Electronic Supplementary Information

Ambipolar Organic Phototransistors with Bulk Heterojunction Films of p-type and n-type Indacenodithienothiophene-Containing Conjugated Polymers

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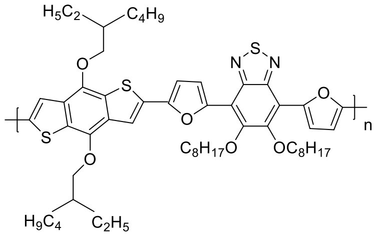
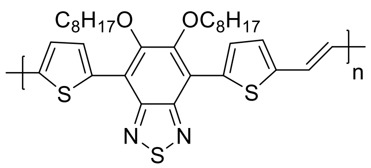
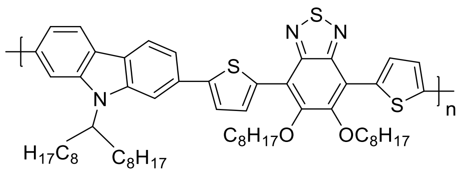
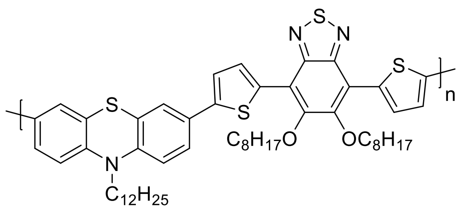
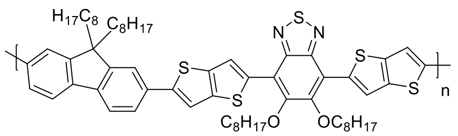
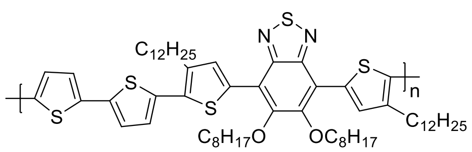
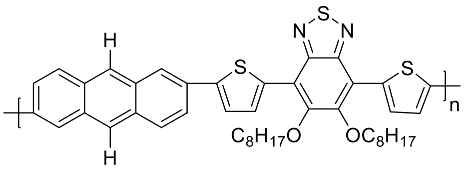
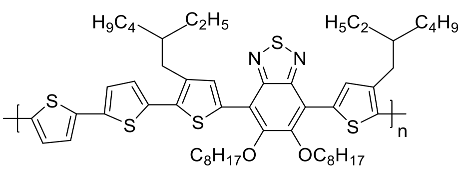
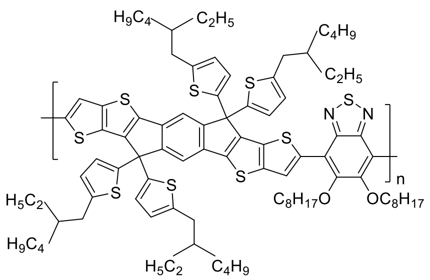
Table S1. Summary of literatures on conjugated polymers based on benzothiadiazole units that contain dioctyloxy groups.

Authors	**Polymer Structure**	**Attached unit** ***Comonomer***	**Applications**	**Year**	**Ref.**
X. Wang, et al.	**PFBT-BDT** 	Furan *Benzene dithiophene derivative*	Organic Solar Cells	2011	SR-1
F. Qing, et al.	**POTBTV** 	Thiophene *Ethylene derivative*	Organic Solar Cells	2011	SR-2
Y. Sun, et al.	**PCTBTC8** 	Thiophene *Carbazole derivative*	Organic Solar Cells	2012	SR-3
D. Yun, et al.	**P2** 	Thiophene *Phenothiazine derivative*	Organic Photovoltaics	2013	SR-4
W. Lee, et al.	**PF8TTBT** 	Thienothiophene *Benz[a]azulene derivative*	Organic Photovoltaics	2014	SR-5
K. Song, et al.	**PQT12oBT** 	3-Dodecylthiophene *Bithiophene*	Organic Photovoltaics	2014	SR-6

