

Supporting Information for

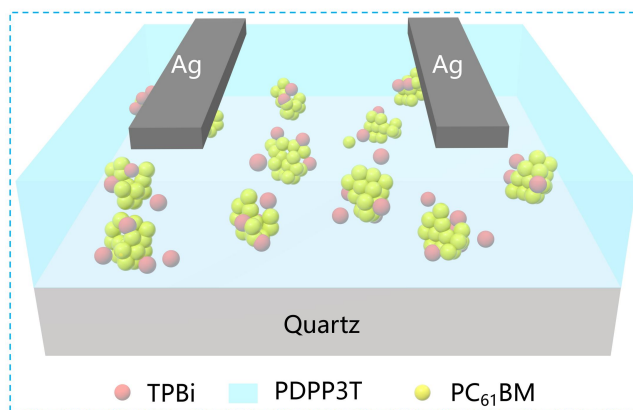
Controlling Electron Transfer in a Lateral Near-Infrared Polymer Photodetector by Adding Higher-LUMO-Level Acceptors: A Technique to Reduce Dark Current

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Yue Qian¹, Shufang Ding¹, Yaqi Chen¹, Chunzhi Jiang¹

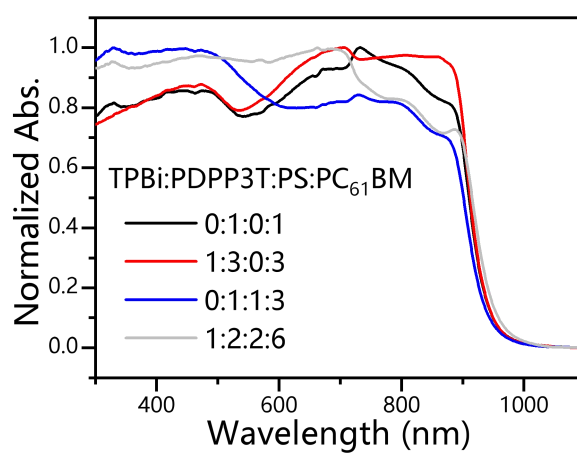
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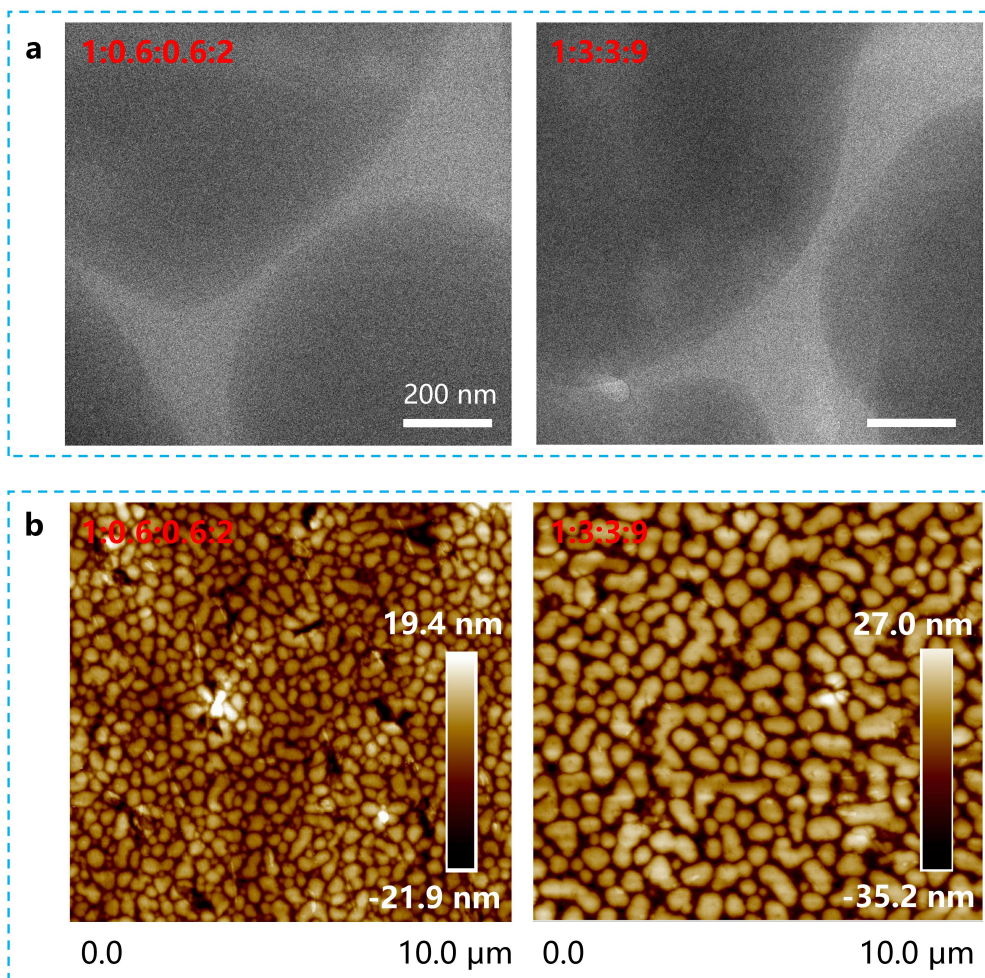
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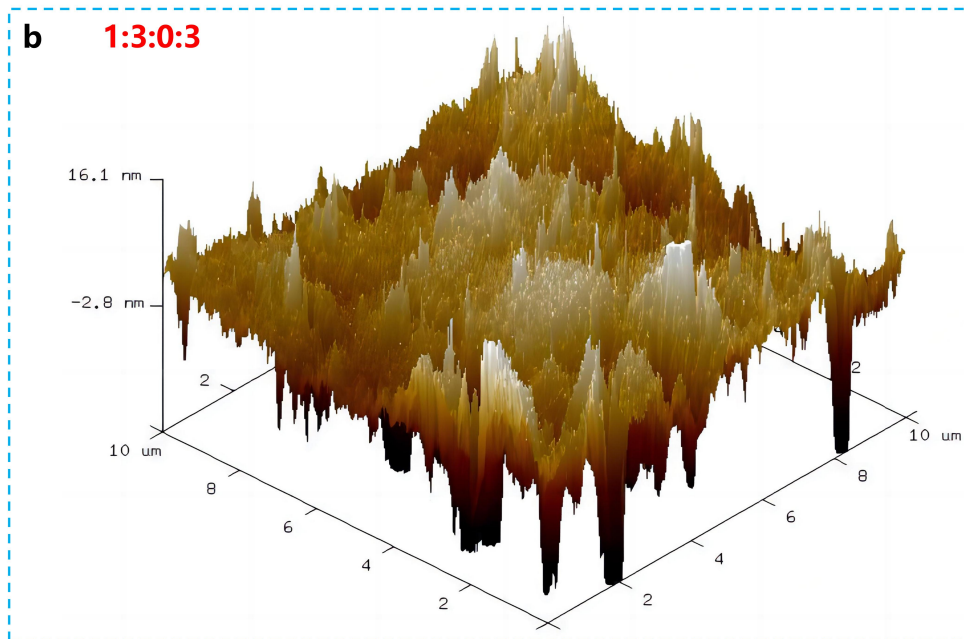
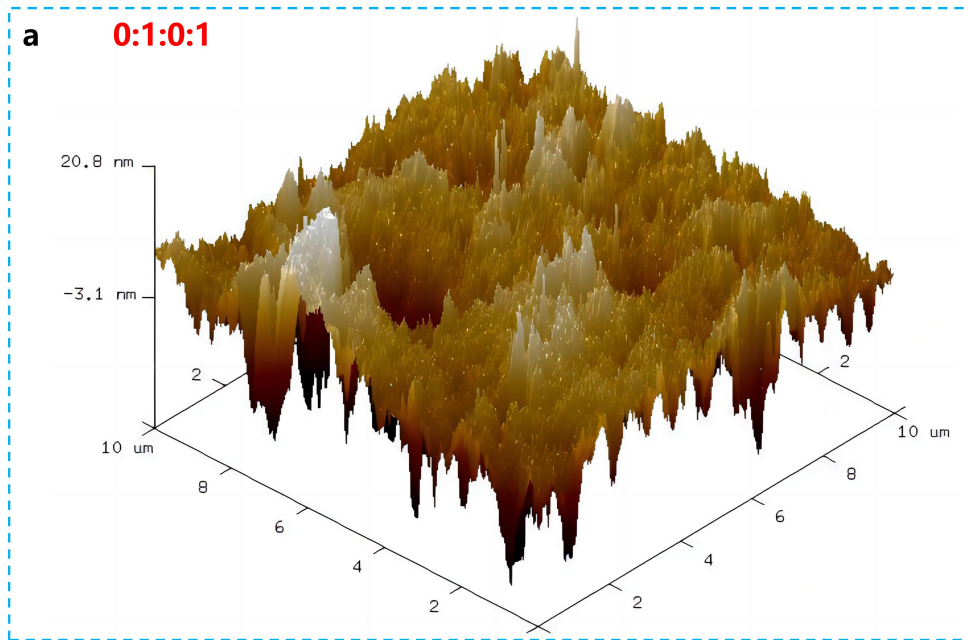
Supplementary Fig. 1 Structure of TPBi:PC₆₁BM:PDPP3T L-PPD.



