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

Supplementary Information

Sn-N/Sn-O Interaction Improving Electron Collection in Non-Fullerene Organic Solar Cells

Lu Hu[†1], *Nan Zhao*[†1, 2], *Xueshi Jiang*[1], *Youyu Jiang*[1], *Fei Qin*[1], *Lulu Sun*[1], *Wen Wang*[1], *and Yinhua Zhou**[1]

[1]Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan 430074, China

[2]China-EU institute for Clean and Renewable Energy, Huazhong University of Science and Technology, Wuhan 430074, China

[†]These authors equally contribute to this work.

*Corresponding author. E-mail: *yh_zhou@hust.edu.cn*

Figure S1 Influence of PEI/PEO concentrations on the the work functions (a) and conductivities (b) of the interlayers.

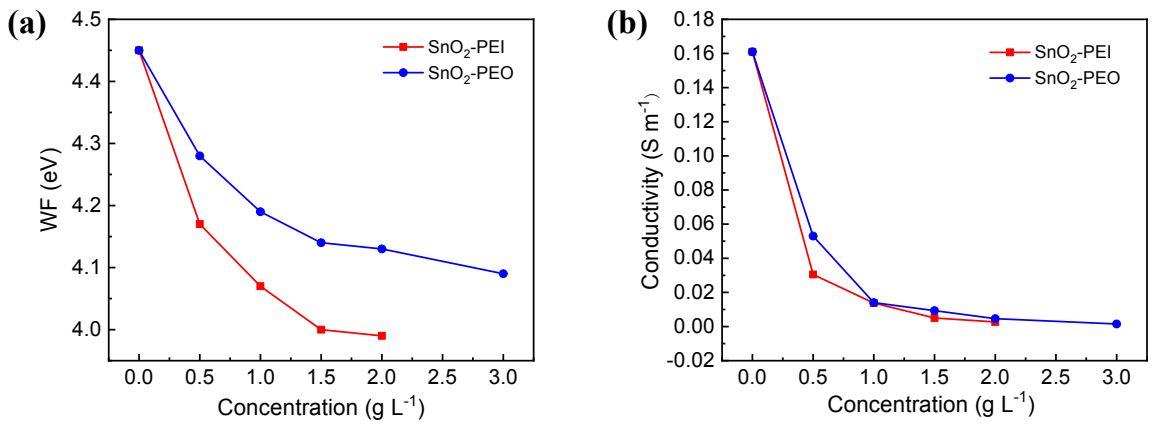

Figure S2 AFM height profiles of (a) ITO/ZnO; (b) ITO/SnO_2; (c)ITO/SnO_2-PEO and (d) ITO/ SnO_2-PEI films.

