Supporting Information

NIR-Sensing Ambipolar Organic Phototransistors with Conjugated Terpolymer Layers Based on Diketopyrrolopyrrole-Benzothiadiazole-Naphthalenediimide Comonomer Units

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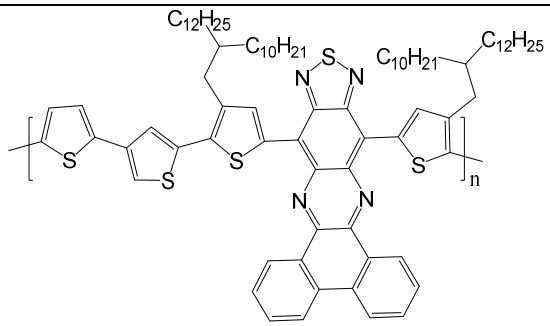
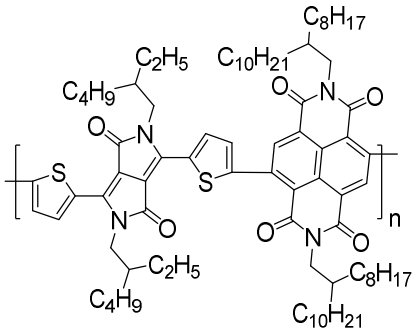
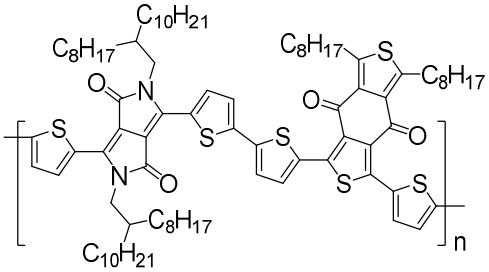
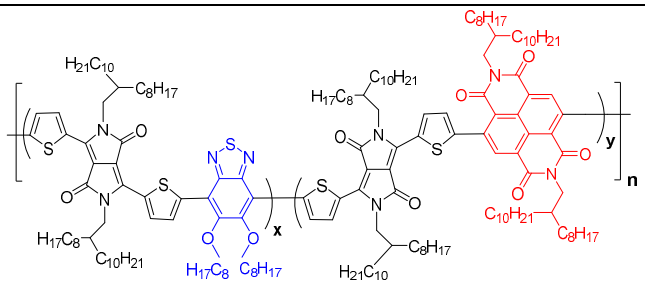
Table S1. Summary of ambipolar-type NIR-absorbing conjugated polymers reported to date.

Authors	Polymer Structure	Device Performances	Refs. (Year)
M. Li, et al.	 PPhTQ (Copolymer)	[Wavelength] 500, 1200 nm [Voltage Window] ±80V [OPTR Application] YES	SR-1 (2015)
P. Wang, et al.	 PNDI-DPP (Copolymer)	[Wavelength] 900 nm [Voltage Window] ±80V [OPTR Application] NO	SR-2 (2015)
G. Zhang, et al.	 P3 (Copolymer)	[Wavelength] 800 nm [Voltage Window] ±80V [OPTR Application] YES	SR-3 (2016)
Y. Cho, et al.	 PDPP-8OBT-NDI (Terpolymer)	[Wavelength] 810 nm, 1100 nm (edge) [Voltage Window] ±10V [OPTR Application] YES	This work (2022)

References for Table S1

SR-1. M. Li, C. An, T. Marszalek, X. Guo, Y. Long, H. Yin, C. Gu, M. Baumgarten, W. Pisula, K. Mullen, *Phenanthrene condensed thiadiazoloquinoxaline donor–acceptor polymer for phototransistor applications*, Electrochem. Commun. 74 (2017) 33-37.

SR-2. P. Wang, H. Li, C. Gu, H. Dong, Z. Xu, H. Fu, *Air-stable ambipolar organic field-effect transistors based on naphthalenediimide– diketopyrrolopyrrole copolymers*, RSC Adv. 5 (2015) 19520.