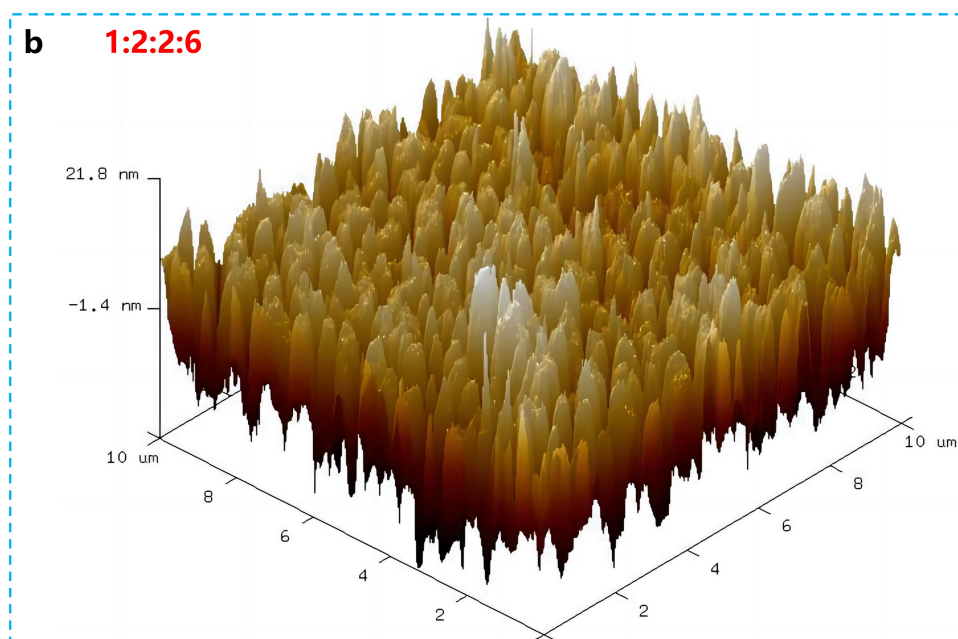
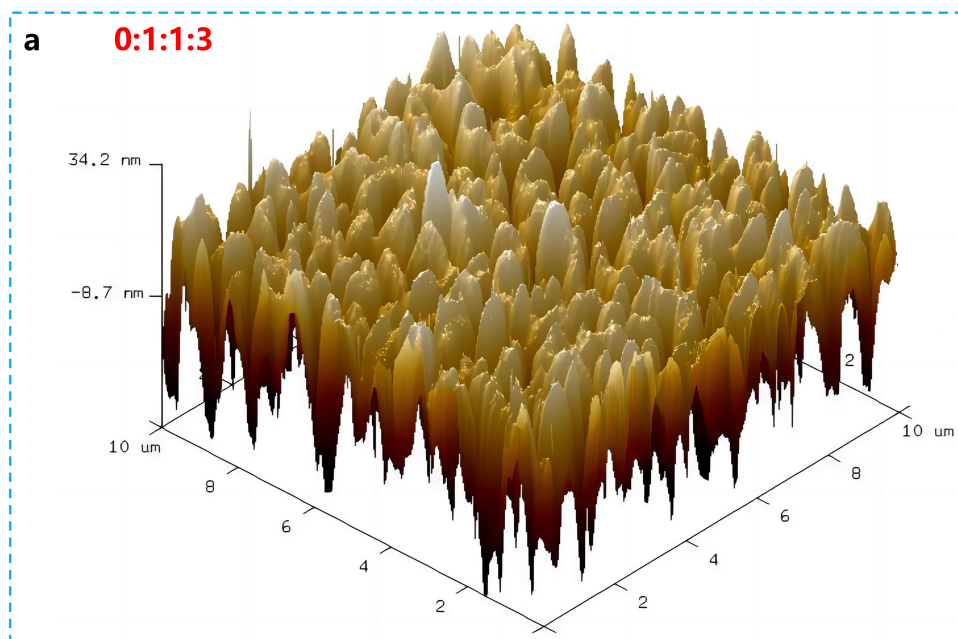
Supplementary Fig. 2 UV-vis absorption spectra of different films.



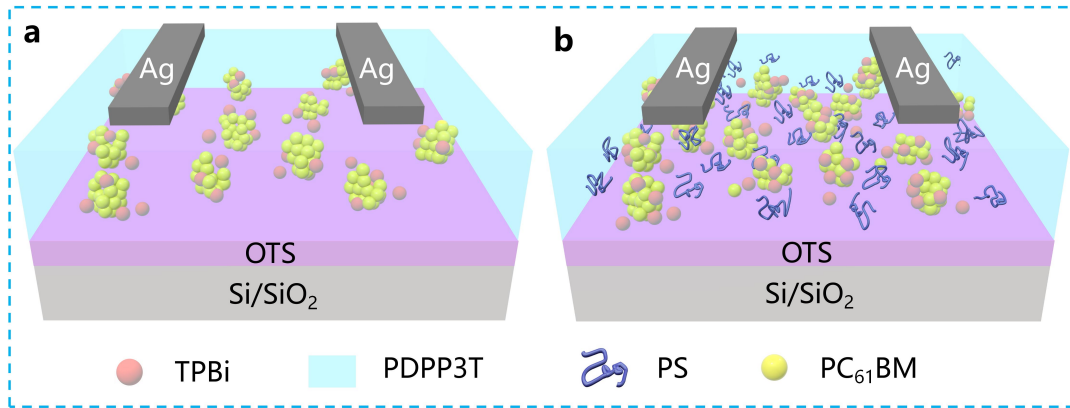
Supplementary Fig. 3 TEM of different films.



