Supporting information for

A Homogeneous Ethanedithiol Doped ZnO Electron Transporting Layer for Polymer Solar Cells

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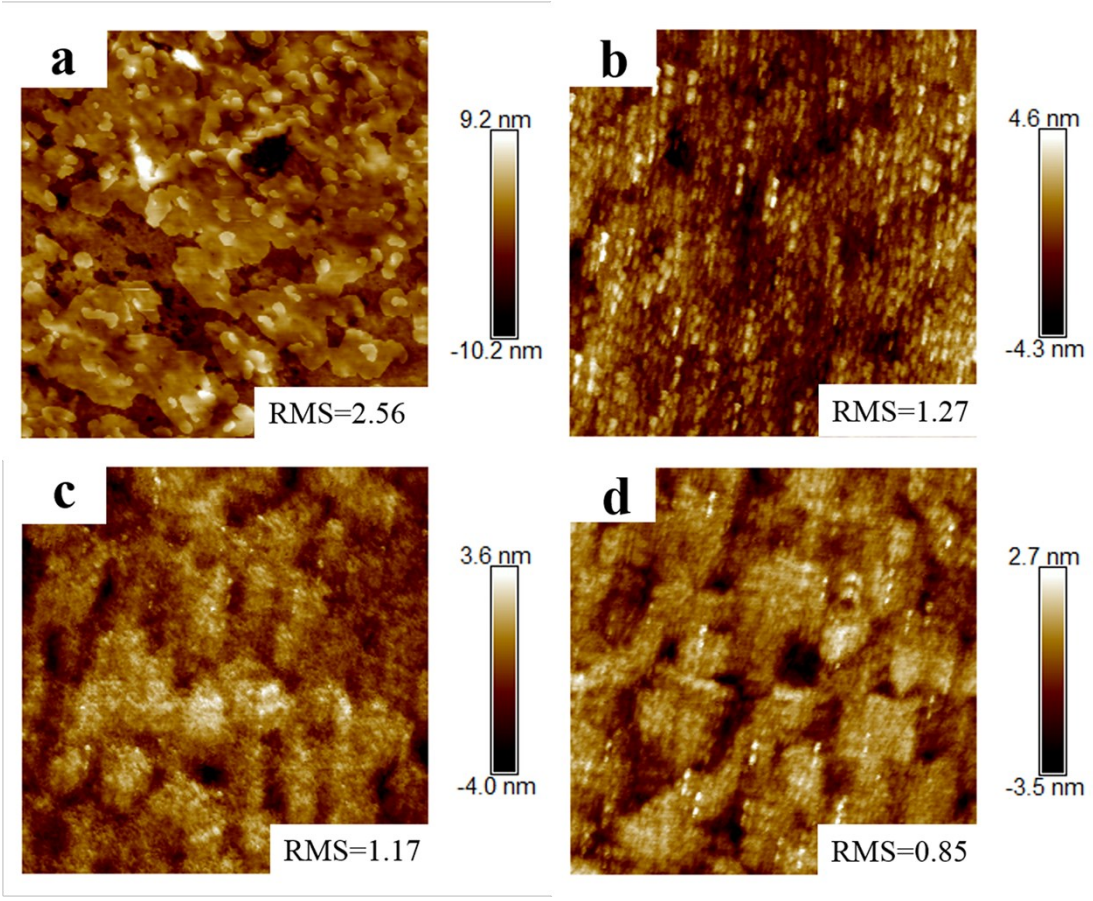

Figure S1. AFM height images (3 × 3 μm) of (a) ZnO, (b) ZnO@0.1%EDT, (c) ZnO@0.5%EDT, and (d) ZnO@5%EDT. The insets give the RMS roughnesses.