SR-3. G. Zhang, J. Guo, J. Zhang, W. Li, X. Wang, H. Lu, L. Qiu, *Benzodithiophenedione and diketopyrrolopyrrole based conjugated copolymers for organic thin-film transistors by structure modulation*, Dyes Pigm. 126 (2016) 20-28.

Table S2. Summary of device parameters under illumination with NIR light (λ = 810 nm) for the OPTRs with the PDPP-8OBT-NDI sensing channel layers. Note that data were taken from the transfer curves in Figure 4a ($V_G = V_D = \pm 10$ V), respectively.

P_{IN} ($\mu W/cm^2$)	*t* (nm)	Channel	ΔV_{TH} (V)	S_p (%)	R_C (mAW^{-1})	DCR
56	40	p	-3.24	78.04	0.33	1.10
		n	3.38	36.02	0.16	
	80	p	-2.25	169.60	1.14	1.21
		n	2.81	165.57	0.98	
169	40	p	-2.87	114.19	0.16	1.11
		n	2.90	62.99	0.10	
	80	p	-2.03	249.01	0.48	1.22
		n	2.43	206.55	0.46	
394	40	p	-2.33	195.85	0.11	1.12
		n	2.37	124.26	0.08	
	80	p	-1.98	335.29	0.29	1.23
		n	2.13	294.26	0.27	
563	40	p	-2.17	245.38	0.10	1.14
		n	2.34	163.48	0.75	
	80	p	-1.25	413.72	0.25	1.27
		n	1.78	373.36	0.24	

Table S3. Summary of device parameters under illumination with NIR light (λ = 905 nm) for the OPTRs with the PDPP-8OBT-NDI sensing channel layers. Note that data were taken from the transfer curves in Figure 4a ($V_G = V_D = \pm 10$ V), respectively.

P_{IN} ($\mu W/cm^2$)	*t* (nm)	Channel	ΔV_{TH} (V)	S_p (%)	R_C (mAW^{-1})	DCR
40	40	p	-3.26	261.78	1.37	1.10
		n	3.81	180.70	1.03	
	80	p	-2.54	203.92	1.63	1.21
		n	2.59	190.98	1.45	
136	40	p	-2.84	303.17	0.52	1.14
		n	3.37	222.30	0.42	
	80	p	-2.51	360.78	0.92	1.24
		n	2.55	325.40	0.85	
319	40	p	-2.31	419.41	0.31	1.16
		n	2.37	311.76	0.25	
	80	p	-2.49	495.09	0.58	1.25
		n	2.54	481.96	0.50	
456	40	p	-2.28	522.48	0.27	1.18
		n	2.32	415.93	0.24	
	80	p	-2.38	665.57	0.56	1.27
		n	2.47	622.54	0.44	