H. Kim, et al.	**P1** 	Thiophene *Anthracene derivative*	Organic Solar Cells	2016	SR-7
S. Eom, et al.	**PT2OBT** 	3-(2-Ethylhexyl)thiophene *Bithiophene*	Organic Photodetectors	2017	SR-8
H. Son, et al.	**PIDTT-8OBT** 	N/A *Indacenodithieno thiophene*	Organic Phototransistors	2021	**This Work**

< Reference for Table S1 >

SR-1. X. Wang, S. Chen, Y. Sun, M. Zhang, Y. Li, X. Li and H. Wang, *Polym. Chem*., 2011, **2**, 2872-2877.

SR-2. F. Qing, Y. Sun, X. Wang, N. Li, Y. Li, X. Li and H. Wang, *Polym. Chem*., 2011, **2**, 2102-2106.

SR-3. Y. Sun, B. Lin, H. Yang and X. Gong, *Polymer*, 2012, **53**, 1535-1542.

SR-4. D. Yun, H. Yoo, S. Heo, H. Song, D. Moon, J. Woo and Y. Park, *J. Ind. Eng. Chem*., 2013, **19**, 421-426.

SR-5. W. Lee, H. Cha, Y. Kim, J. Jeong, S. Hwang, C. Park and H. Woo, *ACS Appl. Mater. Interfaces*, 2014, 6, **22**, 20510–20518.

SR-6. K. Song, M. Choi, H. Song, S. Heo, J. Lee and D. Moon, *Sol. Energy Mater Sol. Cells,* 2014, **120**, 303-309.

SR-7. H. Kim, M. Choi, Y. Han, D. Moon and J. Haw, *J. Ind. Eng. Chem*., 2016, **33**, 209-220.

SR-8. S. Eom, S. Nam, H. Do, J. Lee, S. Jeon, T. Shin, I. Jung, S. Yoon and C. Lee, *Polym. Chem*., 2017, **8**, 3612-3621.