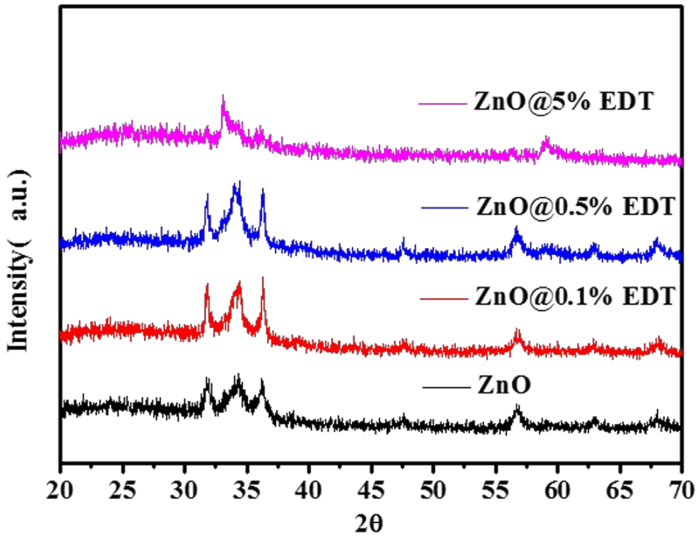

Figure S2. XRD patterns of bare ZnO, ZnO@0.1%EDT, ZnO@0.5%EDT, ZnO@5%EDT.

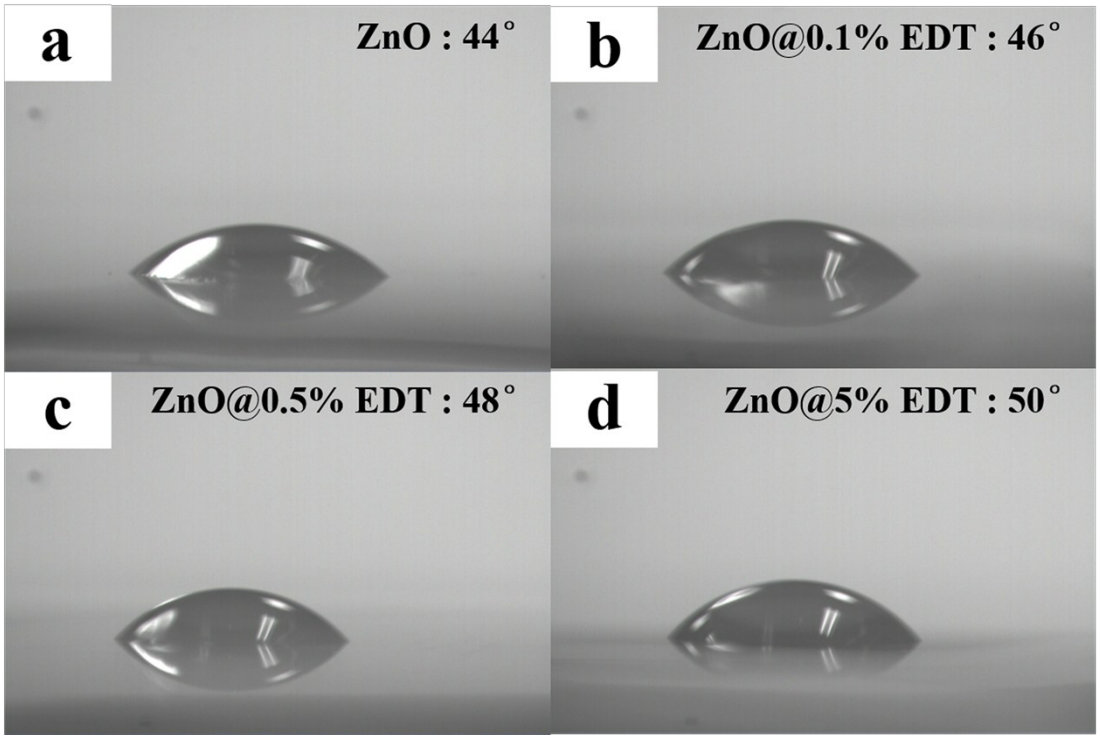

Figure S3. Measured water contact angle between a drop of deionized water for (a) bare ZnO (b) ZnO@0.1%EDT, (c) ZnO@0.5%EDT and (d) ZnO@5%EDT.