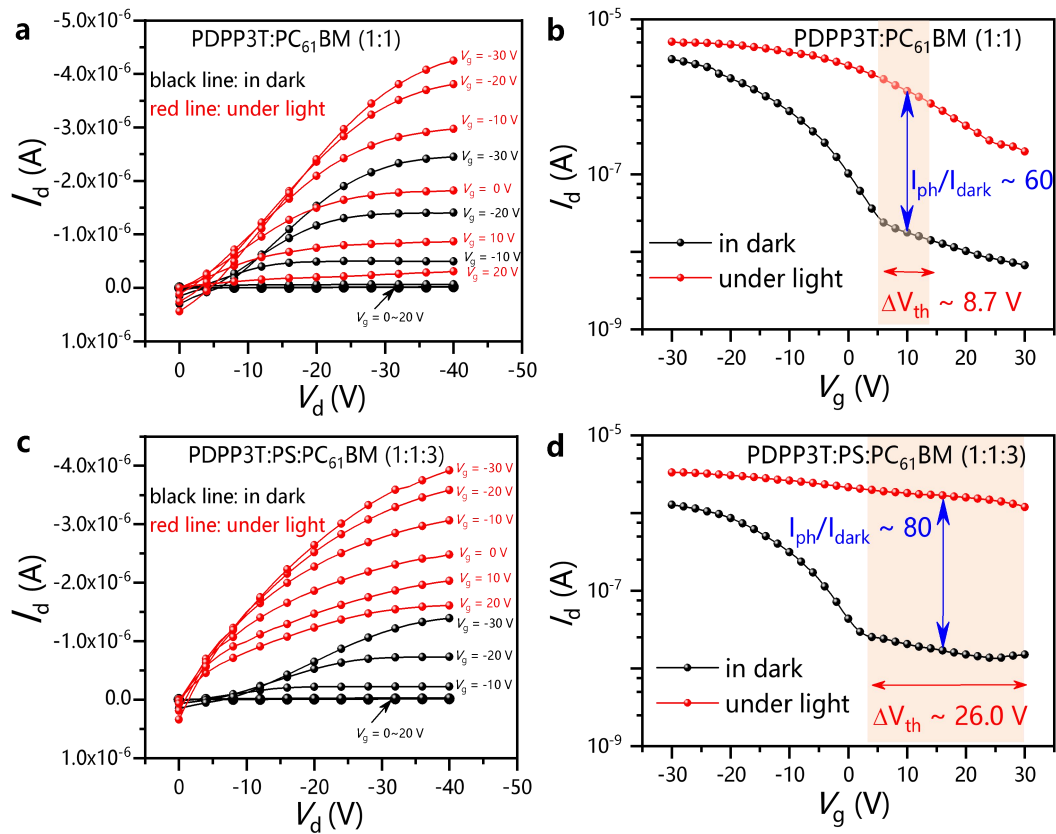
Supplementary Fig. 4 AFM of films with different ratios. a 0:1:0:1. b 1:3:0:3.

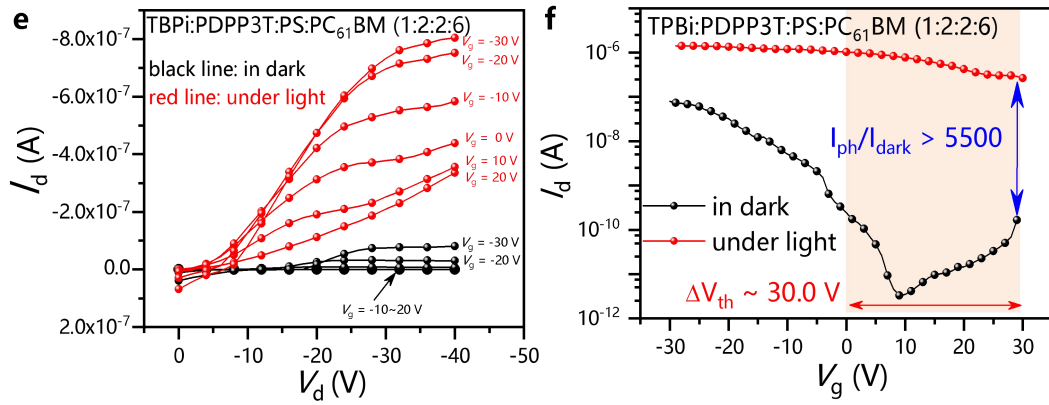


Supplementary Fig. 5 AFM of films with different ratios. a 0:1:1:3. b 1:2:2:6.

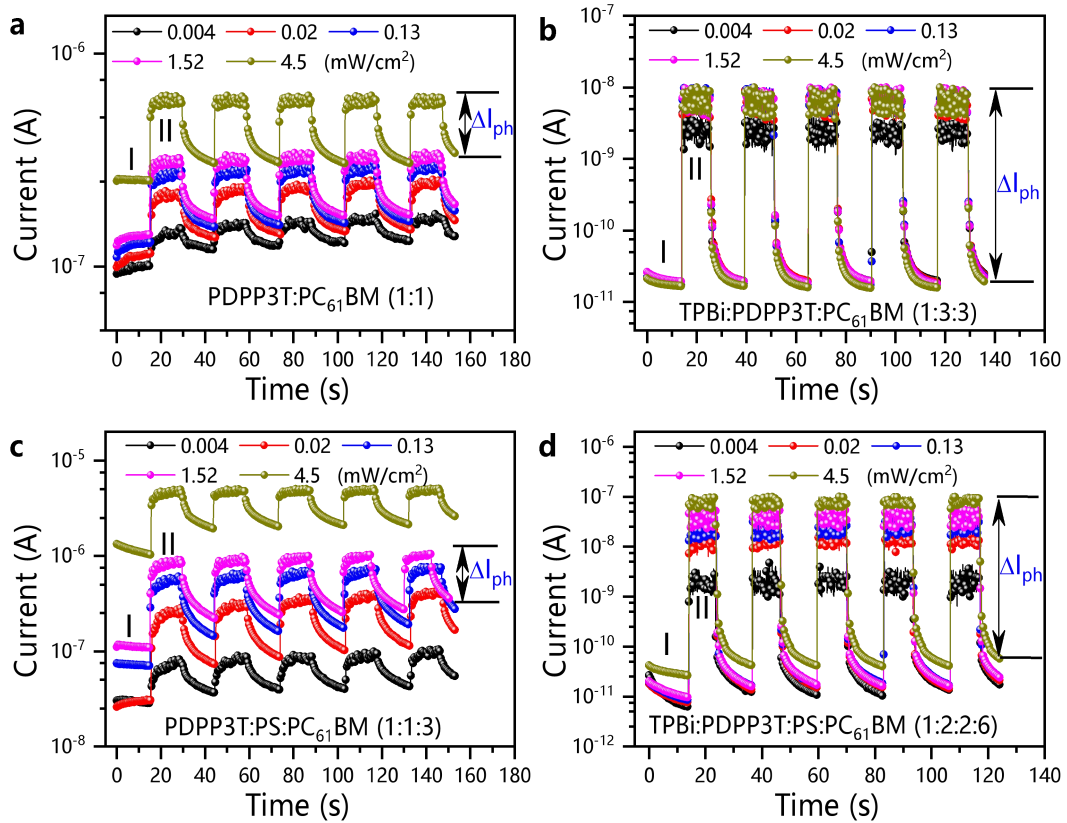


Supplementary Fig. 6 Structures of phototransistors. a Si/SiO₂/OTS/TPBi:PDPP3T:PC₆₁BM device. **b** Si/SiO₂/OTS/TPBi:PDPP3T:PS:PC₆₁BM device.