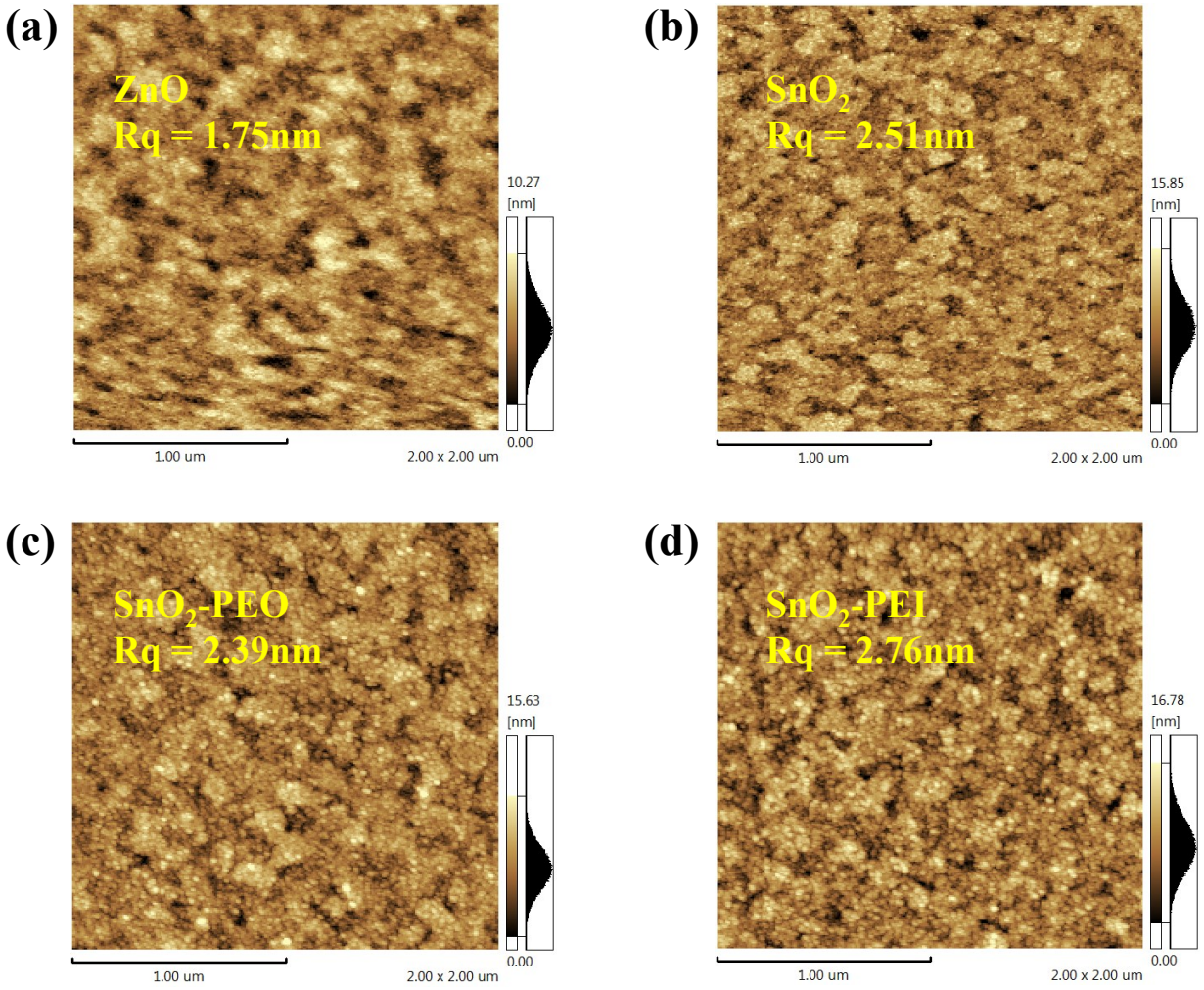

Figure S3 Resistance of (a) ZnO; (b) SnO_2; (c) SnO_2-PEO and (d) SnO_2-PEI films deposited on glass substrate.