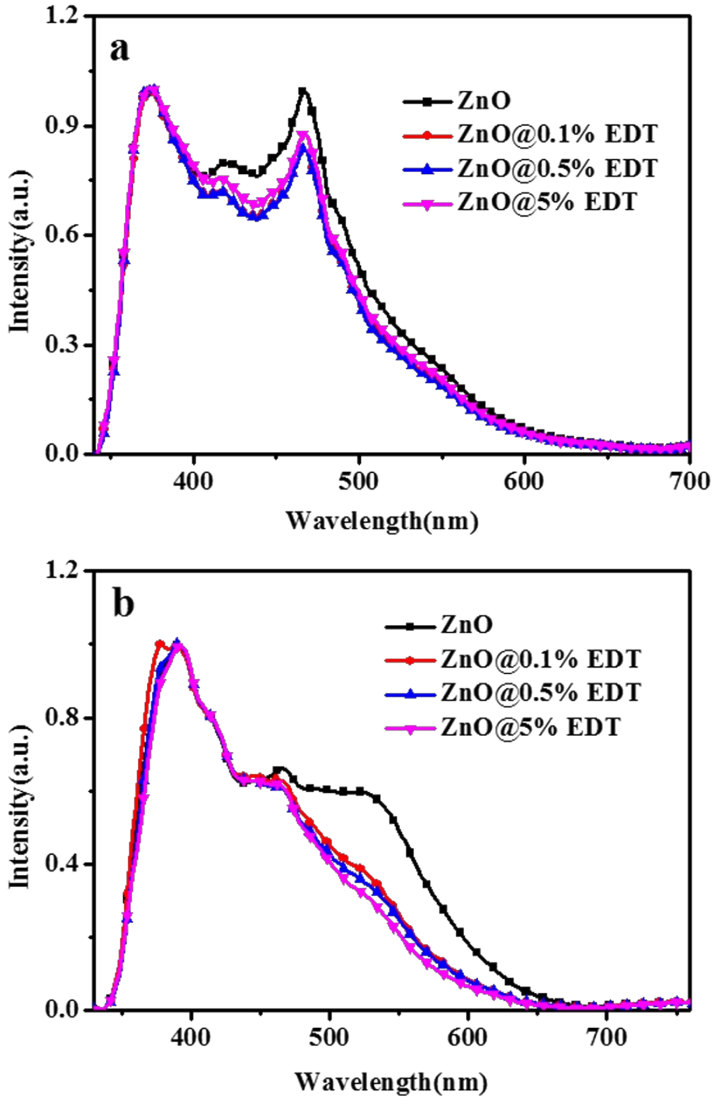

Figure S4. Normalized photoluminescence spectra of bare ZnO, ZnO@0.1%EDT, ZnO@0.5%EDT, ZnO@5%EDT with excitation at (a) 325nm, (b) 310nm.

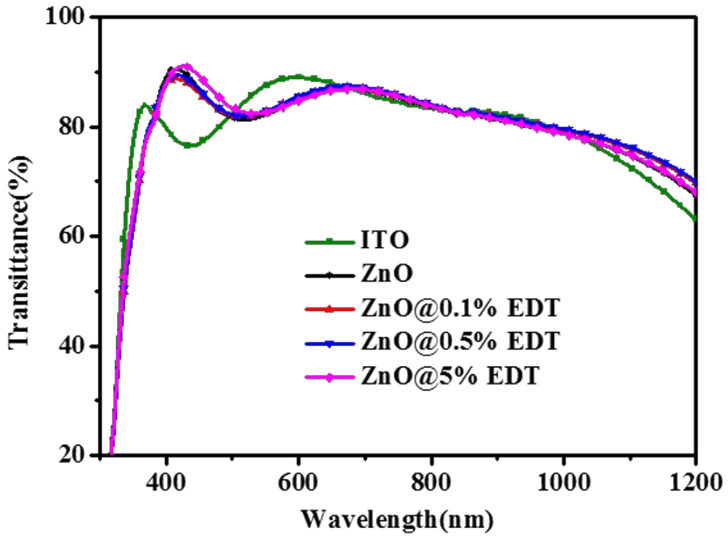

Figure S5. Optical transmission spectra of bare ZnO, ZnO@0.1%EDT, ZnO@0.5%EDT, ZnO@5%EDT.