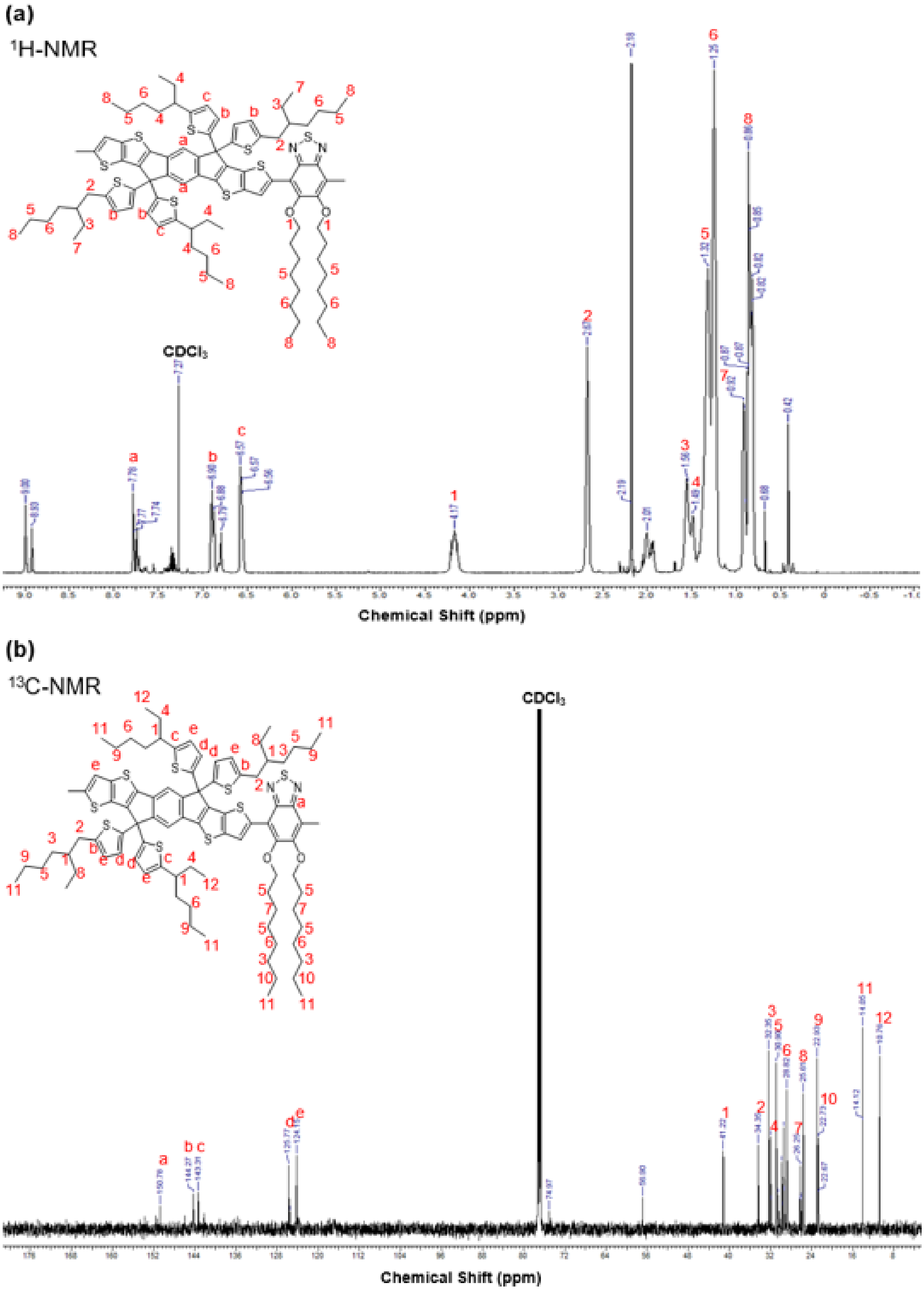


Figure S1. NMR spectra (500 MHz) for PIDTT-8OBT dissolved in $CDCl_3$ as a solvent: (a) ^{1}H-NMR, (b) ^{13}C-NMR. The alphabets and numbers in the molecular structure correspond to those in the peaks of spectra.

