Electronic Supplementary Information

Broadband Organic Photodetectors Based on Ternary Blend Active Layers with Enhanced and Spectrally Flat Response

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Experimental Details

Fabrication of PM-type OPDs: ITO-glass substrates with a resistance of ~15Ω per square (Shenzhen South China Xiangcheng Technology Co., Ltd.) were pre-cleaned by ultrasonication in detergent, deionized-water, acetone and isopropyl-alcohol consecutively (30 min for each). Then, the pre-cleaned ITO substrates were dried in the oven at 70 ^{o}C overnight. Before spin-coating, the ITO substrates were processed by UV-O_3 for 15 min. Then, PEDOT:PSS solution (Baytron PAl 4083) was spin-coated onto the ITO substrates at 5000 rpm for 40 s. All PEDOT:PSS-coated ITO substrates were baked on a hot plate at 120 ^{o}C for 10 min, and then transferred into a N_2-filled glovebox. P3HT (J&K Scientific Ltd.), PTB7-Th (Solarmer Energy, Inc.) and IEICO (Solarmer Energy, Inc.) were mixed with weight ratios of 100-x:x:1 (x=0, 10, 20), to prepare 1,2-dichlorobenzene (*o*-DCB) solutions with a fixed concentration of 40 mg/mL. After sufficient stirring, the prepared solutions were spin-coated onto the PEDOT:PSS-coated substrates at 600 rpm for 25 s in the N_2-filled glovebox. All the active layers were annealed at 80 ^{o}C for 20 s. The thickness of the active layer was about 230 nm. Later, a 100 nm Al layer was deposited on active layers by thermal evaporation under 10^{-5} Pa. The area of active layer was fixed at 4 mm^2.

Measurements: All *J-V* characteristics of PM-type OPDs were measured through an Agilent 4155C semiconductor parameter analyzer. The EQE spectra of OPDs were recorded by using a Newport EQE measuring system. During measurements, the DC regulated power supply, OPDs, and Newport EQE measuring system were connected in series.

In order to measure transient response of the OPDs, an Oscilloscope (RIGOL DS1102CA) was used to measure the variation of voltage on resistor, while the light on/off was realized through an electrical shutter (controlled by computer). The light on/off could not only lead to the variation of photocurrent in OPDs but also result in the change of voltage on resistor. As long as the OPDs and resistor were connected in series, the changing speed of voltage on resistor could represent transient response of photocurrent in OPDs. An optical filter with neutral optical attenuators was used to obtain the adjustable light intensities at the wavelength of 506 nm. The LDR of OPD was measured by the Newport EQE measuring system with different light intensities adjusted by neutral optical attenuators. Ultraviolet to near-infrared absorption spectra of active layers were recorded by a Lambda365 spectrophotometer. The thicknesses of active layers were recorded through the Bruker Dektak XT surface profiler.

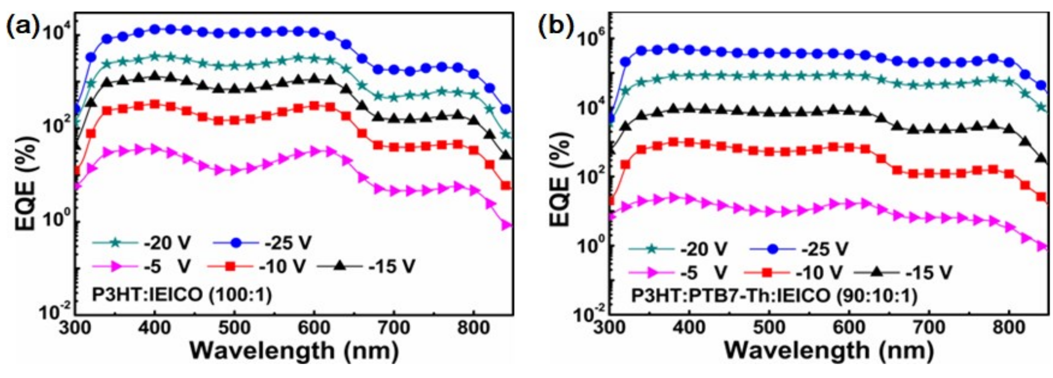

Fig. S1 (a) EQE spectra of the optimized OPD using P3HT:IEICO (100:1, *w*/*w*) as an active layer under different bias voltages; (b) EQE spectra of the optimized OPD using P3HT:PTB7-Th:IEICO (90:10:1, *w*/*w*/*w*) as an active layer under different bias voltages.