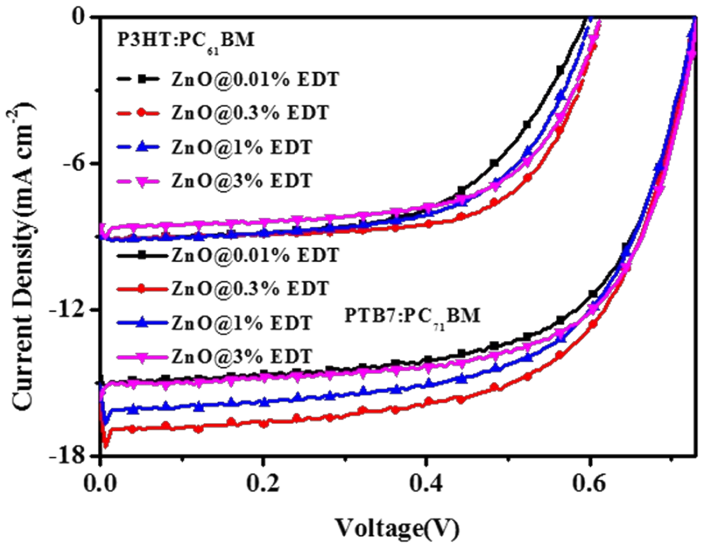

Figure S6. Illuminated *J*–*V* characteristics of devices based on P3HT:$PC_{61}BM$ and PTB7:$PC_{71}BM$ with pristine ZnO, ZnO@0.01% EDT, ZnO@0.3% EDT, ZnO@1% EDT and ZnO@3% EDT as the electron transporting layer.

Table S1. Photovoltaic parameters of devices with ITO/electron transporting layer/active layer/MoO_3/Ag structure. All data of devices had been tested for more than five substrates (20 chips) to ensure reproducibility.

ETL	Active layer	J_{SC} (mA cm^{-2})	V_{OC} (V)	FF (%)	PCE (%)
ZnO@0.01% EDT	P3HT:PC_{61}BM	8.76±0.18	0.594±0.003	61.2±1.2	3.2±0.1
ZnO@0.3% EDT	P3HT:PC_{61}BM	8.86±0.19	0.606±0.005	67.2±1.5	3.6±0.3
ZnO@1% EDT	P3HT:PC_{61}BM	8.97±0.21	0.600±0.004	62.7±1.3	3.4±0.2
ZnO@3% EDT	P3HT:PC_{61}BM	8.61±0.17	0.603±0.002	63.5±1.3	3.3±0.1
ZnO@0.01% EDT	PTB7:PC_{71}BM	14.85±0.22	0.731±0.004	64.7±1.3	7.0±0.2
ZnO@0.3% EDT	PTB7:PC_{71}BM	15.74±0.27	0.730±0.005	66.7±1.6	7.7±0.3
ZnO@1% EDT	PTB7:PC_{71}BM	15.28±0.24	0.728±0.003	66.9±1.5	7.4±0.3
ZnO@3% EDT	PTB7:PC_{71}BM	15.47±0.25	0.731±0.004	64.8±1.4	7.3±0.2

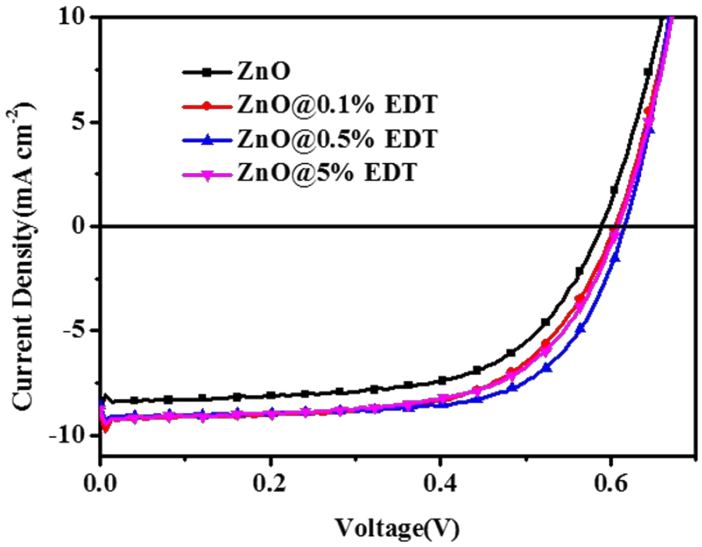

Figure S7. Illuminated *J*–*V* characteristics of devices based on poly(3-hexylthiphene) (P3HT): [6,6]-phenyl-C_{61} butyric acid methyl ester ($PC_{61}BM$) blends using bare ZnO, ZnO@0.1%EDT, ZnO@0.5%EDT, ZnO@5%EDT.