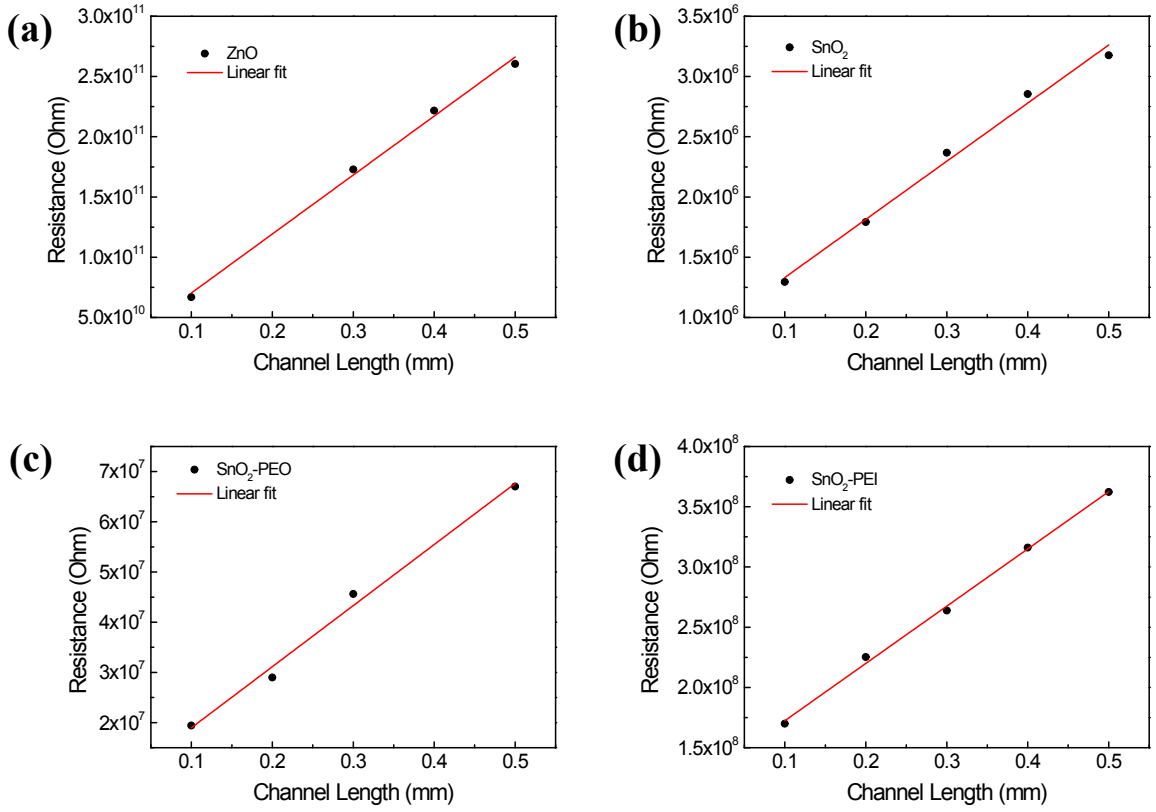

Figure S4 XPS O 1s core level spectra of (a) SnO_2 and (b) SnO_2-PEI films.

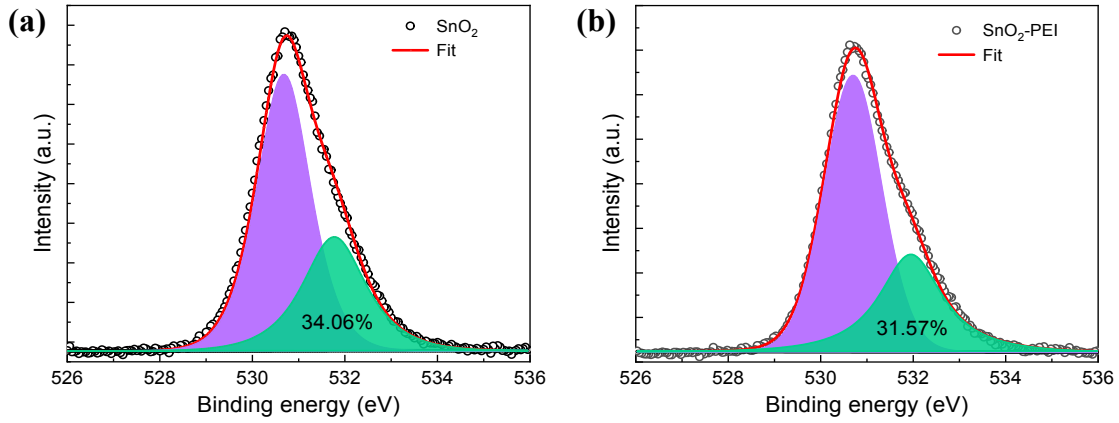

Figure S5 FTIR transmittance spectra of SnO_2; PEI and SnO_2-PEI.