Table S1 Typical EQEs in the literatures of photodiode-architecture OPDs.

λ [nm]	EQE [%]	Device type	Refs.
380	5.12×10^5	Ternary	This work
510	3.81×10^5		
600	3.52×10^5		
780	2.63×10^5		
730	1.59×10^5	Binary	S1
390	1.11×10^5	Binary	S2
510	3.00×10^4		
610	1.16×10^5		
410	4.00×10^4	Binary	S3
510	1.10×10^4		
630	3.75×10^4		
390	2.80×10^4	Binary	S4
510	1.30×10^4		
630	2.50×10^4		
750	4.00×10^3		
650	5.35×10^4	Binary	S5
380	1.67×10^4	Binary	S6
520	4.44×10^3		
625	9.61×10^3		
400	1.12×10^5	Binary	S7
510	5.50×10^4		
630	1.08×10^5		
380	5.75×10^3	Binary	S8
520	2.25×10^3		
625	7.04×10^3		
380	72	Binary	S9
510	70		
640	53		
390	4.55×10^4	Ternary	S10
515	2.48×10^4		
625	3.78×10^4		
750	3.80×10^4		
370	2.00×10^3	Ternary	S11
520	1.20×10^3		
610	1.50×10^3		
740	1.40×10^3		
420	600	Ternary	S12
520	450		
610	480		
780	400		

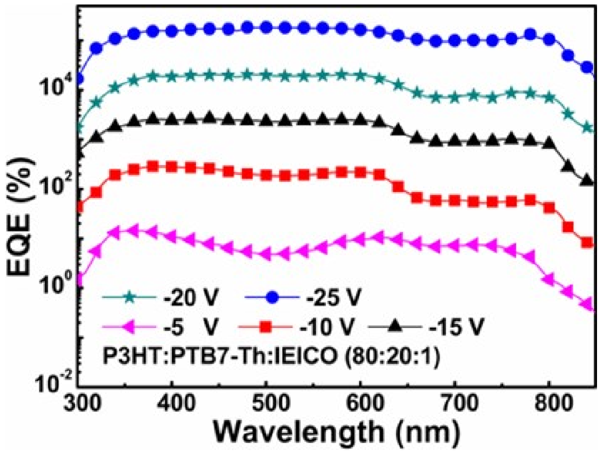

Fig. S2 EQE spectra of the OPD using P3HT:PTB7-Th:IEICO (80:20:1, *w*/*w*/*w*) as an active layer under different bias voltages.

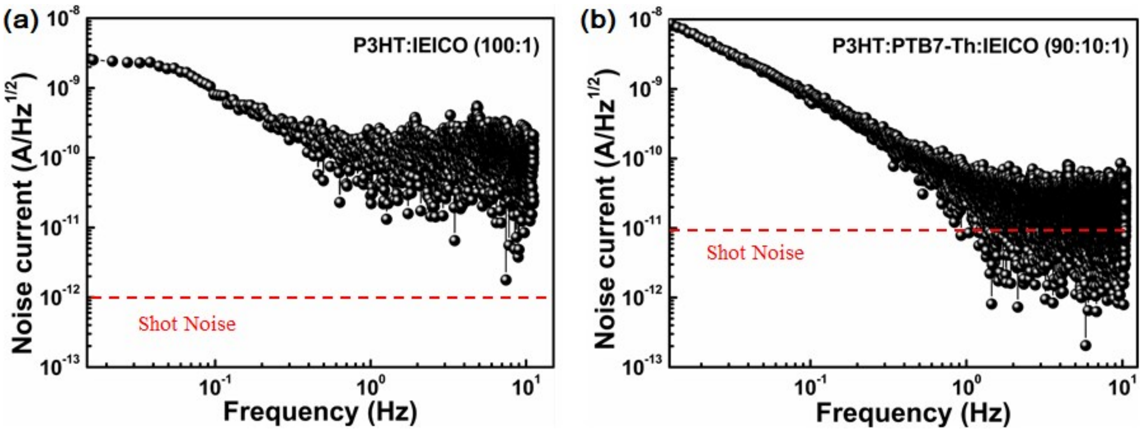

Fig. S3 Noise current (i_n) of the optimized binary and ternary OPDs under -25 V bias.