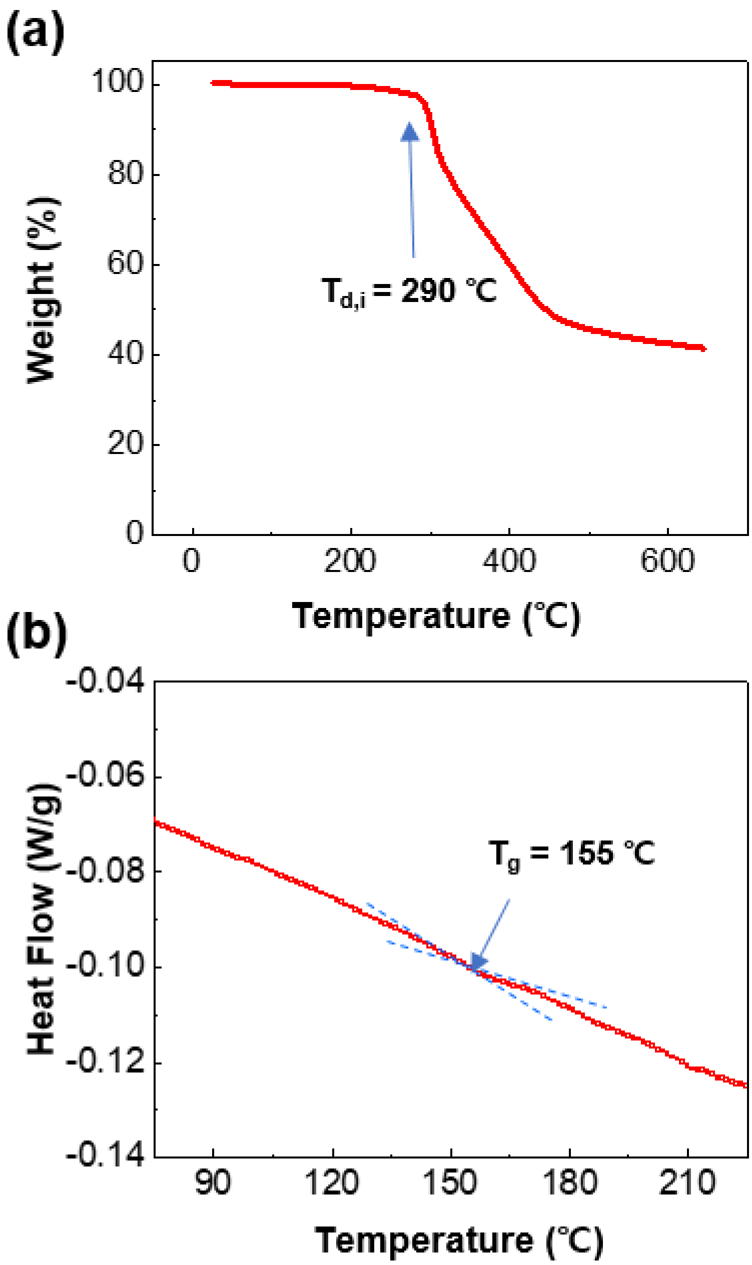


Figure S2. Thermal analysis results for the PIDTT-8OBT powders: (a) TGA thermogram (see arrow for nearly initial decomposition point), (b) DSC thermogram (see arrow for the Tg point). The TGA measurement was performed in a nitrogen environment at a heating rate of 10 °C/min. The DSC thermogram here is the result of third run (from 30 °C to 250 °C at a heating rate of 5 °C/min) after first heating run (from 30 °C to 250 °C at a heating rate of 10 °C/min) and second run (quick cooling from 250 °C to RT).

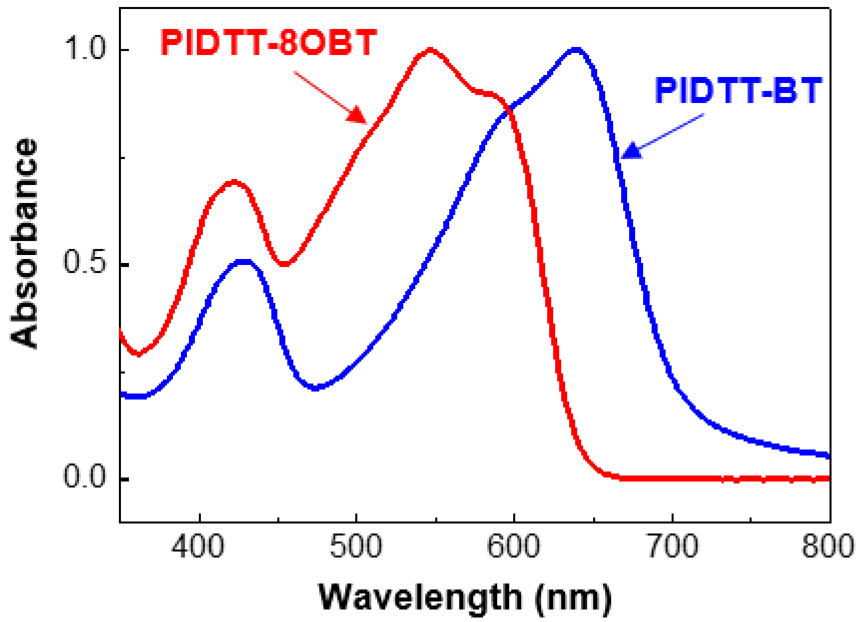


Figure S3. Comparison of optical absorption spectra for the PIDTT-8OBT (red line) and PIDTT-BT (blue line) films.

