Electronic Supplementary Material (ESI) for RSC Advances.

Efficient polymer solar cells employing pure ZnO as cathode interlayers without thickness-dependent and light-soaking effect and negligible electrode selection

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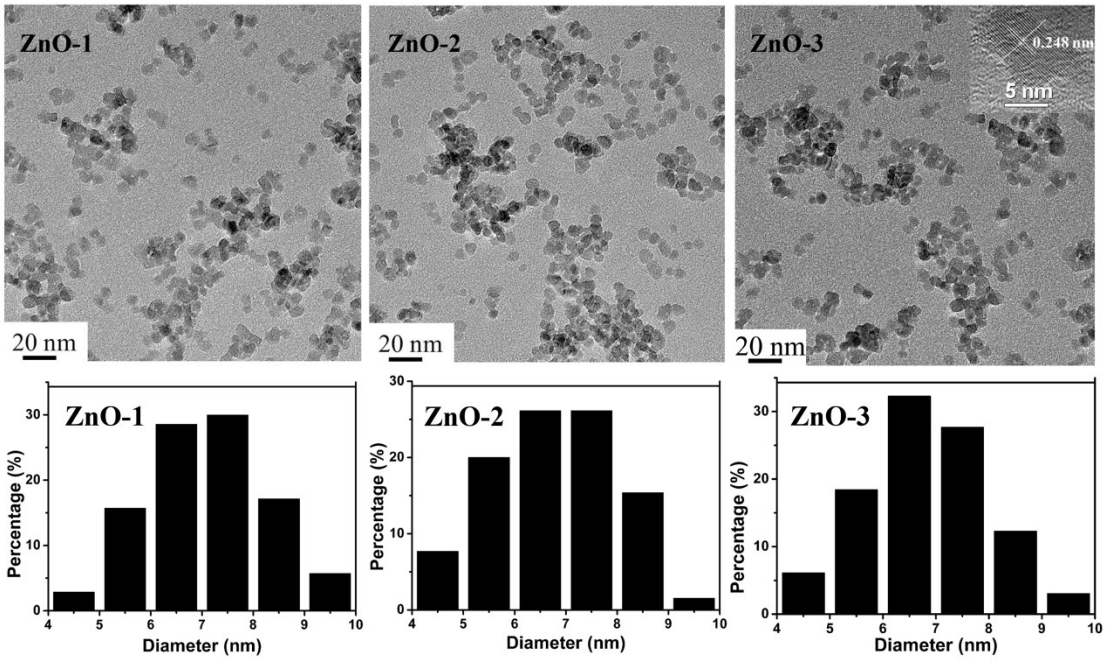


Fig. S1 The TEM images and corresponding size distribution of as-prepared ZnO nanoparticles.

Fig. S1 displays the typical TEM images of the resultant ZnO nanoparticles. All the three synthesized ZnO nanoparticles appeared with the average diameter of about 7 nm, and nanoparticles show partially aggregates. Upon careful measurement from the high-resolution TEM (HRTEM) image in Fig. S1C inset, the lattice spacing of 0.248 nm was identified, corresponding to the (101) facet of ZnO (JCPDS no. 36-1451).

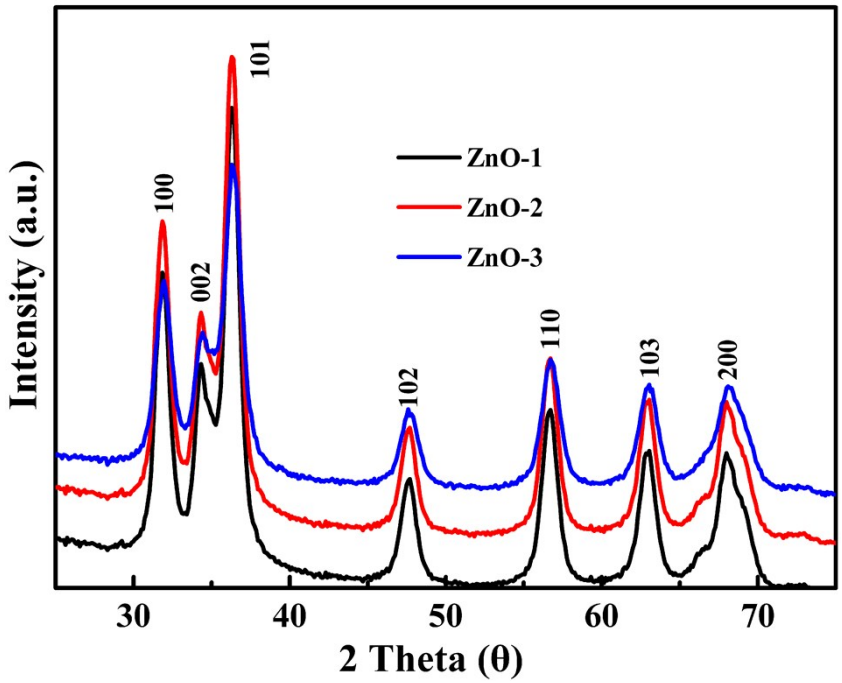


Fig. S2 XRD patterns of the three as-prepared ZnO nanoparticles.

