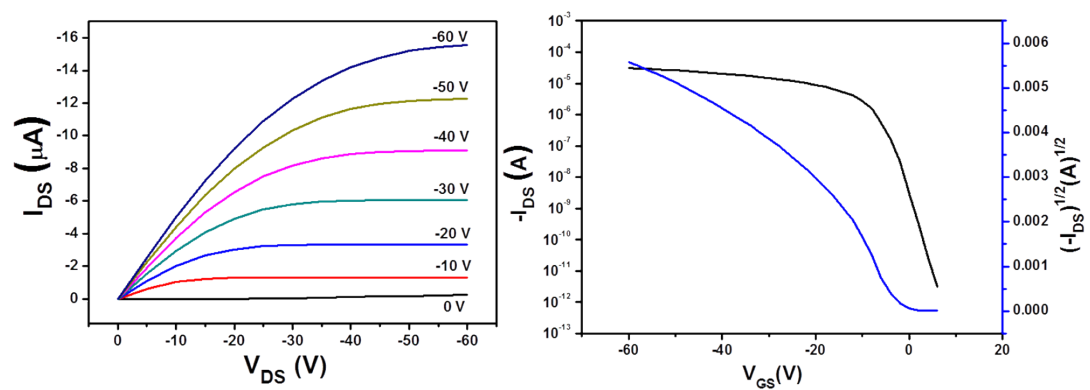


Figure S6. Output and transfer characteristics of OTFTs with a P2 thin film annealed at the optimum annealing temperature.

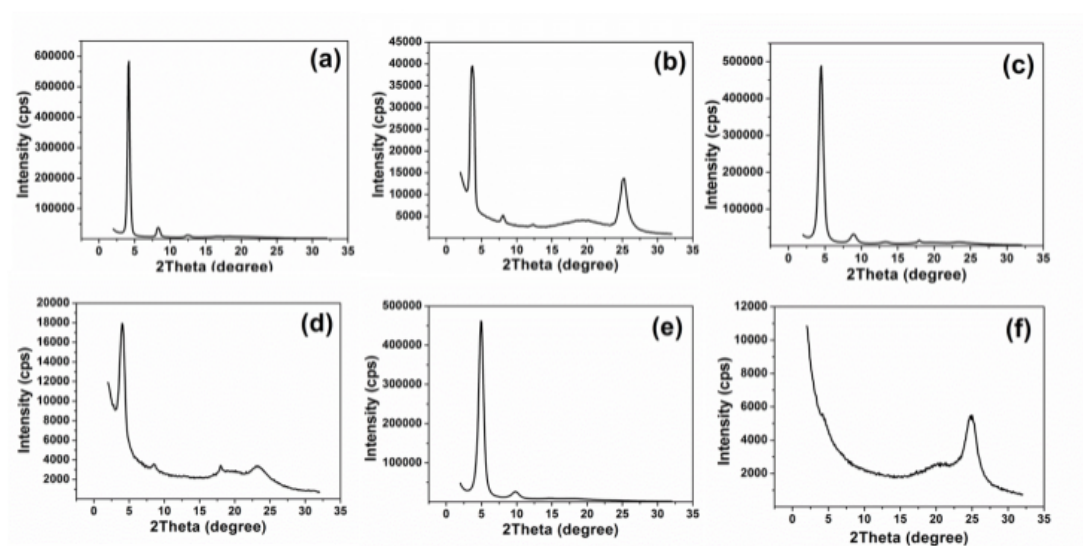


Figure S7. Grazing incidence X-ray diffraction patterns (out-of-plane, a, c and e; in-plane, b, d and f) of P1, P2 and P3 thin films at the optimum annealing temperature.