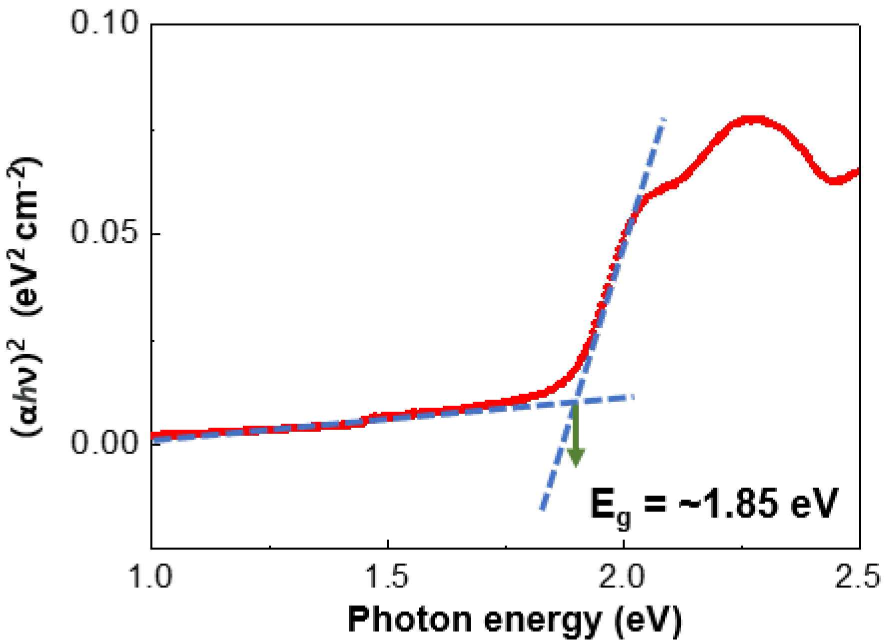


Figure S4. Tauc plot from the optical absorption spectrum of PIDTT-8OBT film (α: absorbance, *h*: the Planck's constant, ν: the frequency of light). The onset point delivers the optical bandgap of ca. 1.85 eV.

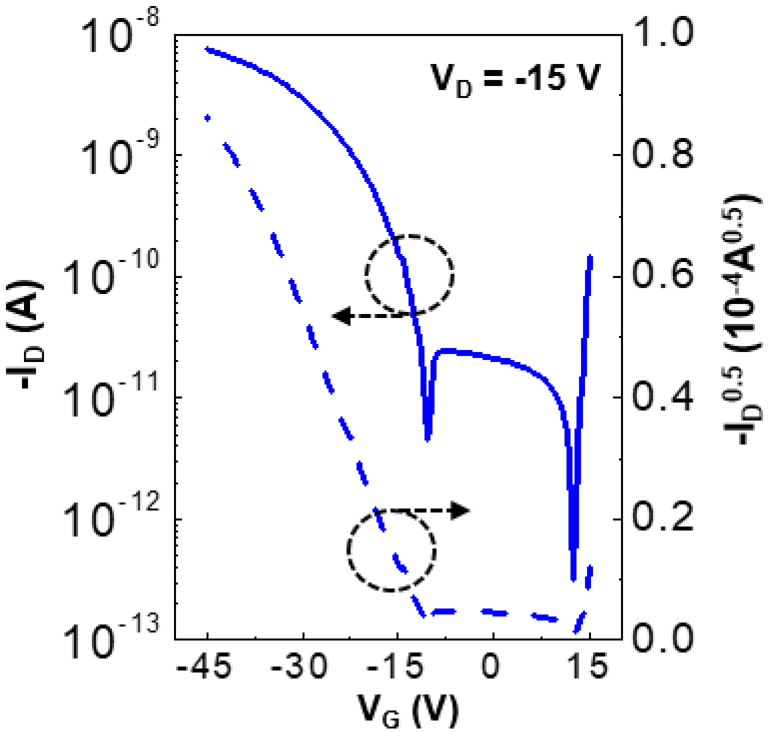


Figure S5. Transfer curve (dark) for the OFET with the pristine PIDTT-8OBT layer at a p-channel mode (V_D = -15 V). The $I^{0.5}$ ~ V_G plot is given in red color.

