

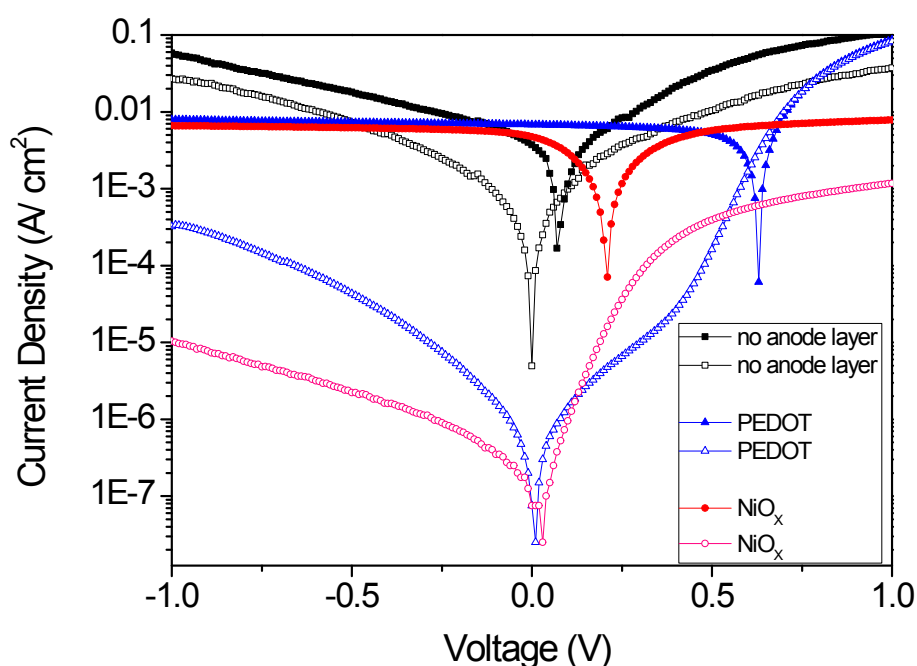
## Reduced leakage current and improved performance of organic photodetector using a ytterbium cathode interlayer

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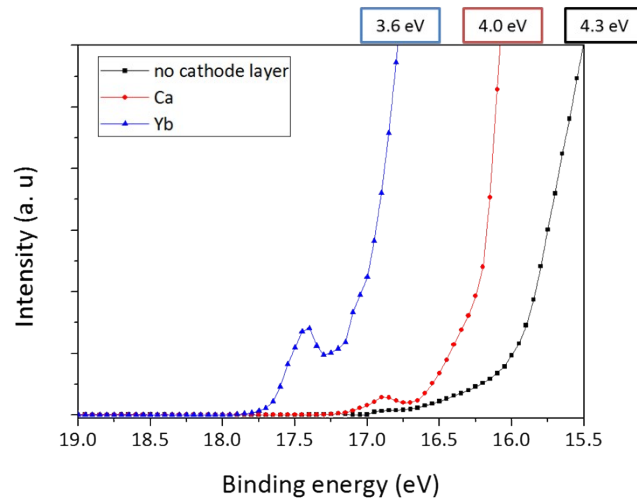
### Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.



