

Supporting Information

Multifunctional bipyramid-Au@ZnO core-shell nanoparticles as a cathode buffer layer for efficient non-fullerene inverted polymer solar cells with improved near-infrared photoresponse

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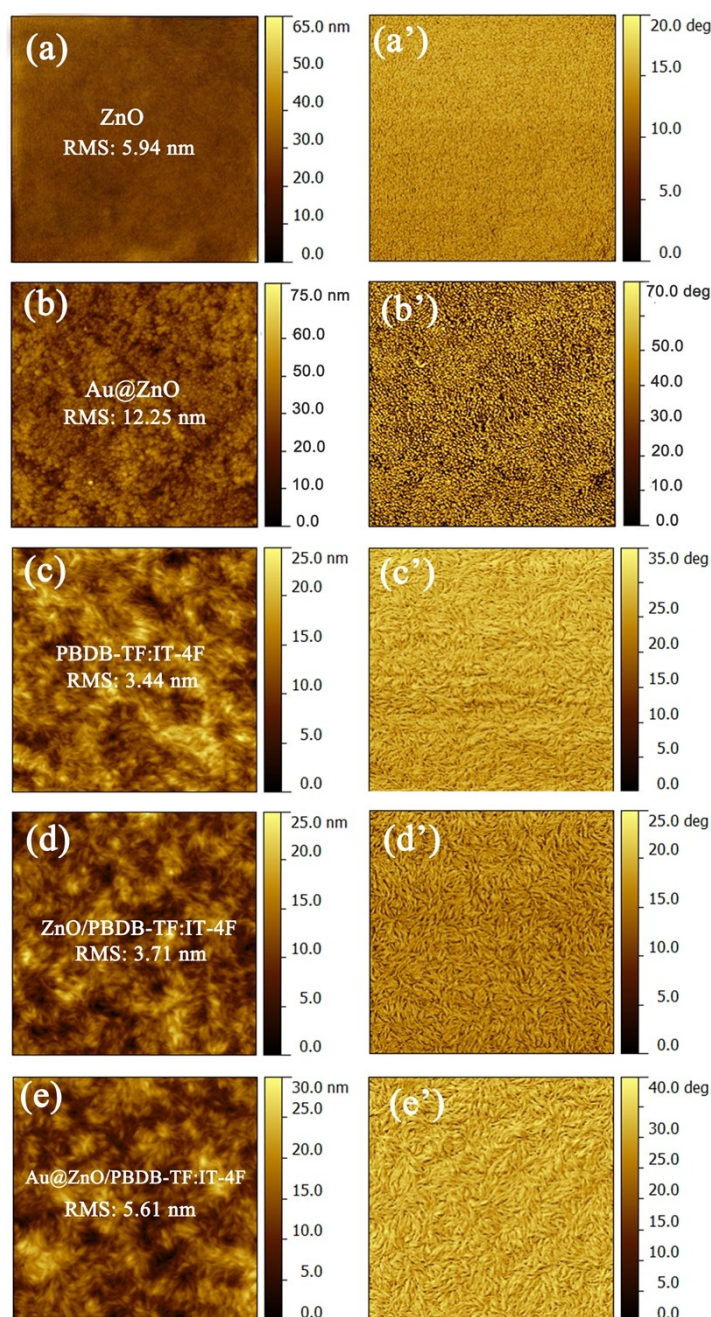


Fig. S1. AFM topography and phase images of the solid thin films of (a) and (a') ZnO; (b) and (b') Au@ZnO; (c) and (c') PBDB-TF:IT-4F; (d) and (d') ZnO/PBDB-TF:IT-4F; and (e) and (e') Au@ZnO/PBDB-TF:IT-4F on glass substrates, respectively.

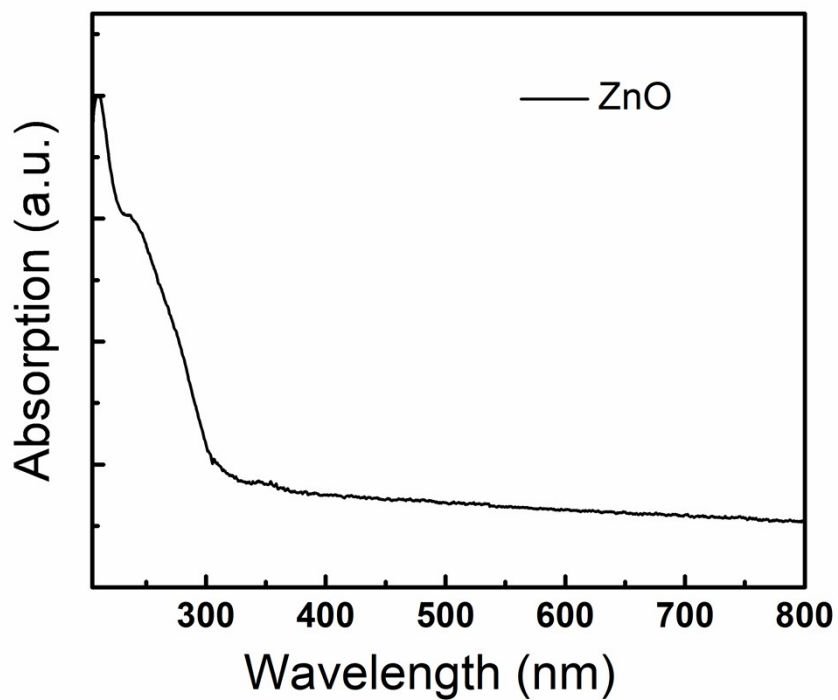


Fig. S2. The absorption spectra of ZnO.