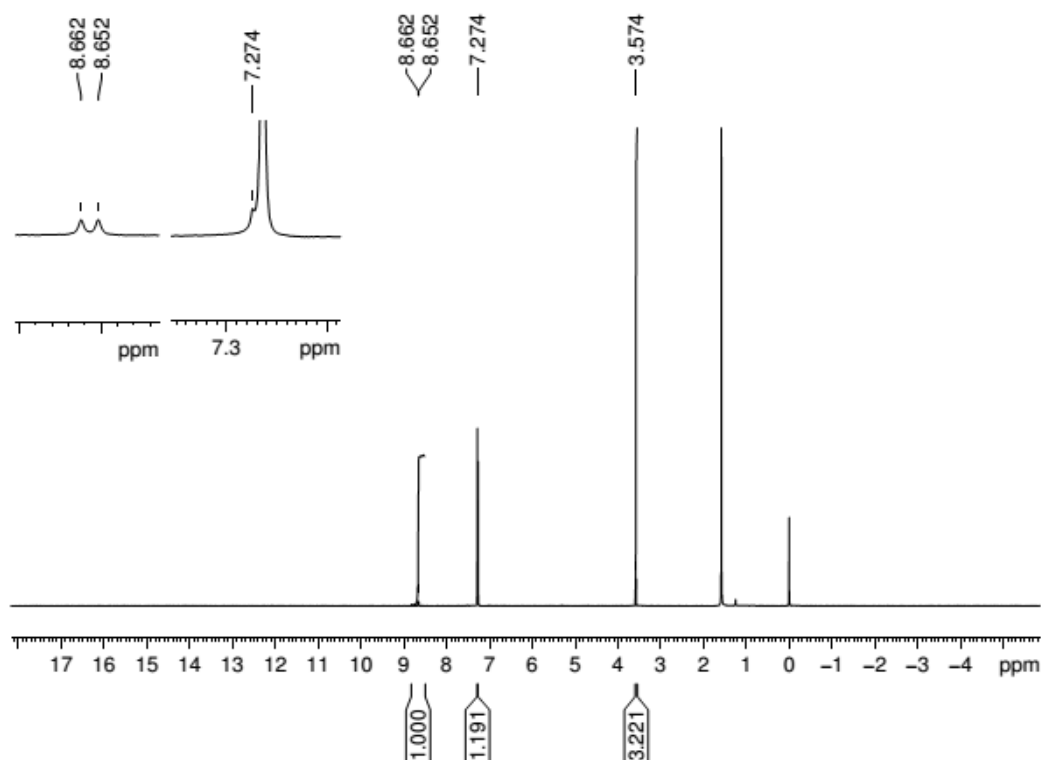


Figure S8. ^1H NMR spectrum of compound 1 in CDCl_3 .