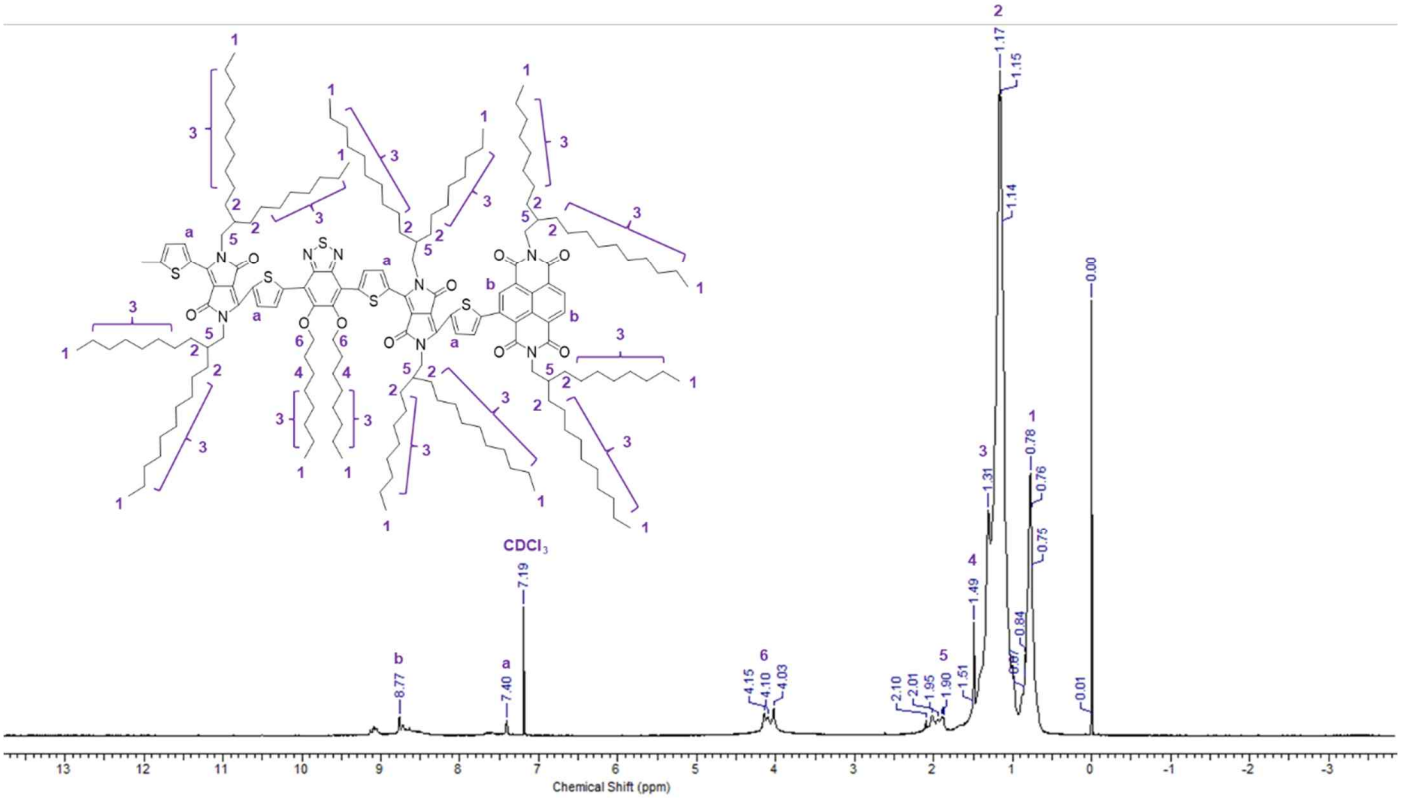


Figure S1. ^{1}H-NMR (700 MHz) spectra for the PDPP-8OBT-NDI polymer (solvent: $CDCl_3$) synthesized in this work. A detailed interpretation of the major peaks is given in the experimental section.