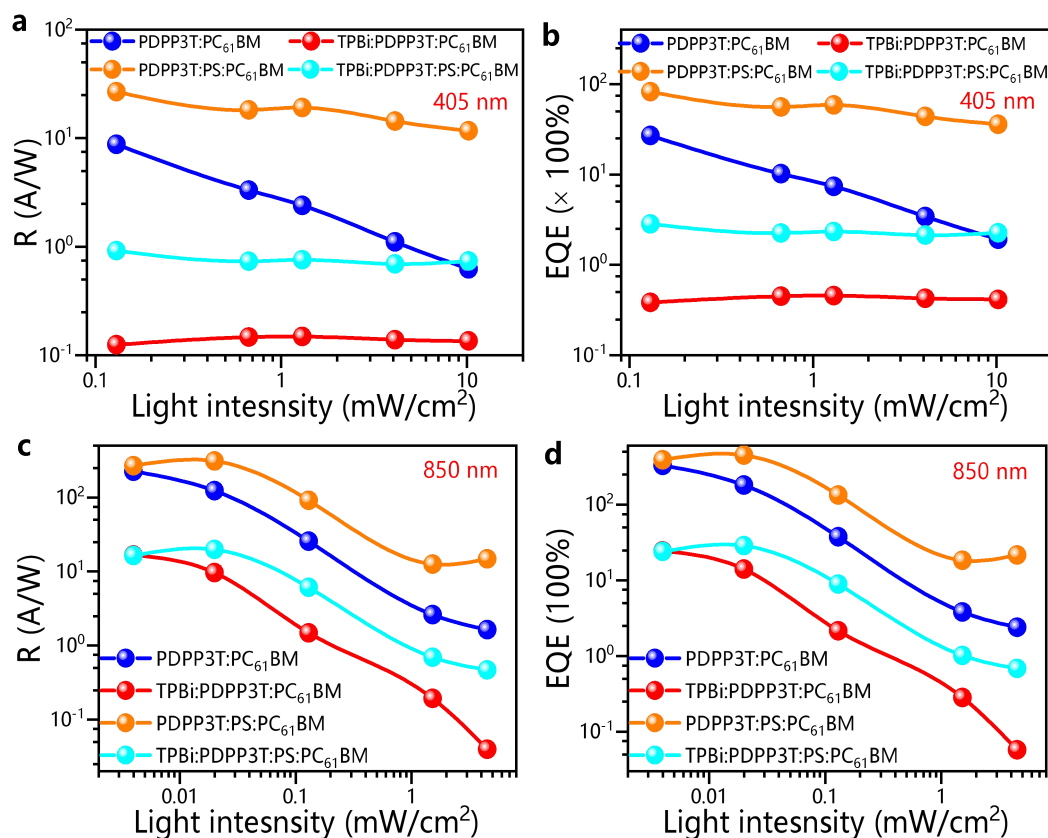


Supplementary Fig. 7 Electrical properties of phototransistors with different doping ratios. Output curve **a** and transfer curve **b** of Si/SiO₂/OTS/PDPP3T:PC₆₁BM device with 1:1 ratio. Output curve **c** and transfer curve **d** of Si/SiO₂/OTS/PDPP3T:PS:PC₆₁BM device with 1:1:3 ratio. Output curve **e** and transfer curve **f** of Si/SiO₂/OTS/TPBi:PDPP3T:PS:PC₆₁BM device with 1:2:2:6 ratio. The light intensity is 0.13 mW/cm² @ 850 nm. The transfer curves were tested with V_d = -30 V. ΔV_{th} is response window of device.

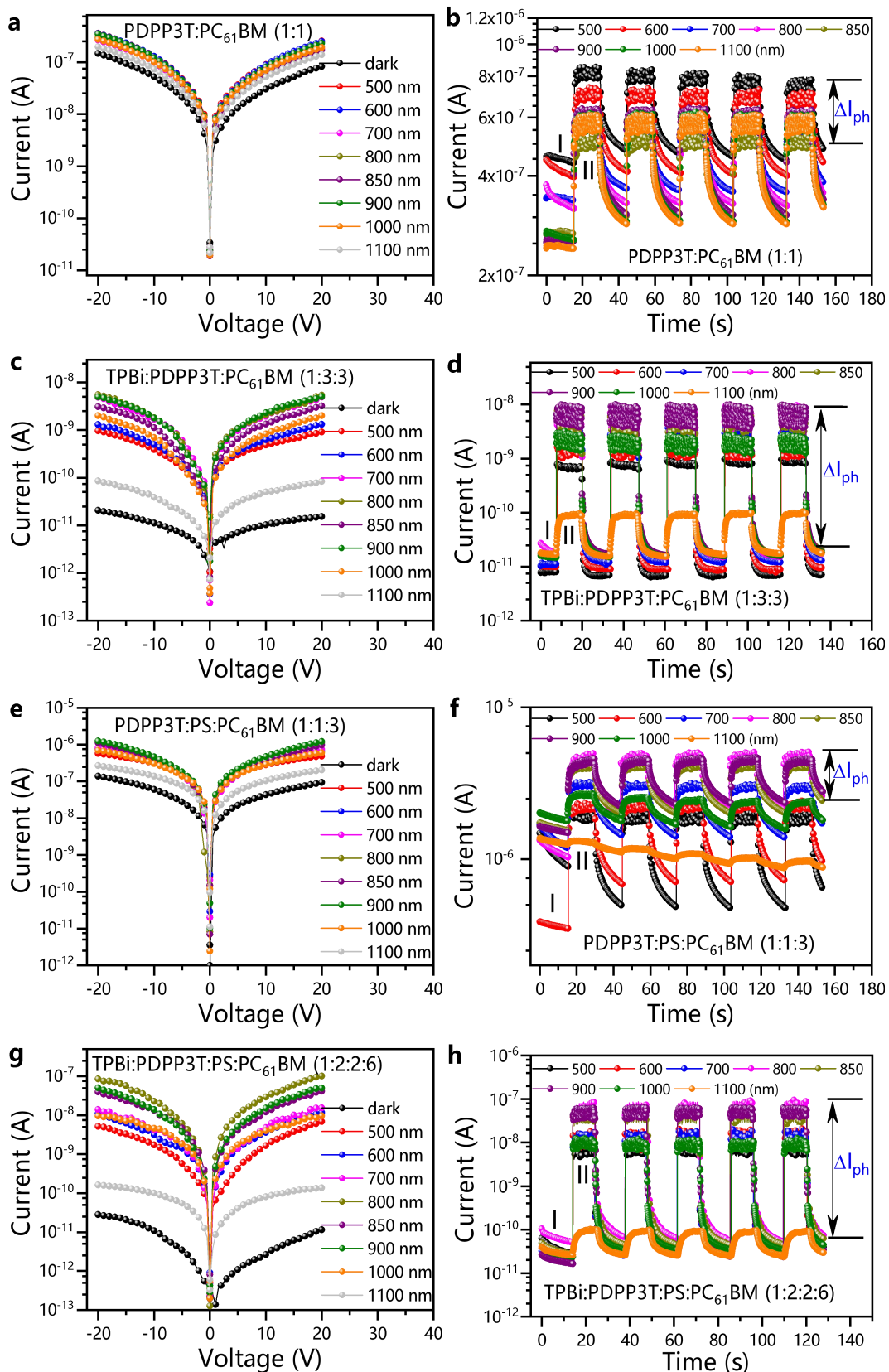


Supplementary Fig. 8 I-Time curves of TPBi:PDPP3T:PS:PC₆₁BM L-PPDs with

different doping ratios exposed to the 850 nm laser. **a** PDPP3T:PC₆₁BM L-PPD with 1:1 ratio. **b** TPBi:PDPP3T:PC₆₁BM L-PPD with 1:3:3 ratio. **c** PDPP3T:PS:PC₆₁BM L-PPD with 1:1:3 ratio. **d** TPBi:PDPP3T:PS:PC₆₁BM L-PPD with 1:2:2:6 ratio. The bias were added at a constant $V = -20$ V during the I -Time curves tested.