The crystal structure of as-prepared ZnO was investigated using powder XRD. As shown in Fig. S2, the three samples displayed similar typical peaks. All typical peaks can be indexed to the hexagonal wurzite structure of the ZnO, in consistence with the standard diffraction data (JCPDS no. 36-1451).

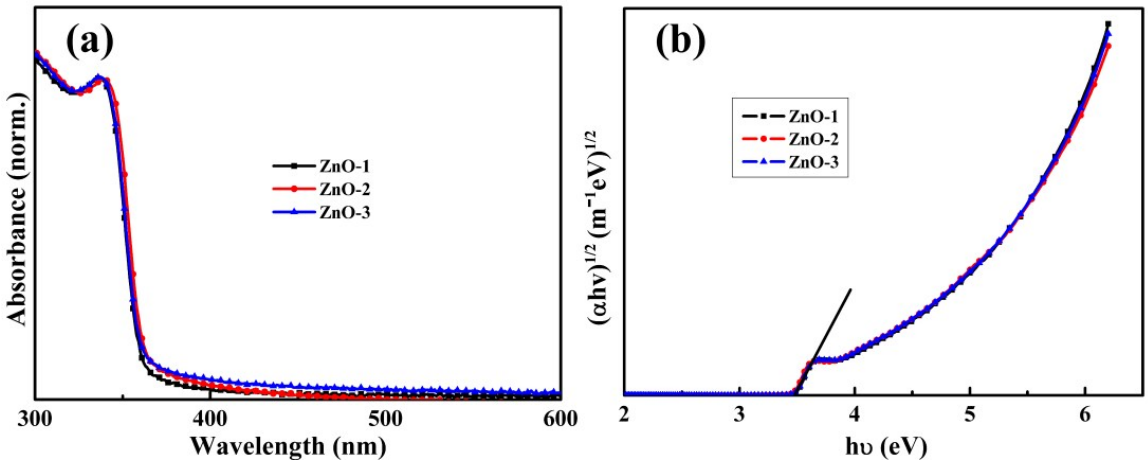
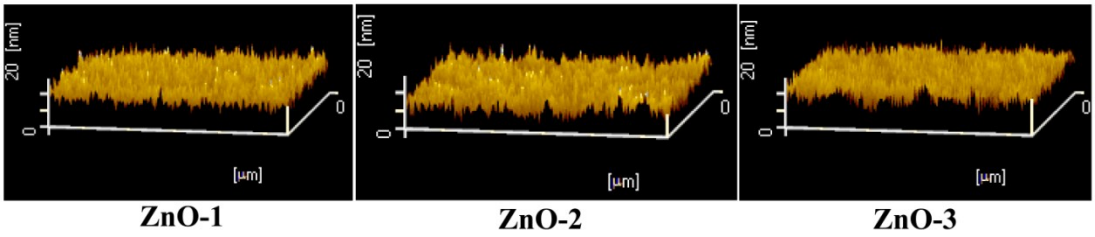


Fig. S3 (a) UV-visible absorption spectra of the three ZnO films. (b) $(\alpha hv)^{1/2}$ verse photon energy (hv) for the three ZnO films. E_g were same about 3.5 eV, which were extracted from the corresponding data.



ZnO-1 **ZnO-2** **ZnO-3**

Fig. S4 AFM images of the as-prepared three kinds of ZnO films.

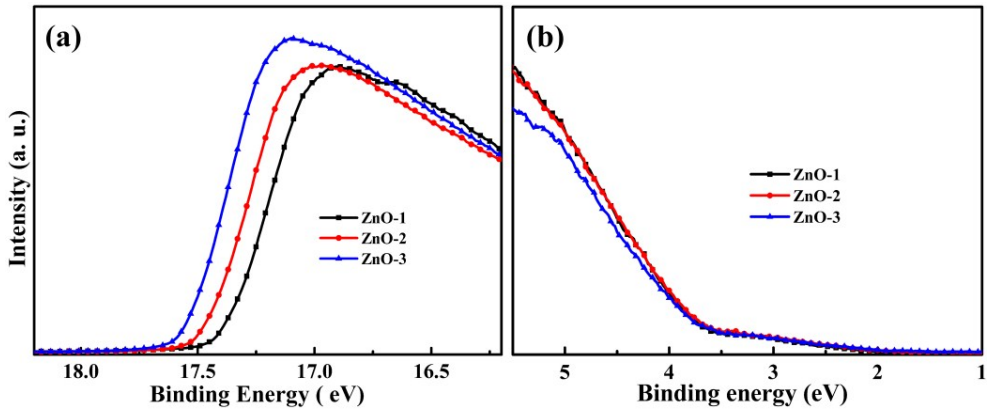


Fig. S5 UPS spectra of the corresponding ZnO films: (a) Secondary electron cut-off region, (b) density of states near the VB edge.