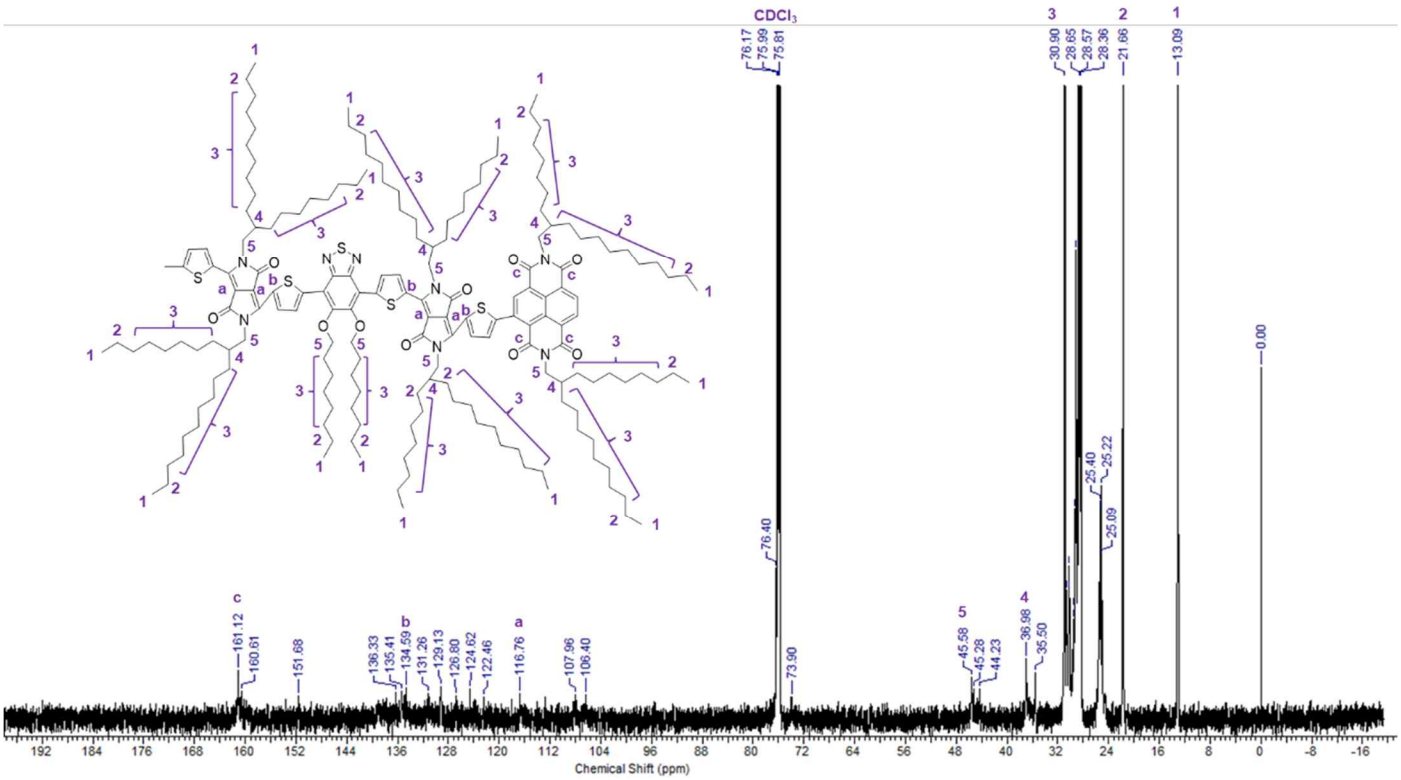


Figure S2. ^{13}C-NMR (700 MHz) spectra for the PDPP-8OBT-NDI polymer (solvent: $CDCl_3$) synthesized in this work. A detailed interpretation of the major peaks is given in the experimental section.