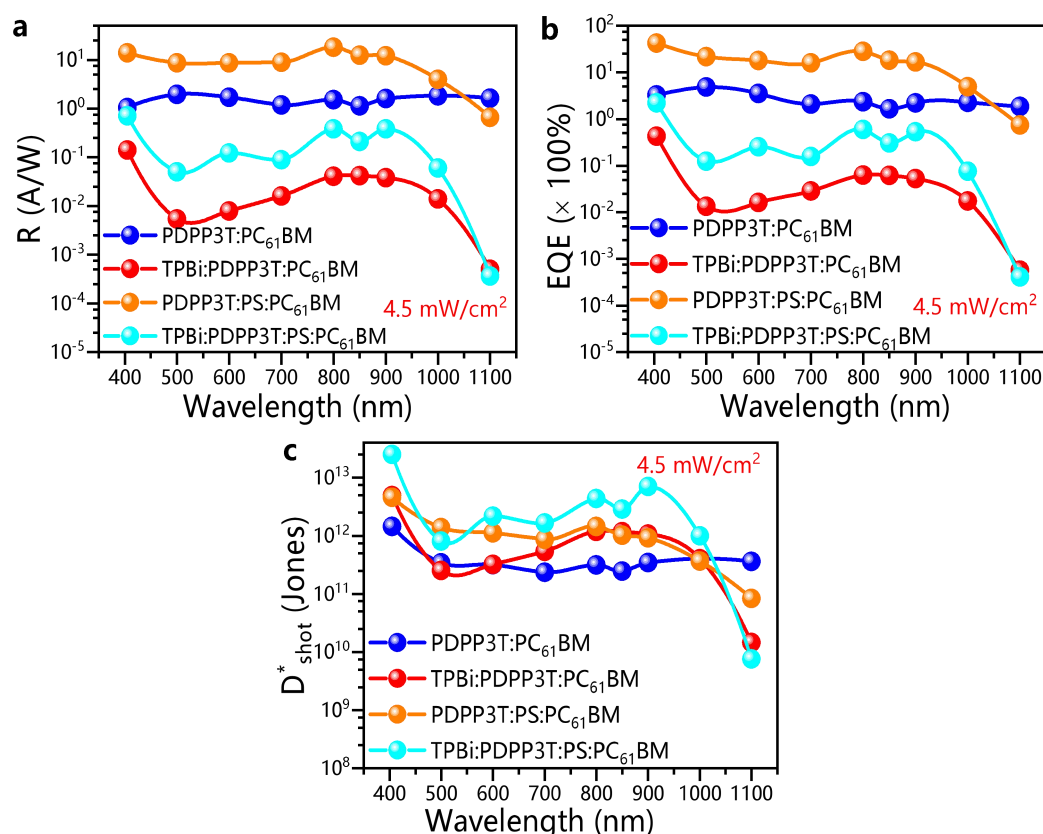
Supplementary Fig. 9 Electrical properties of TPBi:PDPP3T:PS:PC₆₁BM L-PPDs with different doping ratios exposed to the 405 nm and 850 nm laser. a Dependence of R on light intensity at 405 nm laser. **b** Dependence of EQE on light intensity at 405 nm laser. **c** Dependence of R on light intensity at 850 nm laser. **d** Dependence of EQE on light intensity at 850 nm laser.



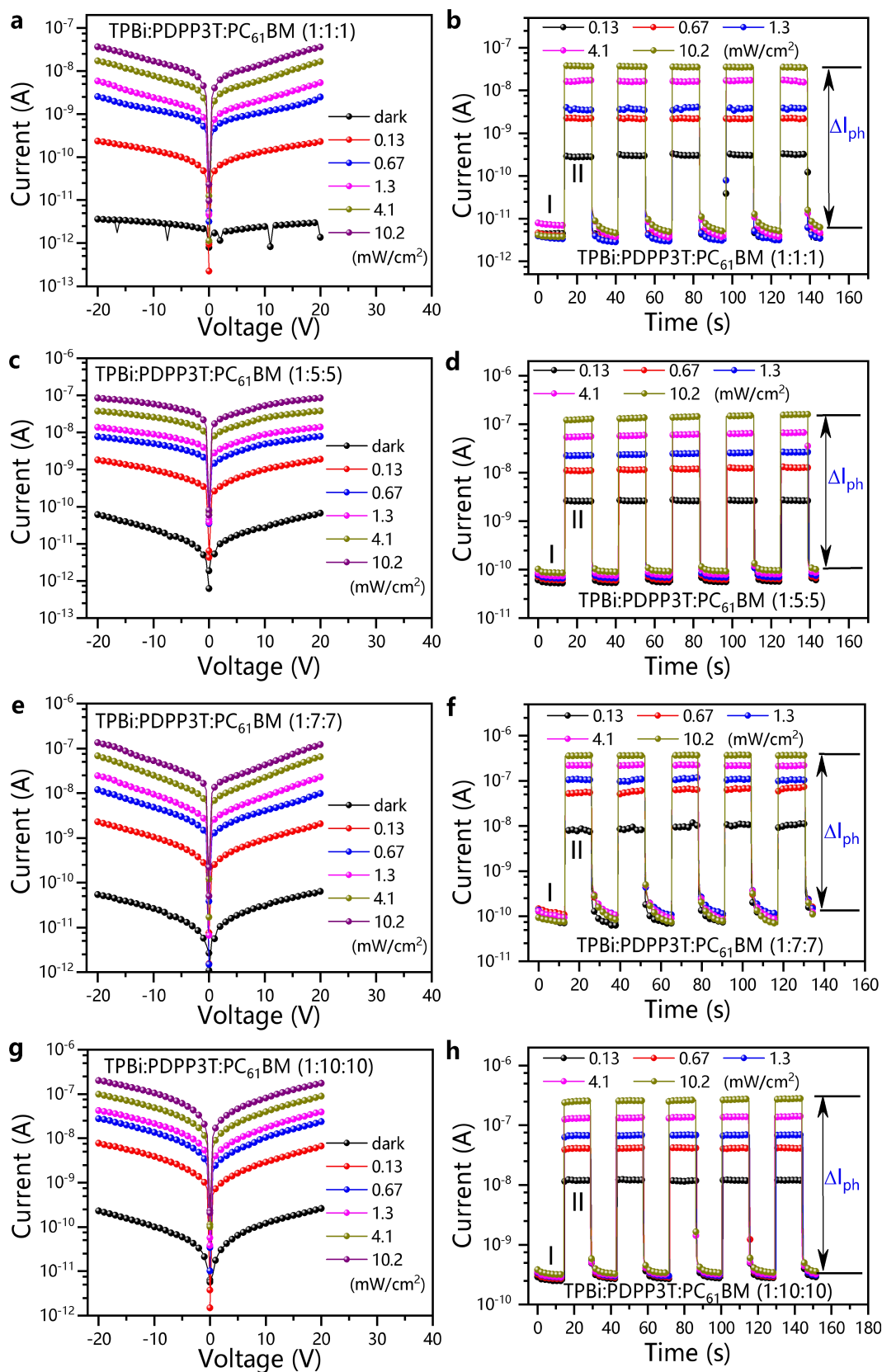
Supplementary Fig. 10 *I-V* curves and *I-Time* curves of TPBi:PDPP3T:PS:PC₆₁BM

L-PPDs exposed to the different wavelength of laser. a, b *I-V* curves and *I-Time*

curves of PDPP3T:PC₆₁BM L-PPD with 1:1 ratio. **c, d** *I-V* curves and *I-Time* curves of TPBi:PDPP3T:PC₆₁BM L-PPD with 1:3:3 ratio. **e, f** *I-V* curves and *I-Time* curves of PDPP3T:PS:PC₆₁BM L-PPD with 1:1:3 ratio. **g, h** *I-V* curves and *I-Time* curves of TPBi:PDPP3T:PS:PC₆₁BM L-PPD with 1:2:2:6 ratio. The bias were added at a constant $V = -20$ V during the *I-Time* curves tested. The light intensity is $4.5 \text{ mW/cm}^2 @ 850 \text{ nm}$.