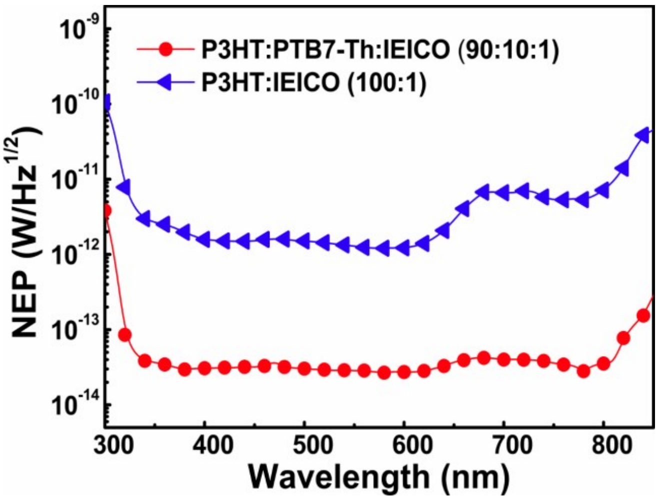

Fig. S4 Noise equivalent power **(**NEP) of the optimized binary and ternary OPDs under -25 V bias,

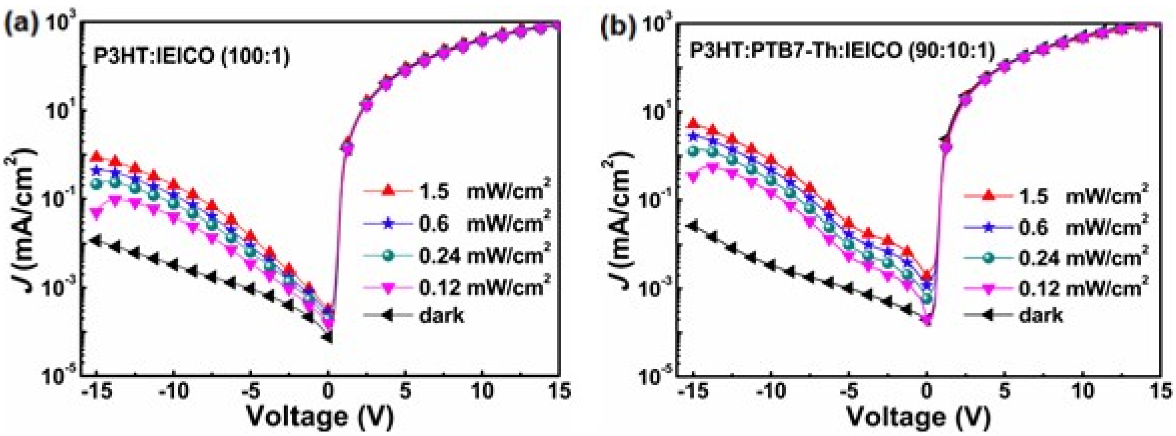

Fig. S5 (a) *J-V* characteristics of the optimized binary OPD using P3HT:IEICO (100:1, *w*/*w*) as an active layer; (b) *J-V* characteristics of the optimized ternary OPD using P3HT:PTB7-Th:IEICO (90:10:1, *w*/*w*/*w*) as an active layer.

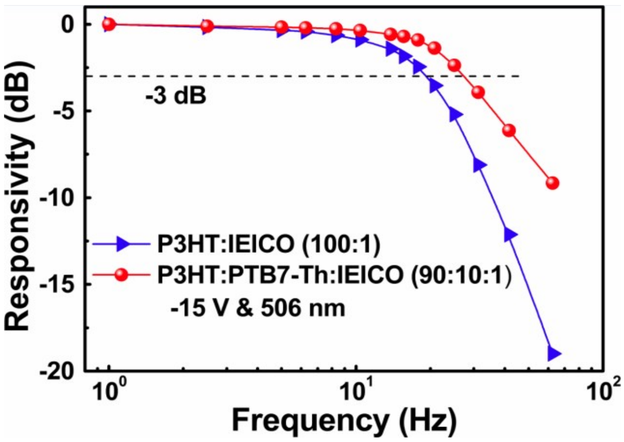

Fig. S6 Frequency dependent responsivity of the optimized ternary and binary OPDs under the incident light of 40 μW/cm^2.

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