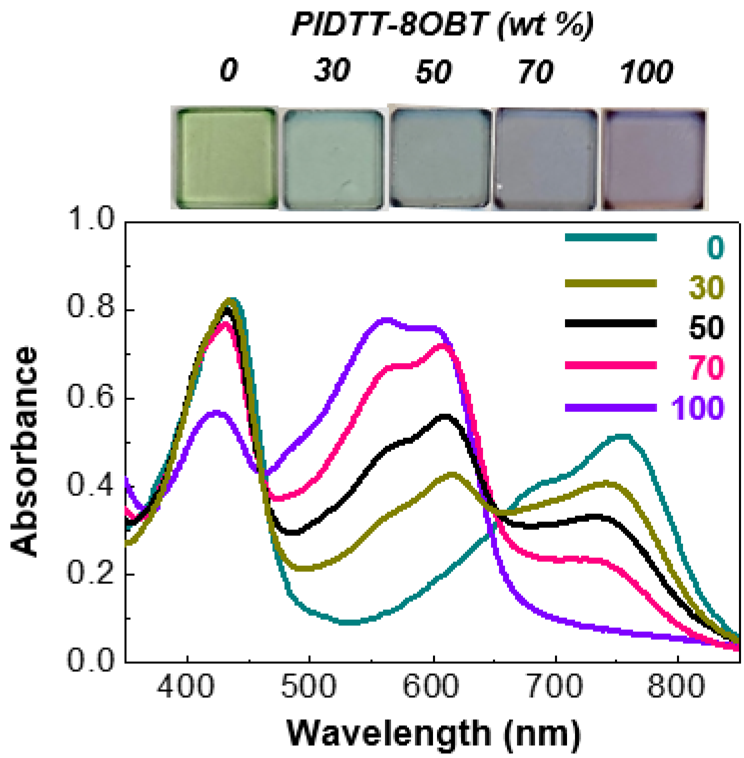


Figure S6. Optical absorption spectra for the PIDTT-8OBT:PIDTT-NDI blend films according to the PIDTT-8OBT weight ratio (top: photographs for the blend films).