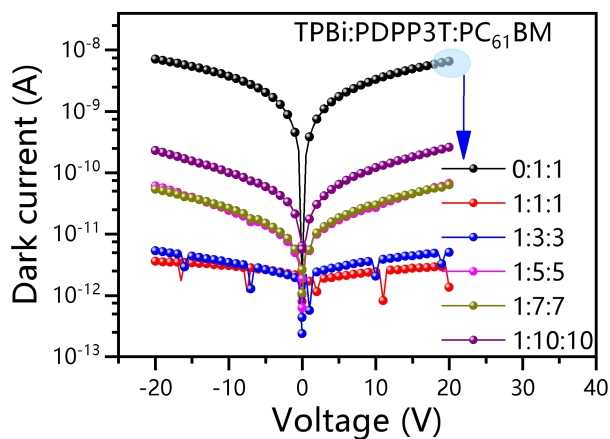
Supplementary Fig. 11 Electrical properties of TPBi:PDPP3T:PS:PC₆₁BM L-PPDs with different doping ratios exposed to the different wavelength of laser. a Dependence of R on wavelength. **b** Dependence of EQE on wavelength. **c** Dependence of D^*_{shot} on wavelength. The light intensity is 4.5 mW/cm^2 .



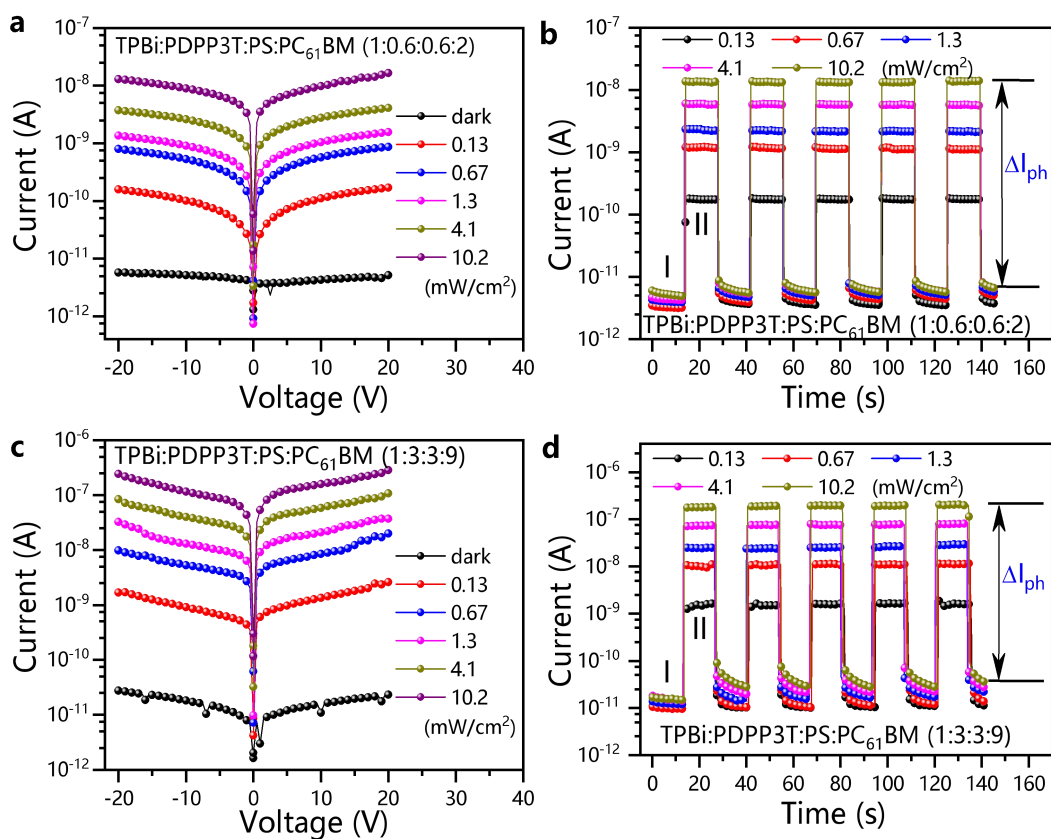
Supplementary Fig. 12 *I-V* curves and *I-Time* curves of TPBi:PDPP3T:PC₆₁BM

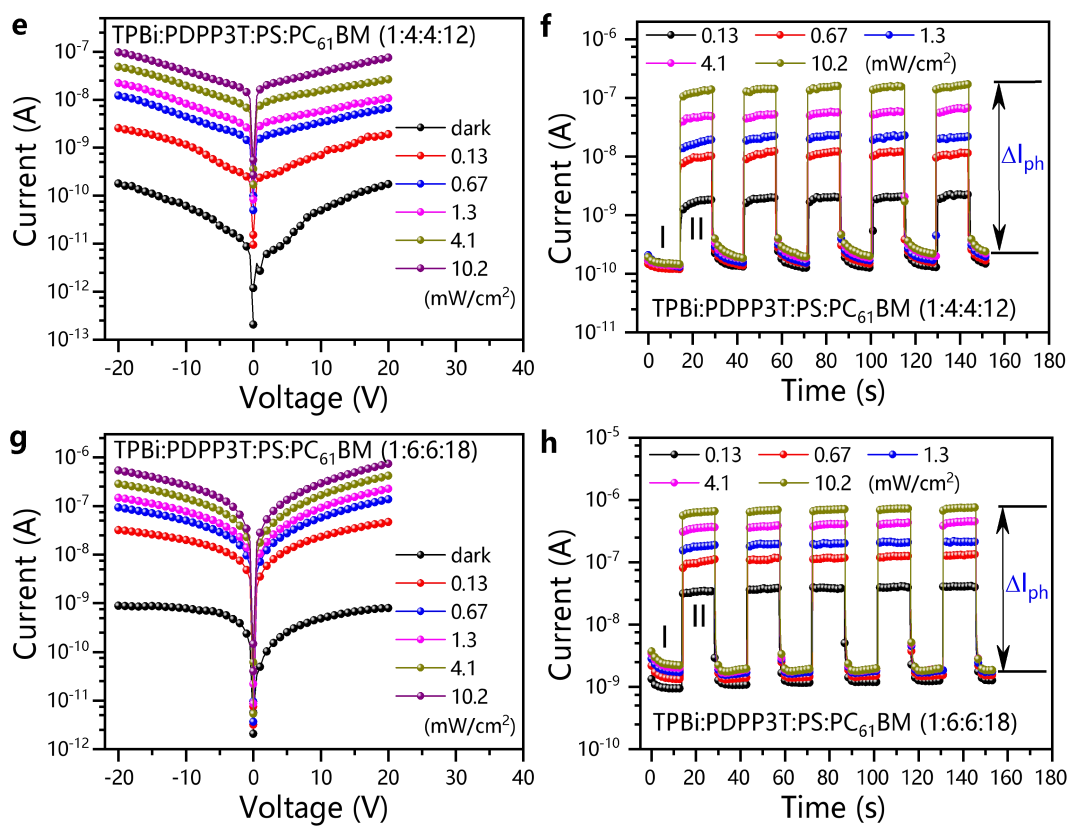
L-PPDs exposed to the 405 nm laser. **a, b** 1:1:1 ratio. **c, d** 1:5:5 ratio. **e, f** 1:7:7 ratio. **g,**

h 1:10:10 ratio. The bias were added at a constant $V = -20$ V during the I-Time curves tested.

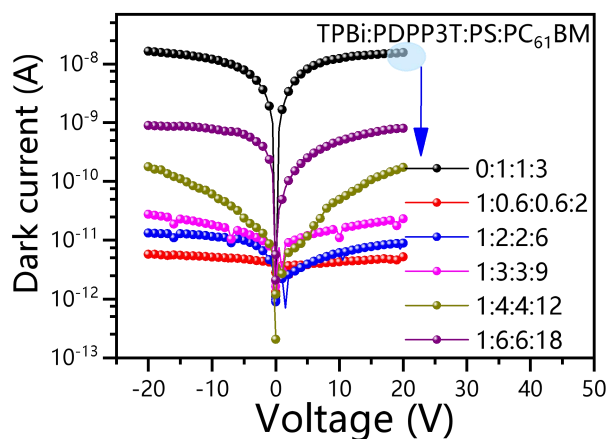


Supplementary Fig. 13 The dark current of TPBi:PDPP3T:PC₆₁BM L-PPDs.

