

Supplementary Information

Texture design of electrode for efficiency enhancement of organic solar cells

Junjie Li, Lijian Zuo, Hongbin Pan, Hao Jiang, Tao Liang, Ye Shi, Hongzheng Chen,

Mingsheng Xu*

State Key Laboratory of Silicon Materials, MOE Key Laboratory of Macromolecular Synthesis and Functionalization, and Department of Polymer Science and Engineering, Zhejiang University, Hangzhou 310027, P. R. China

*email: msxu@zju.edu.cn (MSX)

Table S1. Summary of the photovoltaic performance of ITO/MoO₃/P3HT:PCBM/Al devices with the ITO anodes eroded for different times by using PS nanospheres as etching mask. The parameters were averaged with 8 cells for each type of the devices.

ITO eroding time (min)	J_{sc} (mA/cm ²)	V_{oc} (V)	FF (%)	PCE (%)
0	8.12 ± 0.14	0.62 ± 0.02	0.55 ± 0.02	2.75 ± 0.04
2.0	8.07 ± 0.17	0.64 ± 0.02	0.57 ± 0.04	2.95 ± 0.03
2.5	8.37 ± 0.12	0.65 ± 0.02	0.59 ± 0.02	3.19 ± 0.02
3.0	8.15 ± 0.15	0.65 ± 0.02	0.57 ± 0.03	3.03 ± 0.03
3.5	7.84 ± 0.23	0.64 ± 0.02	0.52 ± 0.02	2.60 ± 0.01

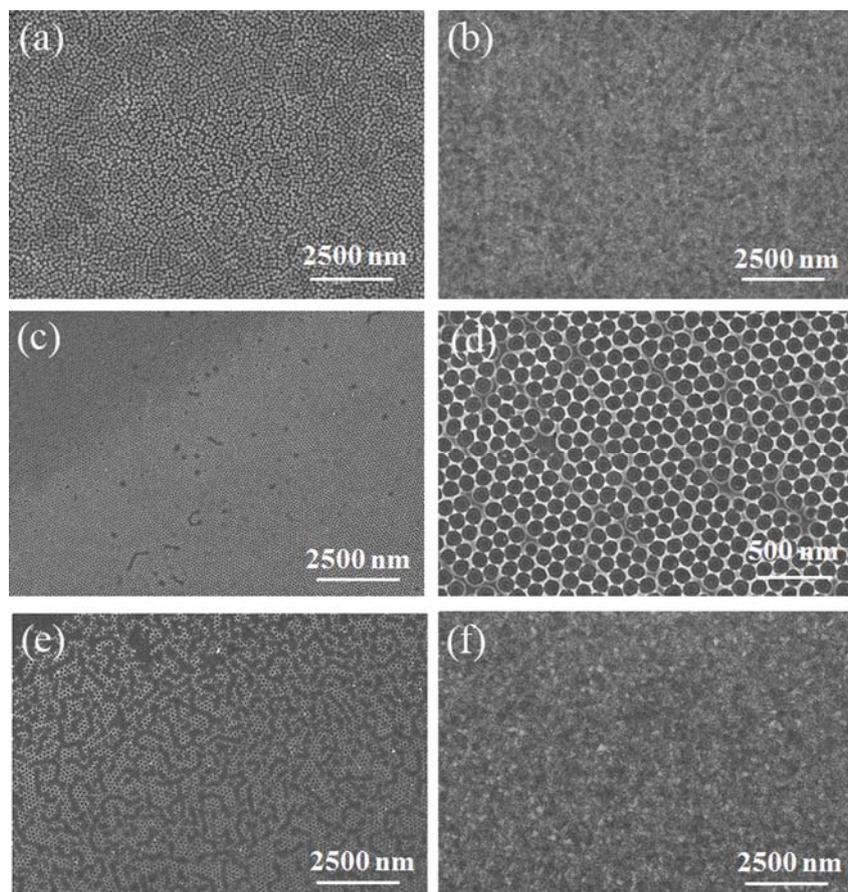


Figure S1. Typical SEM images of ITO anodes eroded for different times. (a) Assembled PS nanospheres on ITO; (b) Eroded for 2.0 min; (c) and (d) Eroded for 2.5 min; (e) Eroded for 3.0 min; (f) Eroded for 3.5 min.