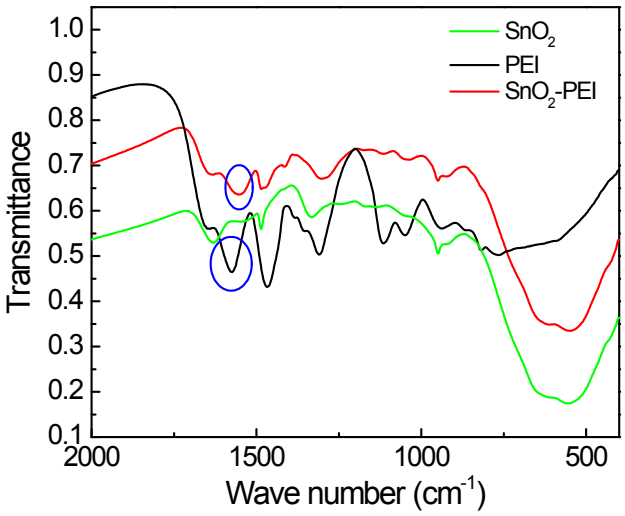

Figure S6 *J-V* characteristics of PM6:IT-4F organic solar cells with different ETLs. The device structure is: glass/ITO/ETL/active layer/MoO_3/Ag.

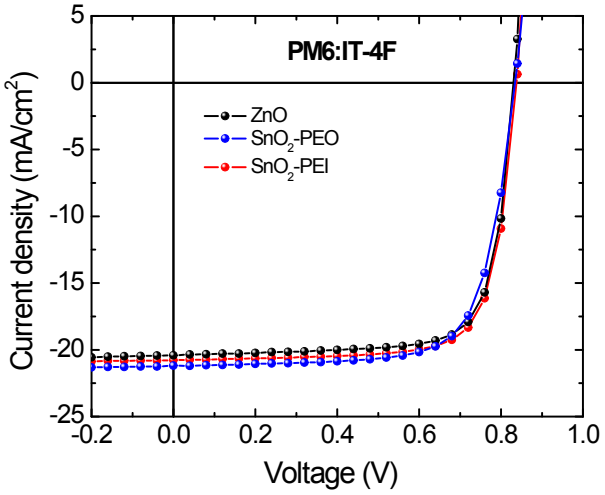

Figure S7 (a) *J-V* characteristics of organic solar cells with PEI or PEO modified ZnO as ETLs. The device structure is: glass/ITO/ETL/active layer/MoO_3/Ag. (b) The photo-stability of devices based on PEI or PEO modified ZnO under continuous AM1.5 illumination (provided by solar simulator) in a nitrogen-filled glove box.

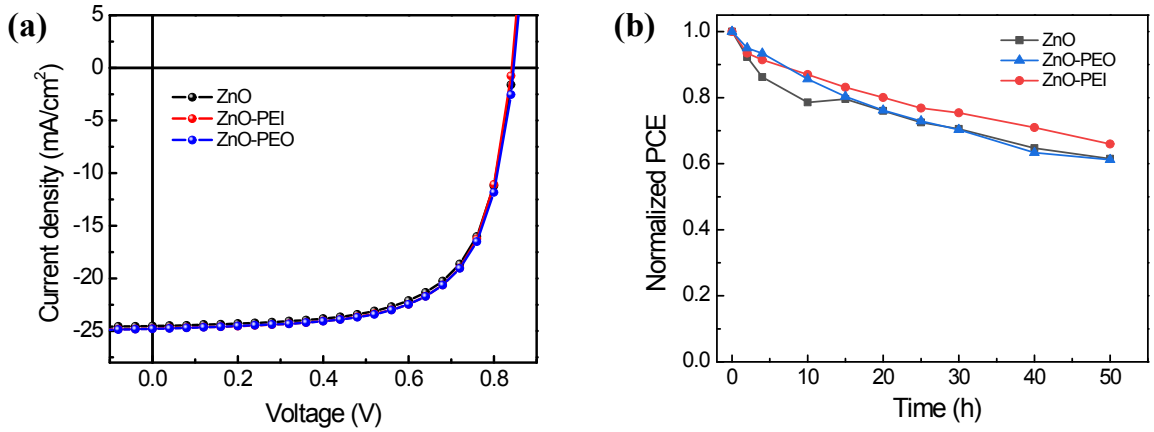

Table S1 Conductivity values of ETLs (Lateral conductivity extracted from the plots in the **figure S3**).