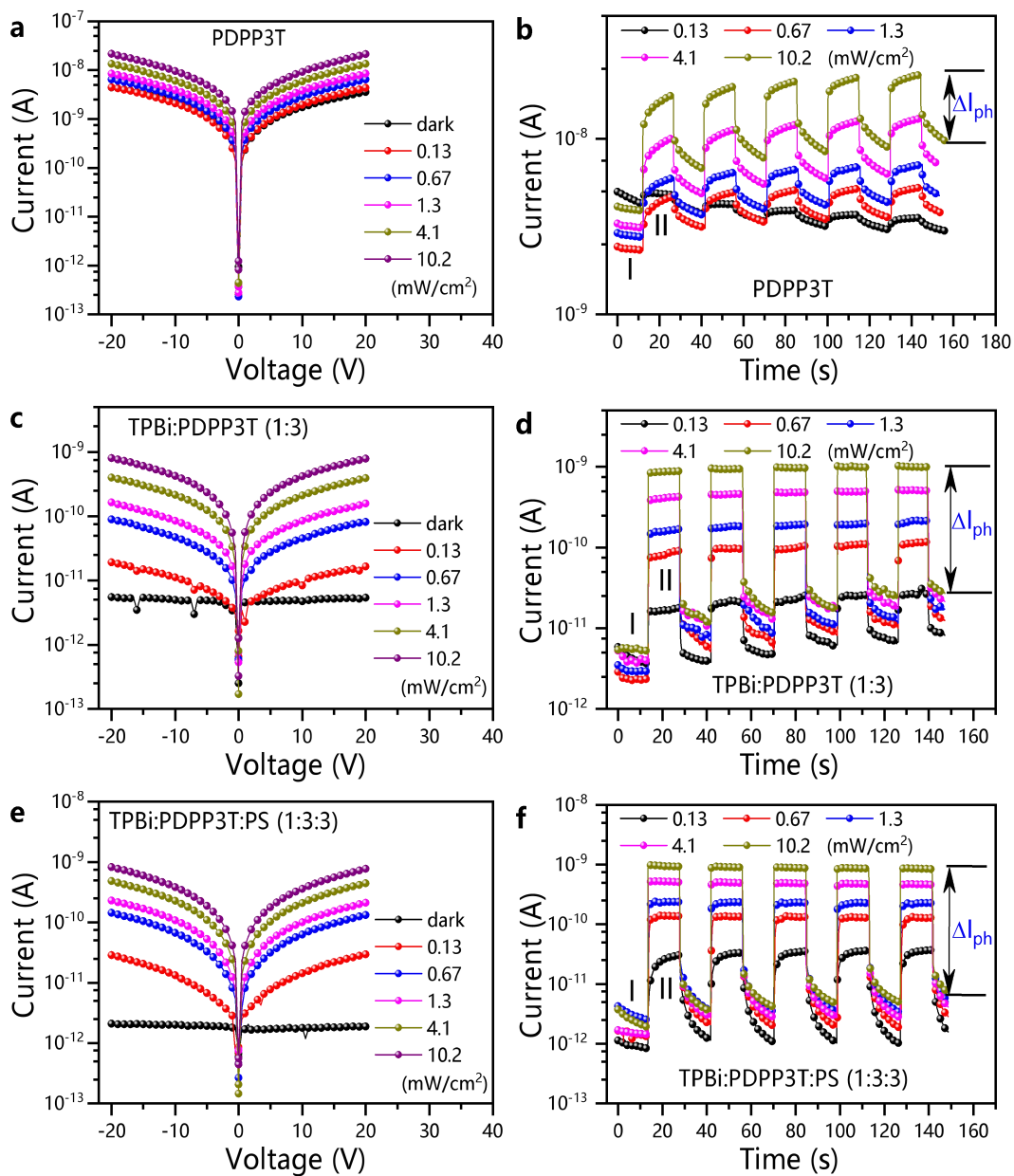




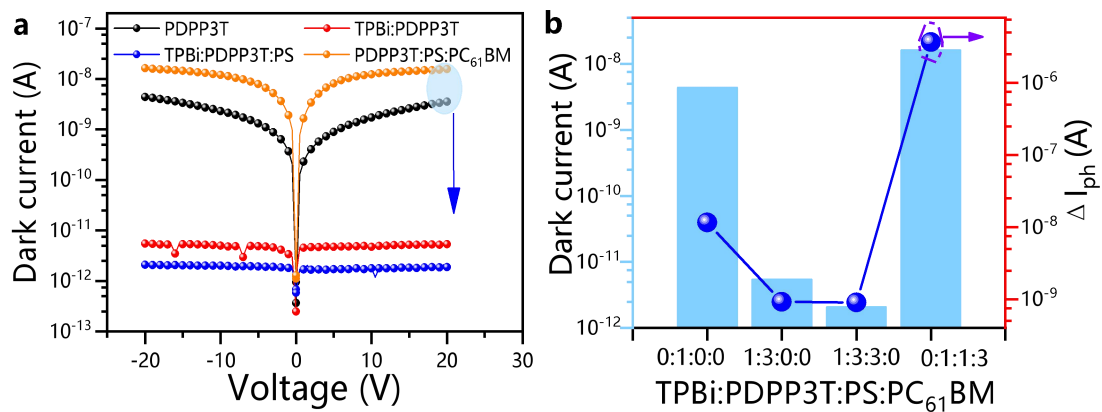
Supplementary Fig. 14 *I-V* curves and *I-Time* curves of TPBi:PDPP3T:PS:PC₆₁BM L-PPDs exposed to the 405 nm laser. **a, b** 1:0.6:0.6:2 ratio. **c, d** 1:3:3:9 ratio. **e, f** 1:4:4:12 ratio. **g, h** 1:6:6:18 ratio. The bias were added at a constant $V = -20$ V during the *I-Time* curves tested.



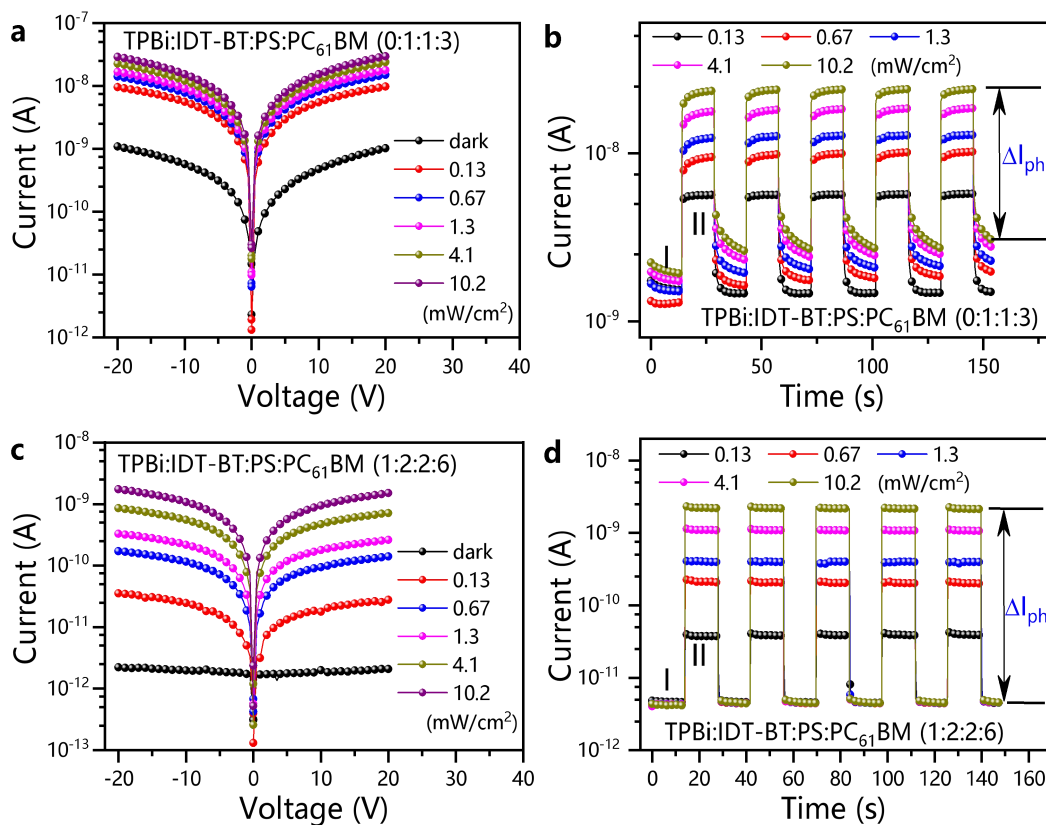
Supplementary Fig. 15 The dark current of TPBi:PDPP3T:PS:PC₆₁BM L-PPDs.