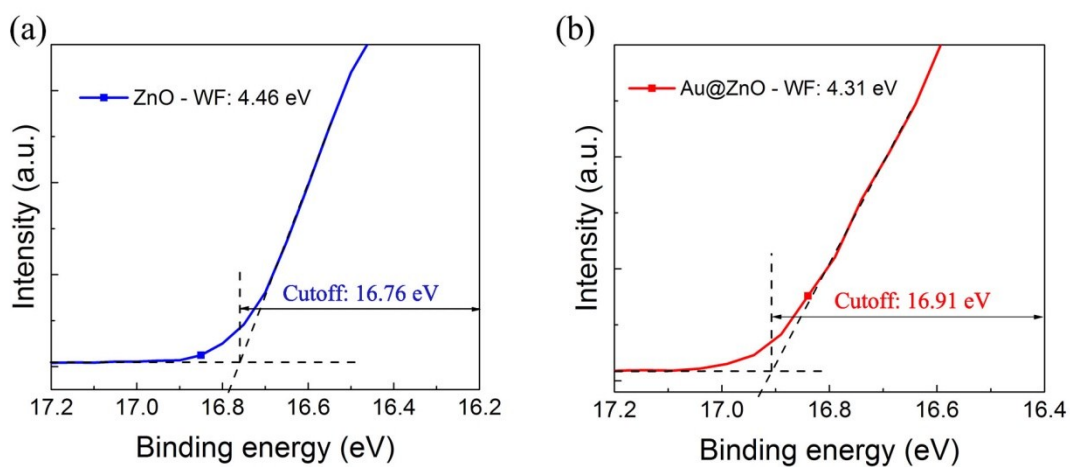


Fig. S3. UPS spectra of high-binding energy secondary-electron cutoff of (e) ZnO and (f) Au@ZnO.

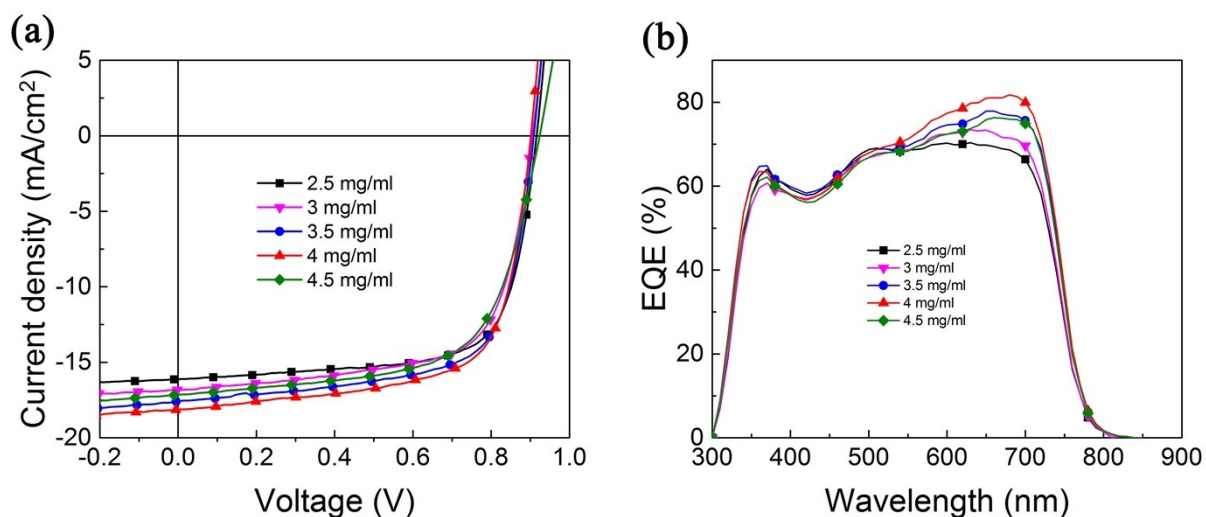


Fig. S4. Current density-voltage ($J-V$) curves and external quantum efficiency (EQE) spectra of PSCs based on PBDBTDD:ITIC with different concentrations of Au@ZnO used to form the CBL.

Table S1. Photovoltaic parameters of PSCs based on PBDBTDD:ITIC with different concentration of Au@ZnO as CBL.

Concentration [mg/mL]	V_{oc} [V]	J_{sc} [mA cm ⁻²]	FF [%]	PCE [%]
2.5	0.89	15.69	67.19	9.38
3.0	0.88	16.53	65.56	9.53
3.5	0.88	17.75	66.27	10.35
4.0	0.88	18.86	65.53	10.88
4.5	0.87	17.46	65.34	9.93

Table S2. Short lifetime τ_1 , fast lifetime τ_2 and average lifetime τ_{avg} for the solid thin films of PBDBTBD:ITIC, and PBDB-TF:IT-4F with ZnO or Au@ZnO spin-coated on quartz glass.

Solid film	τ_1 [ns]	B_1 [%]	τ_2 [ns]	B_2 [%]	τ_{avg} [ns]
PBDBTBD:ITIC	1.05	0.05	12.19	0.0132	9.26
ZnO/PBDBTBD:ITIC	0.16	0.16	10.65	0.0002	5.70
Au@ZnO/PBDBTBD:ITIC	0.25	0.22	9.47	0.0032	3.52
PBDB-TF:IT-4F	0.72	0.08	11.46	0.0114	8.29
ZnO/PBDB-TF:IT-4F	0.19	0.29	14.86	0.0031	6.78
Au@ZnO/PBDB-TF:IT-4F	0.17	0.16	7.30	0.0014	2.15