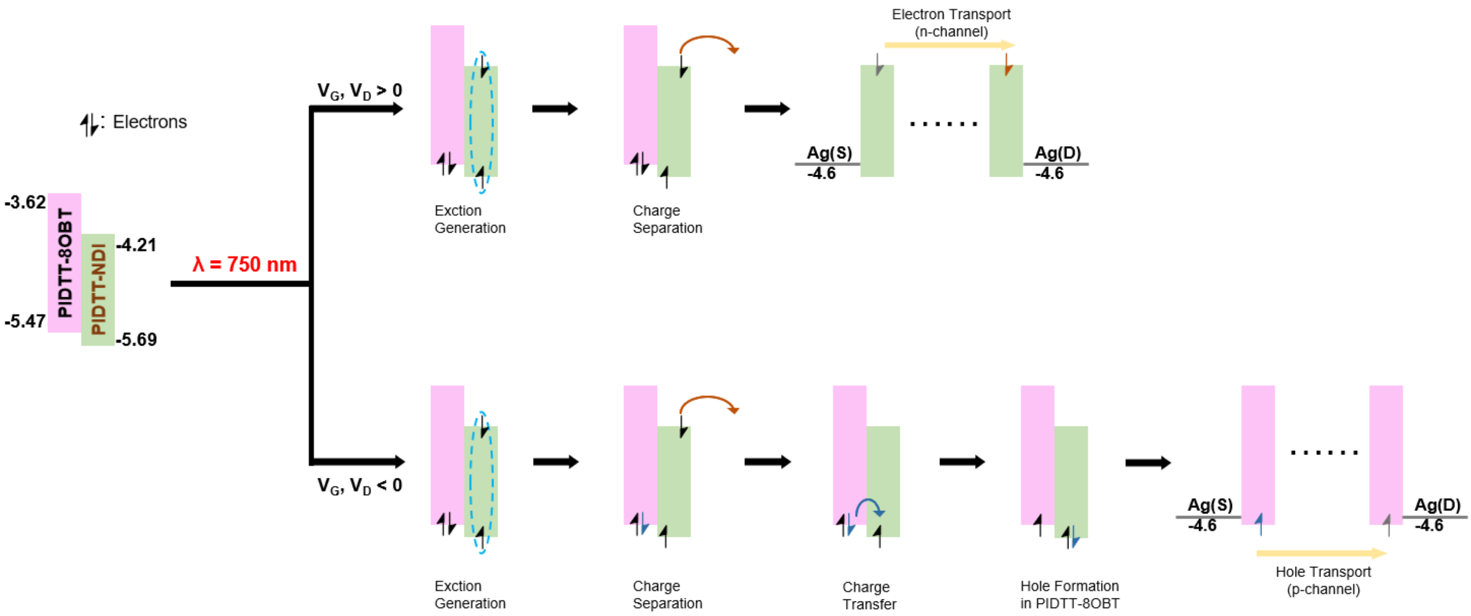


Figure S7. Photo-sensing mechanism for the ambipolar OPTRs with the PIDTT-8OBT:PIDTT-NDI BHJ layers under the deep red light (λ = 750 nm) illumination that cannot be absorbed by the PIDTT-8OBT component.

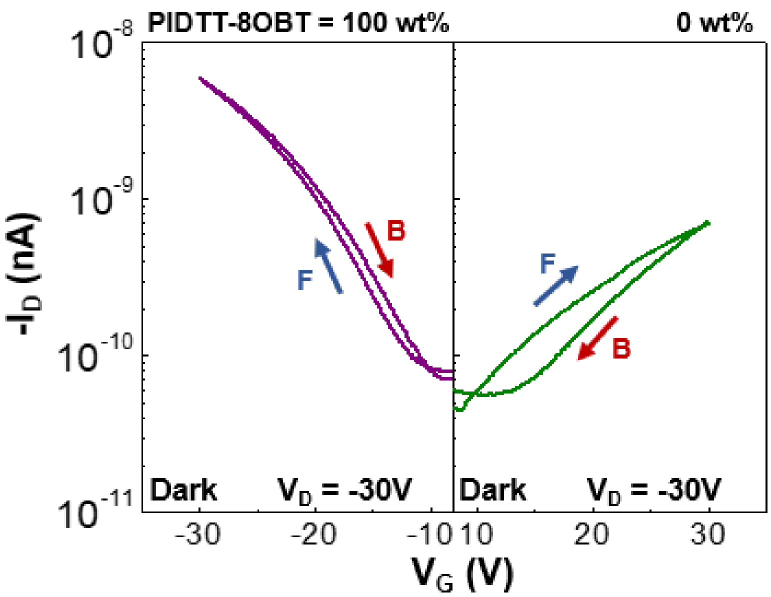


Figure S8. Transfer curves swept between V_G = -30 V to V_G = +30 V in the dark for the OFETs with the pristine PIDTT-8OBT (100 wt%) and PIDTT-NDI (0 wt%) channel layers. 'F' and 'B' indicate the forward and backward sweep directions, respectively.