ETL	**ZnO**	**SnO_2**	**SnO_2-PEO**	**SnO_2-PEI**
Lateral conductivity ($S\ m^{-1}$)	2.24×10^{-6}	0.123	0.011	1.75×10^{-3}
Vertical conductivity ($S\ m^{-1}$)	2.30×10^{-5}	0.101	0.050	0.015

Table S2 Data statistics of PM6:Y6:IDIC solar cell based on different ETLs (Date extracted from the plots in the above **figure S7a**). The device structure is: glass/ITO/ETL/active layer/MoO_3/Ag.

ETL	V_{OC} (V)	J_{SC} ($mA\ cm^{-2}$)	FF	PCE (%)
ZnO	0.84	24.5	0.67	13.8
ZnO-PEO	0.85	24.8	0.67	14.0
ZnO-PEI	0.84	24.8	0.67	14.0

Table S3 The original V_{OC} data of the devices with different ETLs in photo-stability measurement.

Time (h)	V_{OC}(ZnO) (V)	V_{OC}(SnO_2-PEO) (V)	V_{OC}(SnO_2-PEI) (V)
0	0.85	0.85	0.84
1	0.83	0.84	0.84
2	0.84	0.84	0.84
4	0.82	0.84	0.83
6	0.82	0.83	0.83
8	0.81	0.83	0.83
10	0.81	0.83	0.83
12	0.81	0.83	0.83
14	0.80	0.82	0.82
16	0.80	0.83	0.83
27	0.77	0.81	0.82
37	0.77	0.81	0.81
50	0.74	0.80	0.81

Table S4 The original J_{SC} data of the devices with different ETLs in photo-stability measurement.

Time (h)	J_{SC}(ZnO) (mA cm^{-2})	J_{SC}(SnO_2-PEO) (mA cm^{-2})	J_{SC}(SnO_2-PEI) (mA cm^{-2})
0	25.14	25.78	26.00
1	23.78	25.55	25.31
2	22.50	25.74	24.91
4	18.66	25.44	23.49
6	16.37	25.31	22.60
8	15.24	25.17	21.76
10	14.93	25.77	21.68
12	14.36	25.91	21.52
14	13.40	25.92	21.02
16	12.84	25.63	20.33
27	11.77	25.32	18.75
37	11.57	24.68	17.10
50	11.27	24.80	17.82

Table S5 The original FF data of the devices with different ETLs in photo-stability measurement.

Time (h)	FF(ZnO)	FF(SnO_2-PEO)	FF(SnO_2-PEI)
0	0.72	0.72	0.72
1	0.70	0.70	0.68
2	0.68	0.69	0.68
4	0.65	0.68	0.68
6	0.63	0.67	0.67
8	0.62	0.67	0.66
10	0.62	0.66	0.65
12	0.61	0.65	0.65
14	0.61	0.65	0.65
16	0.60	0.64	0.64
27	0.58	0.62	0.61
37	0.57	0.61	0.59
50	0.55	0.58	0.57

Table S6 The original PCE data of the devices with different ETLs in photo-stability measurement.

Time (h)	PCE(ZnO) (%)	PCE(SnO_2-PEO) (%)	PCE(SnO_2-PEI) (%)
0	15.25	15.75	15.80
1	13.95	14.94	14.41
2	12.71	14.86	14.19
4	9.99	14.45	13.22
6	8.47	14.14	12.59
8	7.73	13.86	11.93
10	7.51	14.04	11.69
12	7.10	13.98	11.51
14	6.57	13.88	11.18
16	6.17	13.64	10.72
27	5.26	12.75	9.33
37	5.01	12.14	8.23
50	4.61	11.61	8.19