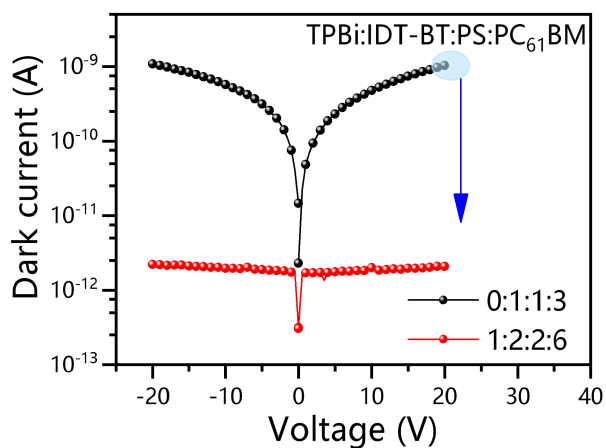
Supplementary Fig. 16 *I-V* curves and *I-Time* curves of different L-PPDs exposed to the 405 nm laser. **a, b** PDPP3T L-PPD. **c, d** TPBi:PDPP3T L-PPD with 1:3 ratio. **e, f** TPBi:PDPP3T:PS L-PPD with 1:3:3 ratio. The bias were added at a constant $V = -20$ V during the *I-Time* curves tested.



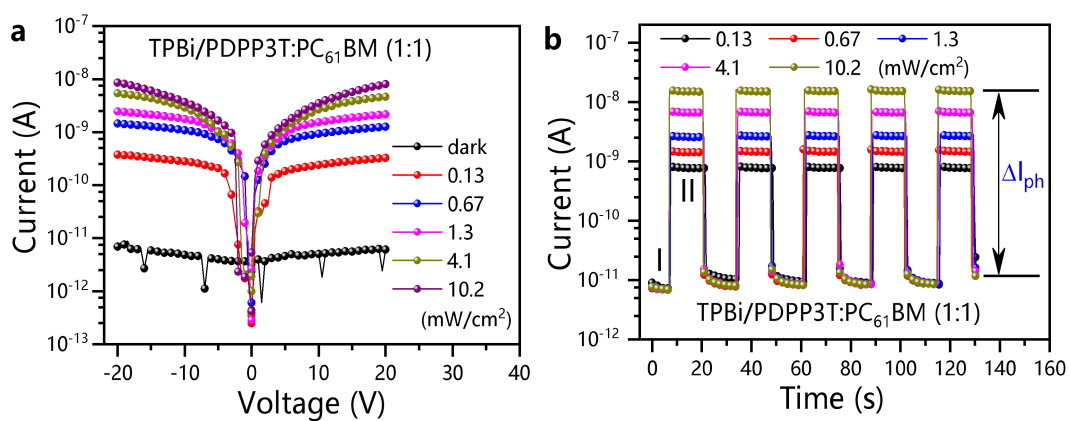
Supplementary Fig. 17 Electrical properties of different L-PPDs exposed to the 405 nm laser. a Dark current. **b** Dependence of dark current and ΔI_{ph} on different doping ratios.



Supplementary Fig. 18 I-V curves and I-Time curves of TPBi:IDT-BT:PS:PC₆₁BM L-PPDs exposed to the 405 nm laser. a, b 0:1:1:3 ratio. **c, d** 1:2:2:6 ratio. The bias were added at a constant $V = -20$ V during the I-Time curves tested.

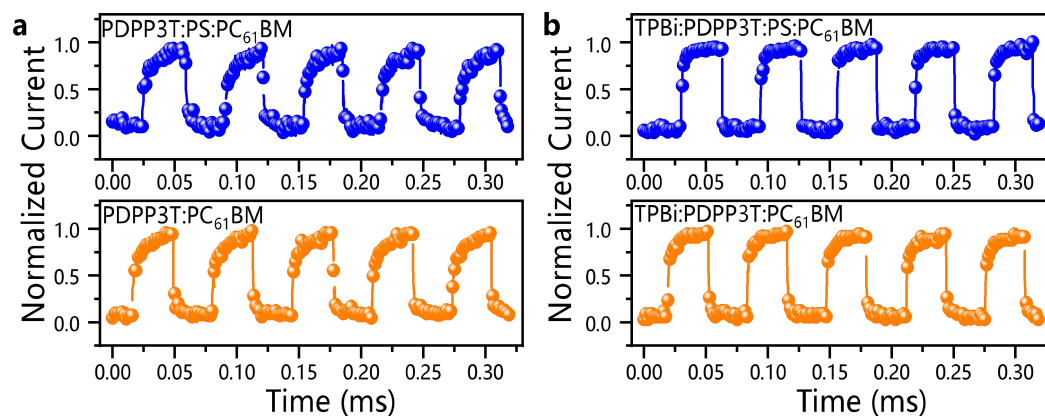


Supplementary Fig. 19 The dark current of TPBi:IDI-BT:PS:PC₆₁BM L-PPDs.



Supplementary Fig. 20 *I-V* curves and *I-Time* curves of TPBi/PDPP3T:PC₆₁BM (1:1)

L-PPD exposed to the 405 nm laser. **a** *I-V* curves. **b** *I-Time* curves. The bias were added at a constant $V = -20$ V during the *I-Time* curves tested.



Supplementary Fig. 21 On/off switching properties of different devices. **a**

PDPP3T:PC₆₁BM and PDPP3T:PS:PC₆₁BM L-PPDs. **b** TPBi:PDPP3T:PC₆₁BM and TPBi:PDPP3T:PS:PC₆₁BM L-PPDs. The light intensity is 10.42 mW/cm² @ 405 nm.

Table S1. Summary of the UV-vis spectra and UPS analysis.

	UV-vis absorption		UPS			
	λ_{onset} (nm) ^a	E_g^{opt} (eV) ^b	E_{Cutoff} (eV)	E_V-E_F (eV)	E_{HOMO} (eV) ^c	E_{LUMO} (eV) ^d
PDPP3T	961	1.29	17.93	2.00	5.29	4.00
PC ₆₁ BM	623	1.99	18.35	3.25	6.12	4.13
TPBi	362	3.42	18.46	3.52	6.28	2.86

^a the absorption onset wavelength of the film, ^b optical bandgap calculated via λ_{onset} , ^c HOMO levels obtained by the E_{Cutoff} and E_V-E_F values, ^d LUMO levels determined by the E_{HOMO} and E_g^{opt} .