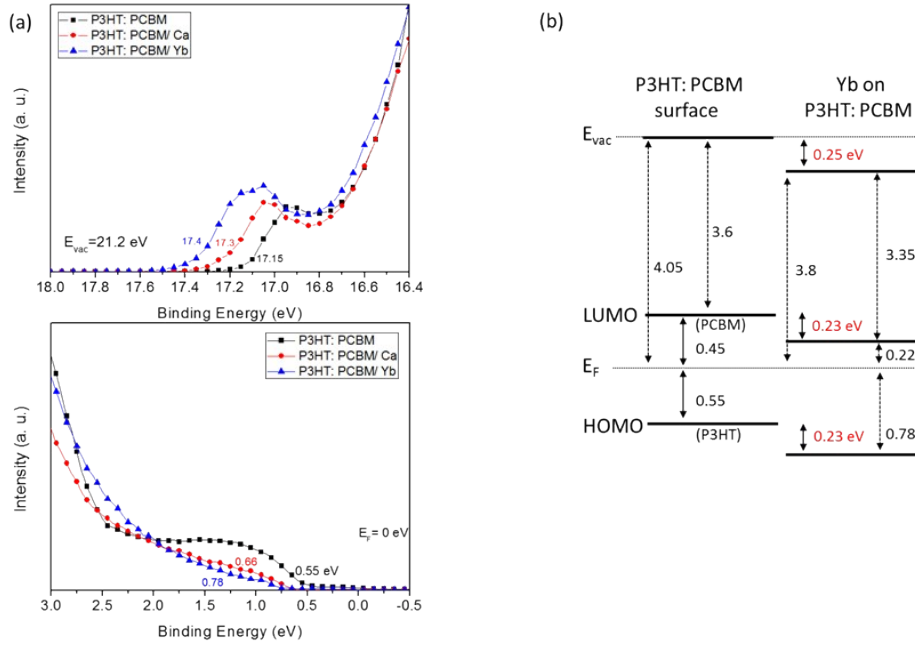
**Fig S1.** J–V characteristics of devices with different anode interlayers (solid dots represent illuminated conditions and open circles represent dark conditions): no anode layer, PEDOT:PSS, and NiO<sub>x</sub> under dark and illuminated conditions at 1 sun (100 mW/cm<sup>2</sup>).

**Table S1.** J–V characteristics of devices with different anode interlayers

	Photocurrent density (A/cm <sup>2</sup> )	Dark current density (A/cm <sup>2</sup> )
ITO/ P3HT:PCBM/Al	$1.80 \times 10^{-2}$	$9.25 \times 10^{-3}$
ITO/ PEDOT:PSS/ P3HT:PCBM/Al	$1.87 \times 10^{-2}$	$4.28 \times 10^{-4}$
ITO/ NiO <sub>x</sub> / P3HT:PCBM/Al	$6.57 \times 10^{-3}$	$9.67 \times 10^{-6}$



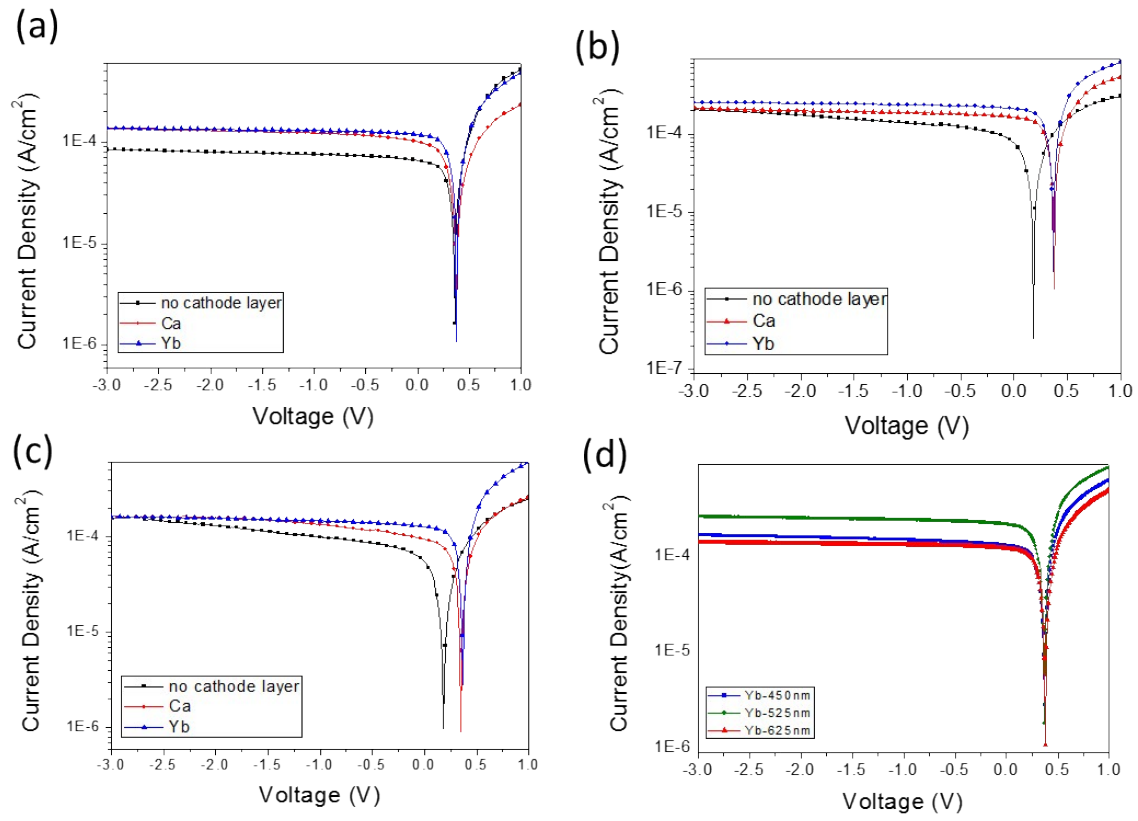
**Fig S2.** High-binding-energy cut-off region of the UPS spectra of an Al cathode (no interlayer) and Ca and Yb cathode interlayers for the P3HT:PC<sub>60</sub>BHJ.