Table S2. Photovoltaic parameters of devices with ITO/electron transporting layer/P3HT:$PC_{61}BM$/MoO_3/Ag structure. All data of devices had been tested for more than five substrates (20 chips) to ensure reproducibility.

ETL	J_{SC} (mA cm^{-2})	V_{OC} (V)	FF (%)	R_s Ω cm^2	R_{sh} Ω cm^2	PCE (%)
ZnO	8.83±0.14	0.593±0.002	59.2±1.1	9.03±0.17	547±22	3.1±0.1
ZnO@0.1%EDT	9.22±0.16	0.604±0.003	63.8±1.3	1.80±0.13	676±24	3.6±0.2
ZnO@0.5%EDT	8.59±0.15	0.614±0.004	71.1±1.4	1.18±0.14	1164±26	3.8±0.2
ZnO@5%EDT	8.40±0.14	0.612±0.002	67.5±1.2	2.06±0.16	625±23	3.5±0.1

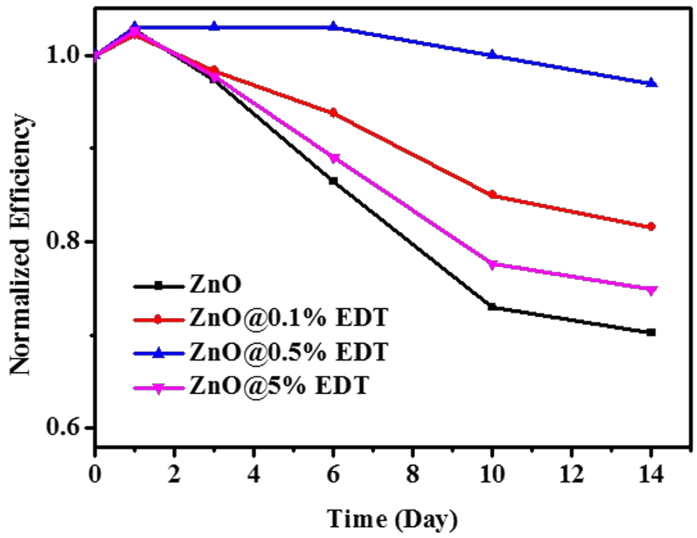

Figure S8. Normalized efficiency decay of inverted solar cells with bare ZnO, ZnO@0.1%EDT, ZnO@0.5%EDT, and ZnO@5%EDT electron transporting layer.

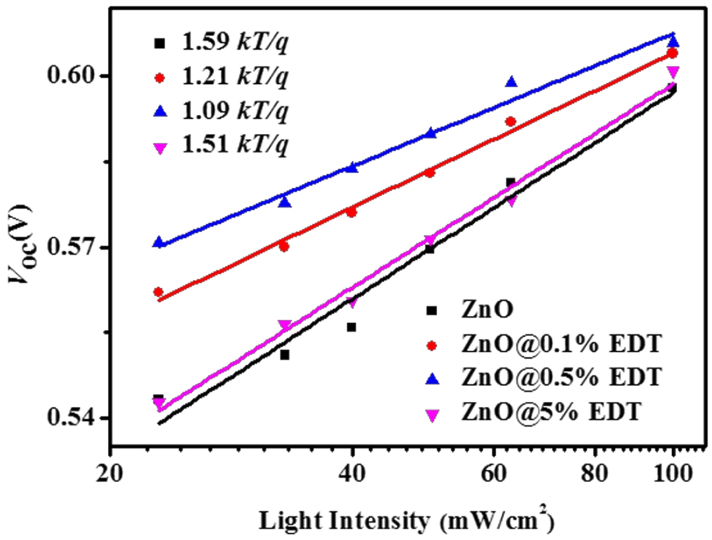

Figure S9. Measured Vo_C of cells with bare ZnO, ZnO@0.1%EDT, ZnO@0.5%EDT and ZnO@5%EDT layers plotted against light intensity (symbols).