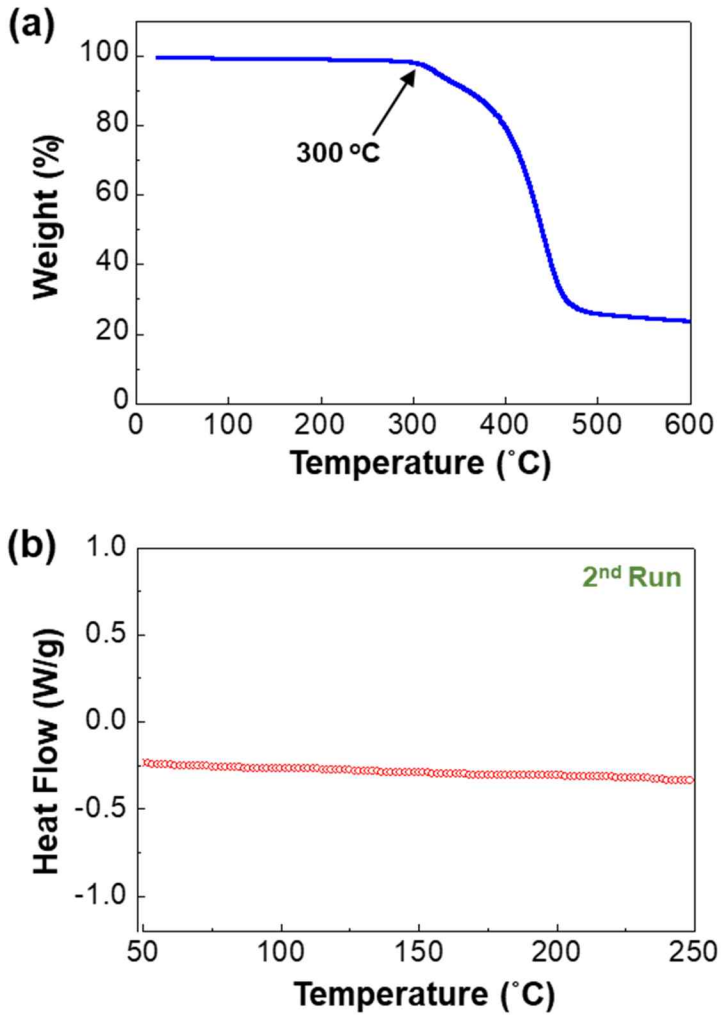


Figure S3. TGA (a) and DSC (b) thermograms (nitrogen environment) for the PDPP-8OBT-NDI polymer. The TGA measurement was carried out by heating at a ramp rate of 10 ºC/min, while the DSC measurement was performed by scanning at a heating rate of 5 ºC/min (second run).

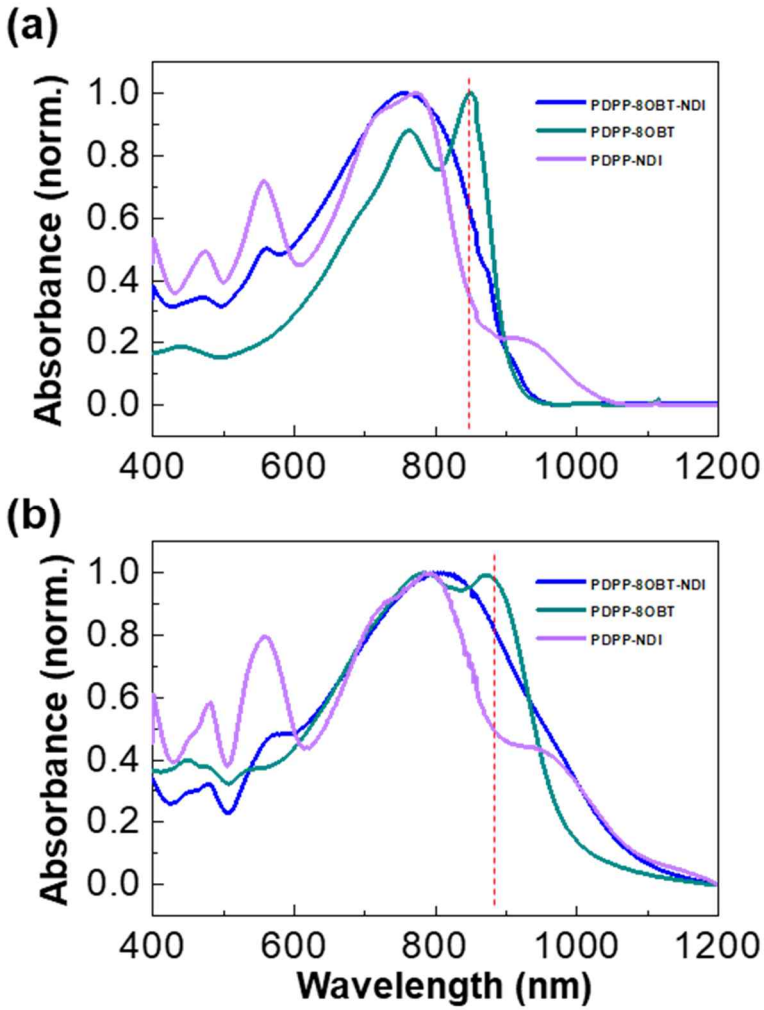


Figure S4. Optical absorption spectra of PDPP-8OBT, PDPP-NDI, and PDPP-8OBT-NDI polymers: (a) solutions (solvent: toluene), (b) films. On the basis of optical absorption spectra, the composition ratio of 8OBT to NDI comonomer in the PDPP-8OBT-NDI chains was calculated to 8OBT:NDI = 0.54:0.46 (from solutions) and 0.62:0.38 (from films).