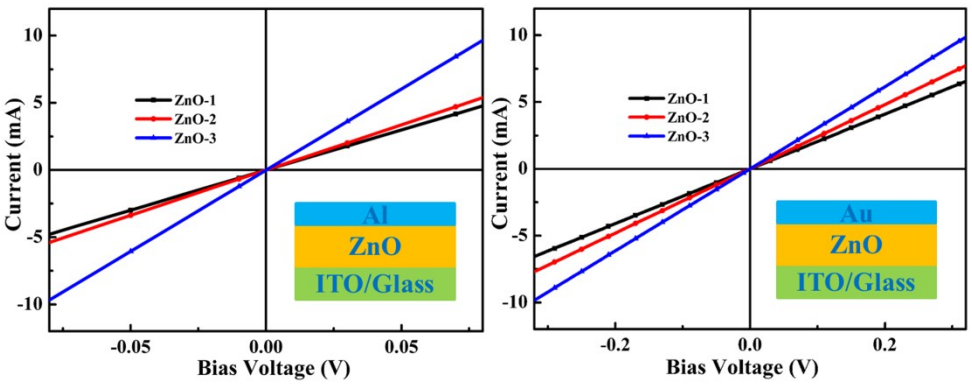


Fig. S6 I-V curves of the electron-only transfer devices.

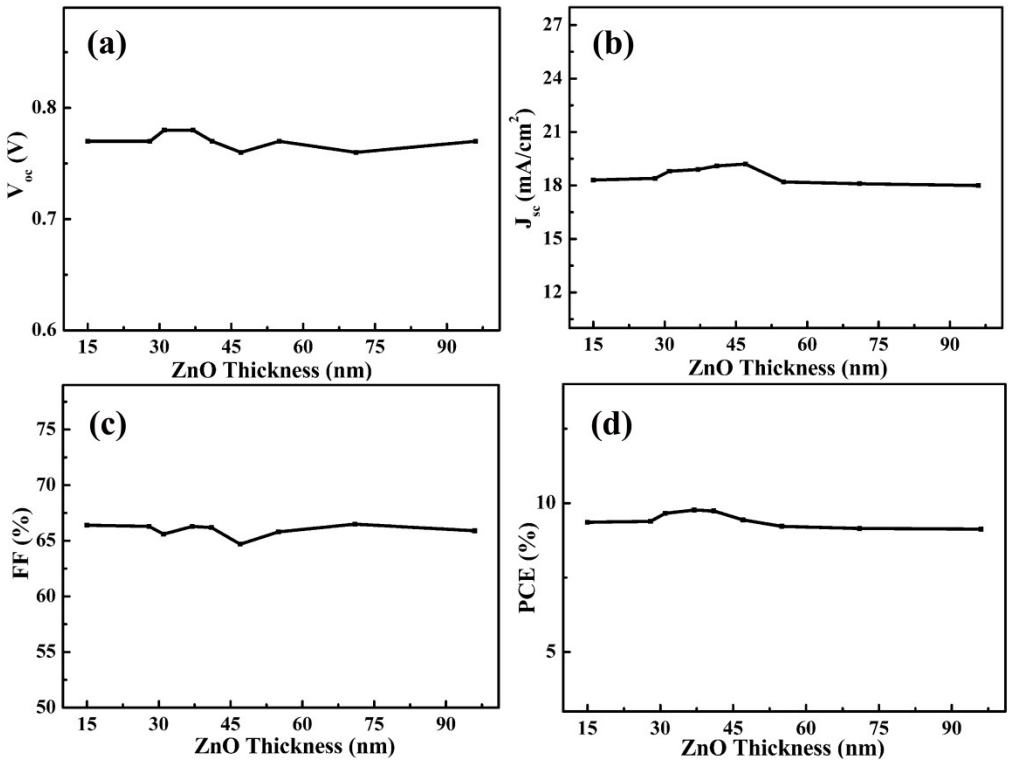


Fig. S7 Photovoltaic parameters of the PTB7-Th:$PC_{71}BM$ PSCs with various ZnO-3 thicknesses from 15 nm to 96 nm.

Table S1 Device parameters of PSCs based on the different electron transporting layers and Ag/Au cathode under the Illumination of AM 1.5G, 100 mW cm^{-2}

PTB7-Th:$PC_{71}BM$ （Ag Cathode）	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)
NO ZnO	0.29	14.51	34.61	1.46
ZnO-1 (37 nm)	0.77	18.20	65.95	9.24
ZnO-2 (37 nm)	0.78	18.36	66.90	9.58
ZnO-3 (37 nm)	0.78	18.45	68.24	9.82
PTB7-Th:$PC_{71}BM$ （Au Cathode）	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)
NO ZnO	/	/	/	/
ZnO-1 (37 nm)	0.77	17.47	62.31	8.38
ZnO-2 (37 nm)	0.78	17.77	63.56	8.81
ZnO-3 (37 nm)	0.78	17.80	64.42	8.94