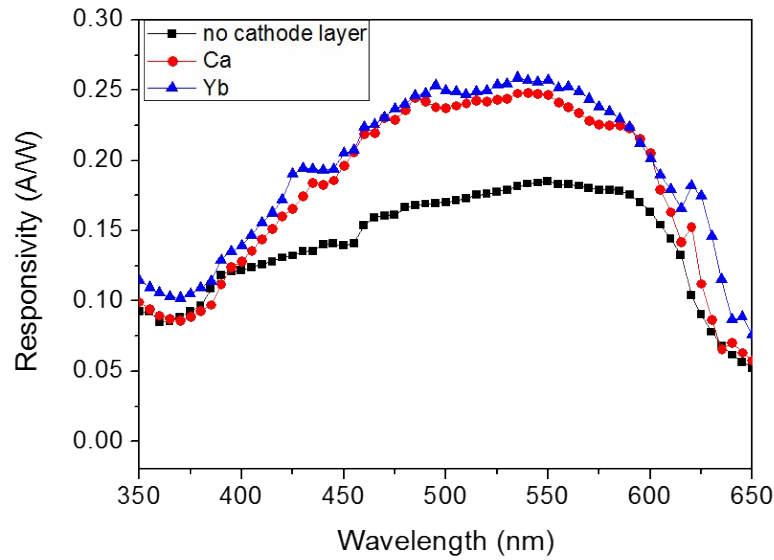
**Fig S3.** (a) UPS spectra of P3HT:PC<sub>60</sub>BM, P3HT:PC<sub>60</sub>BM/Ca, and P3HT:PC<sub>60</sub>BM/Yb on ITO glass. (b) Energy band diagram deduced from the interface between P3HT:PCBM and Yb

**Table S2.** Parameters of the J–V characteristics for OPDs under reverse voltages

$J_{\text{dark}}$ (A/ cm <sup>2</sup> )	no cathode layer	Ca	Yb
0 V	$5.00 \times 10^{-8}$	$5.75 \times 10^{-9}$	$1.25 \times 10^{-9}$
-1 V	$9.67 \times 10^{-6}$	$3.25 \times 10^{-7}$	$3.65 \times 10^{-8}$
-2 V	$3.33 \times 10^{-5}$	$1.11 \times 10^{-6}$	$8.31 \times 10^{-8}$
-3 V	$7.10 \times 10^{-5}$	$3.17 \times 10^{-6}$	$1.13 \times 10^{-7}$



**Fig S4.** J-V characteristics for organic photodiodes with several cathode interlayers under 1 sun of illumination (a)–(c) with red, green, and blue color filters (a transmittance of approximately 55%) under 1 sun of illumination, respectively. (d) The parameter for each wavelength of the OPD with the Yb layer.



**Fig S5.** Responsivity of the OPD with different cathode interlayers at 1.2 mW/cm<sup>2</sup>.