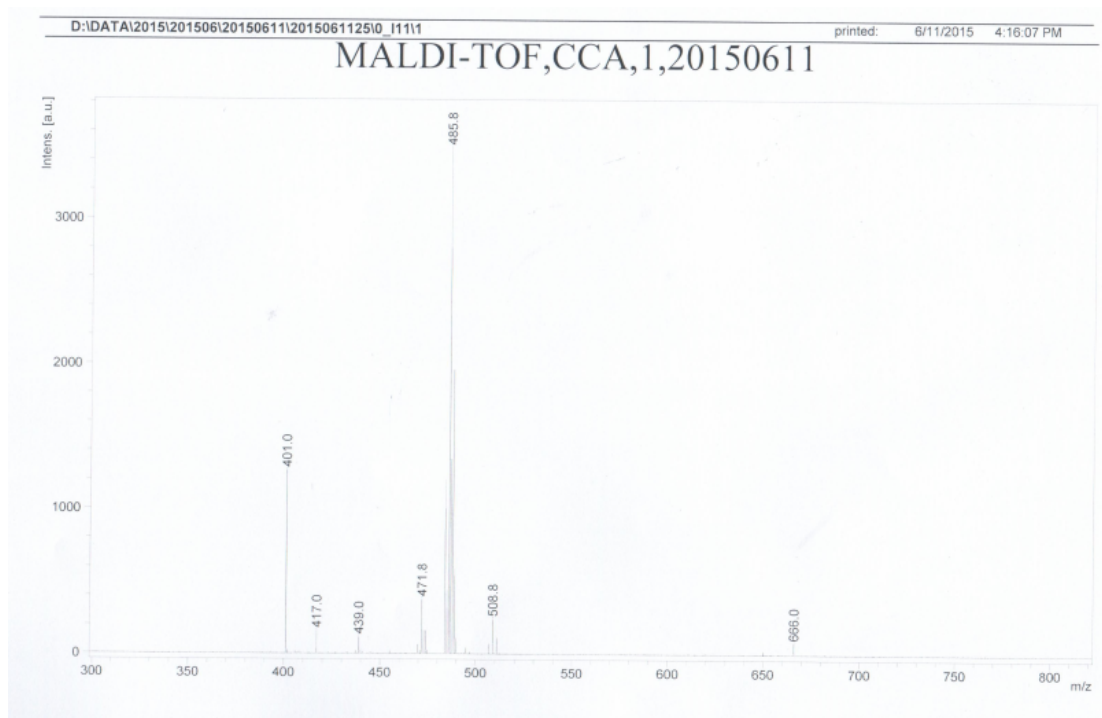


Figure S9. Mass spectrum of compound 1.

Table S1. OTFT properties of as-spun P1 at different annealing temperatures.

annealing temperature (°C)	μ_h a) ($\text{cm}^2\text{V}^{-1}\text{s}^{-1}$)	$I_{\text{on}}/I_{\text{off}}$	V_T (V)
25	0.001~0.001	$10^4\sim 10^5$	-8
80	0.003~0.003	$10^5\sim 10^6$	-4~3
120	0.002~0.003	$10^5\sim 10^5$	-4~3
160	0.002~0.003	$10^4\sim 10^5$	-6~-2
200	0.001~0.001	$10^4\sim 10^5$	-8~-6

a) At least 6 transistors are fabricated for P1.

Table S2. OTFT properties of as-spun P2 at different annealing temperatures.

annealing temperature (°C)	μ_h a) ($\text{cm}^2\text{V}^{-1}\text{s}^{-1}$)	$I_{\text{on}}/I_{\text{off}}$	V_T (V)
25	0.08~0.11	$10^5\sim 10^6$	-3~0
80	0.14~0.22	$10^5\sim 10^7$	-4~1
120	0.22~0.29	$10^6\sim 10^7$	-4~0
160	0.22~0.27	$10^6\sim 10^6$	-5~1
200	0.19~0.25	$10^5\sim 10^6$	5~1

a) At least 6 transistors are fabricated for P2.

Table S3. OTFT properties of as-spun P3 at different annealing temperatures.

annealing temperature (°C)	μ_h ^{a)} (cm ² V ⁻¹ s ⁻¹)	I_{on}/I_{off}	V_T (V)
25	0.07~0.09	10 ³ ~10 ⁴	4~5
80	0.26~0.30	10 ⁶ ~10 ⁶	4~6
120	0.38~0.47	10 ⁵ ~10 ⁷	0~3
160	0.36~0.42	10 ⁶ ~10 ⁷	0~3
200	0.51~0.67	10 ⁵ ~10 ⁷	3~6
240	0.50~0.61	10 ⁷ ~10 ⁷	0~2
280	0.22~0.30	10 ⁵ ~10 ⁷	-5~0

^{a)}At least 6 transistors are fabricated for P3.

Table S4. OTFT performance comparison of these thin films at same annealing temperatures.

Polymers Annealing temperature	P1		P2		P3	
	$\mu_{h\max}$ (cm ² V ⁻¹ s ⁻¹)	I_{on}/I_{off}	$\mu_{h\max}$ (cm ² V ⁻¹ s ⁻¹)	I_{on}/I_{of} _f	$\mu_{h\max}$ (cm ² V ⁻¹ s ⁻¹)	I_{on}/I_{off}
25 °C	0.001	10 ⁵	0.11	10 ⁶	0.09	10 ⁴
80 °C	0.003	10 ⁶	0.22	10 ⁷	0.30	10 ⁶
120 °C	0.003	10 ⁵	0.29	10 ⁷	0.47	10 ⁶
160 °C	0.003	10 ⁵	0.27	10 ⁶	0.42	10 ⁷
200 °C	0.001	10 ⁵	0.25	10 ⁶	0.67	10 ⁷