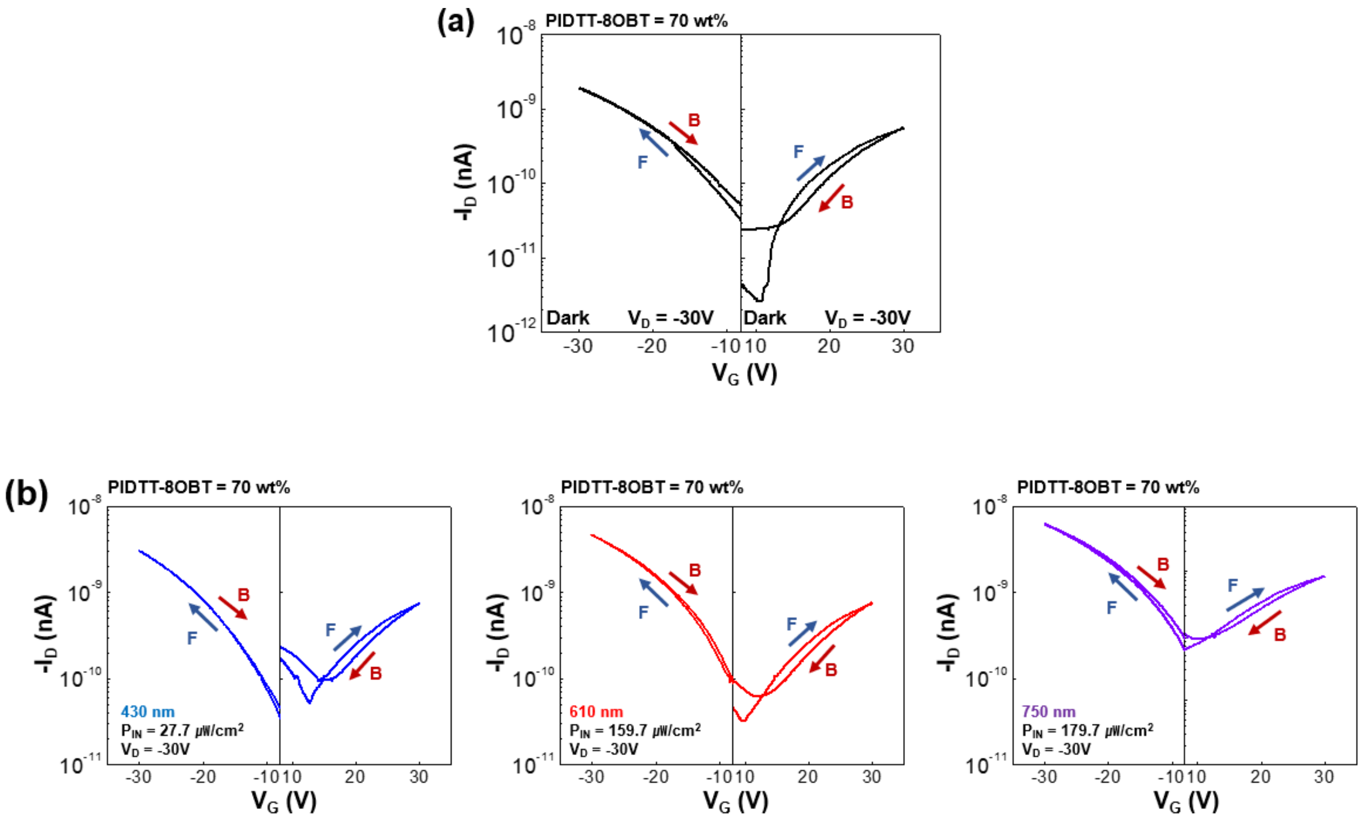


Figure S9. Transfer curves swept between V_G = -30 V to V_G = +30 V for the ambipolar OFETs with the PIDTT-8OBT:PIDTT-NDI blend layers (PIDTT-8OBT = 70 wt%): (a) dark, (b) illumination. 'F' and 'B' indicate the forward and backward sweep directions, respectively.