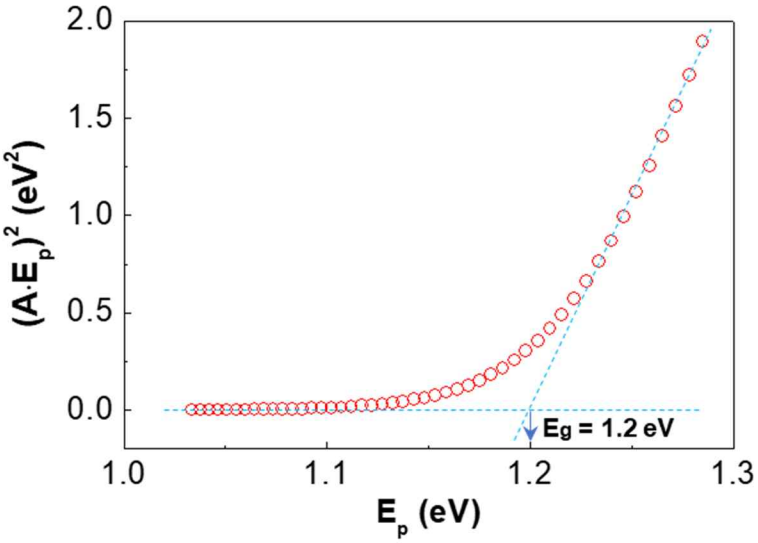


Figure S5. Tauc plot of the PDPP-8OBT-NDI film (original data: from the optical absorption spectrum in Figure 1b). **A** and **E**$_P$ denote absorbance and photon energy, respectively.

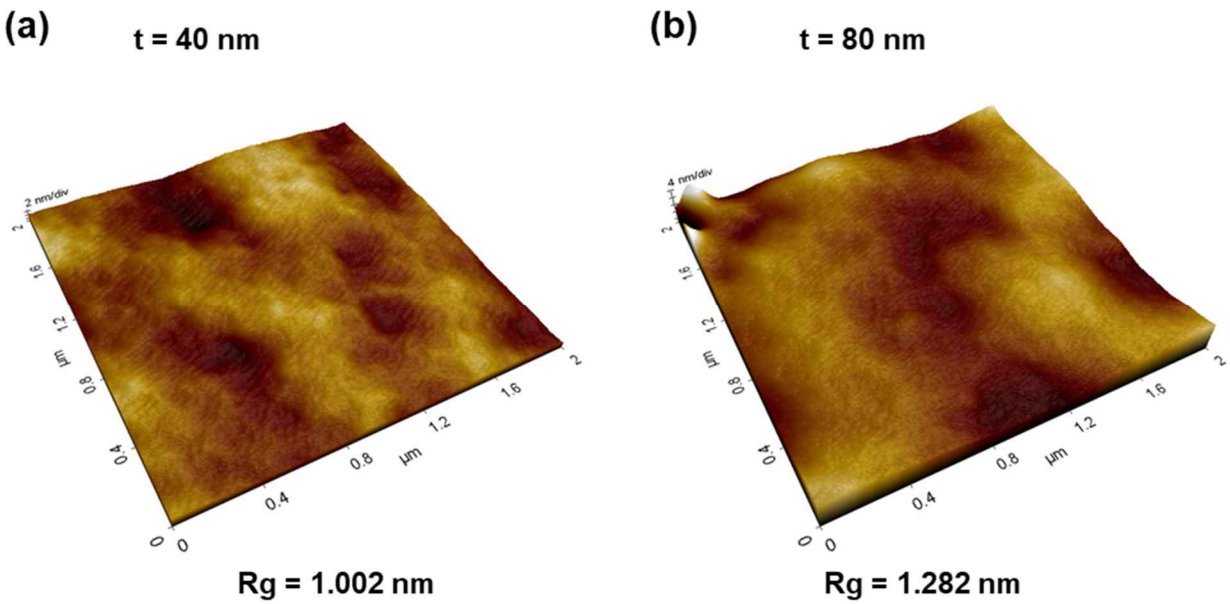


Figure S6. AFM (height-mode, 2 μm x 2 μm) images of the PDPP-8OBT-NDI films: (a) t = 40 nm, (b) t = 80 nm. Note that the root-mean-square (rms) roughness (Rg) from the AFM images was measured in the range of ca. 1.0 ~ 1.3 nm, which corresponds to ca. 1.6 ~ 2.5% compared to the thickness of films.