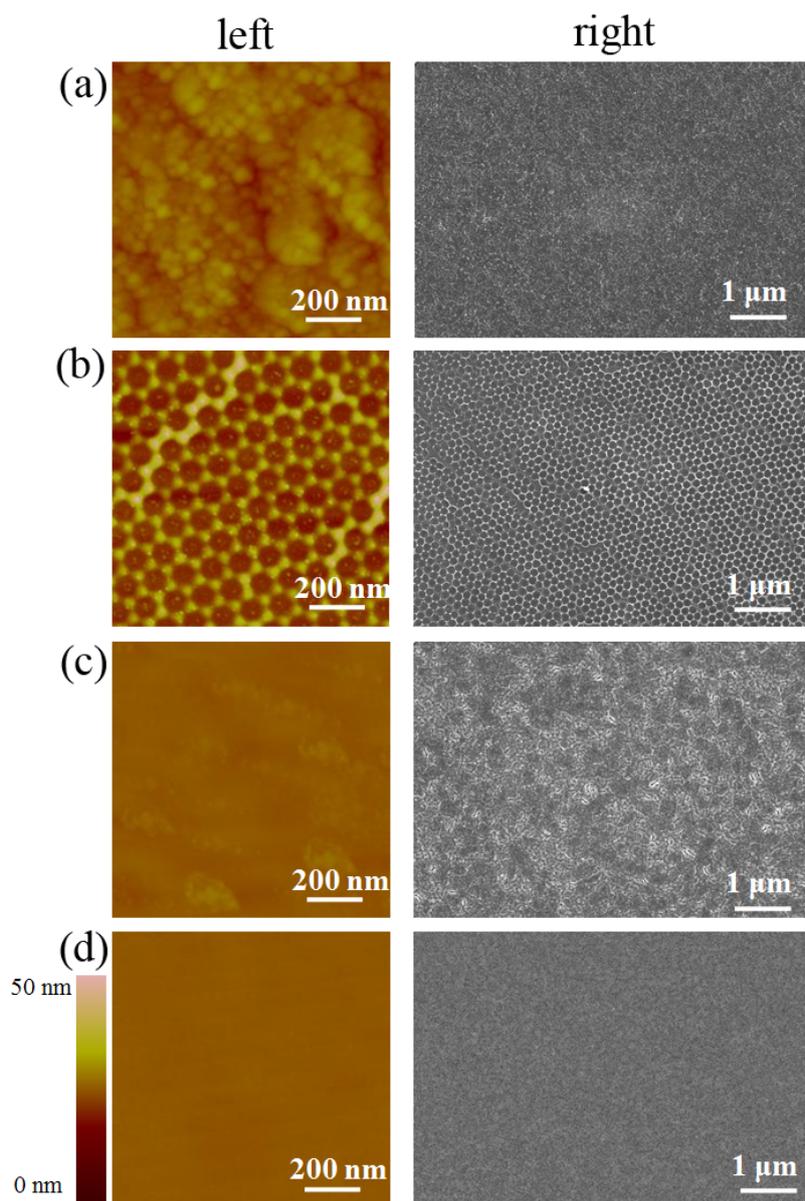


Figure S2. Erosion temperature effect on ITO surface with fixed eroding time of 2.5 min. (a) Eroding temperature of 10 °C, RMS roughness of 2.10 nm; (b) Eroding temperature of 20 °C, RMS roughness of 4.89 nm; (c) Eroding temperature of 35 °C, RMS roughness of 0.47 nm; and (d) Eroding temperature of 50 °C, RMS roughness of 0.17 nm. Left panel is AFM image and right panel is corresponding SEM image. In the case of eroding at 50 °C, the ITO layer on the glass is completely etched away.

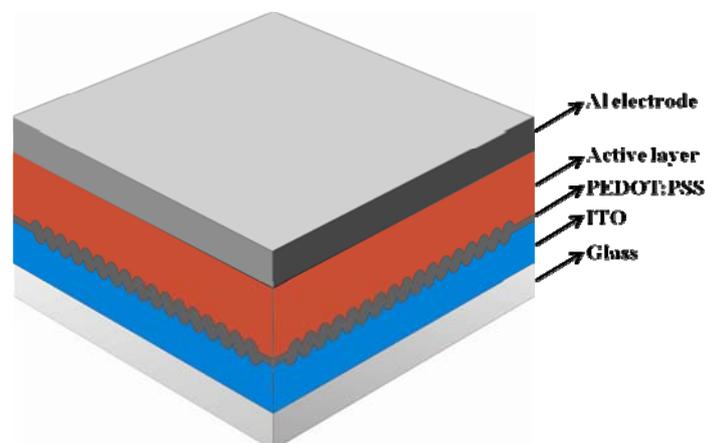


Figure S3. Schematic diagram of fabricated P3HT:PCBM bulk heterojunction solar cells with textured ITO anode and PEDOT:PSS as anode buffer layer.

Table S2. Summary of the photovoltaic performance of ITO/PEDOT:PSS/P3HT:PCBM/Al devices with the ITO anode eroded with HCl for different times by using PS nanospheres as etching mask.

ITO eroding time (min)	J _{sc} (mA/cm ²)	V _{oc} (V)	FF(%)	η(%)
0	8.03	0.64	0.55	2.85
2.0	8.02	0.64	0.53	2.73
2.5	8.28	0.64	0.55	2.89
3.0	8.11	0.64	0.53	2.76
3.5	7.93	0.62	0.55	2.70

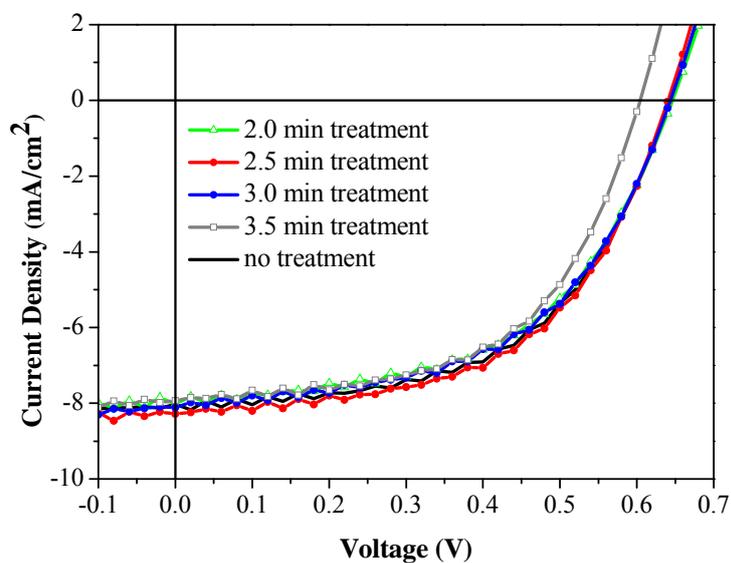


Figure S4. The *J*-*V* curves of the ITO/PEDOT:PSS/P3HT:PCBM/Al solar cells with the ITO anodes eroded for different times. The *J*-*V* curves were measured under 100 mW/cm² AM 1.5G solar illumination.

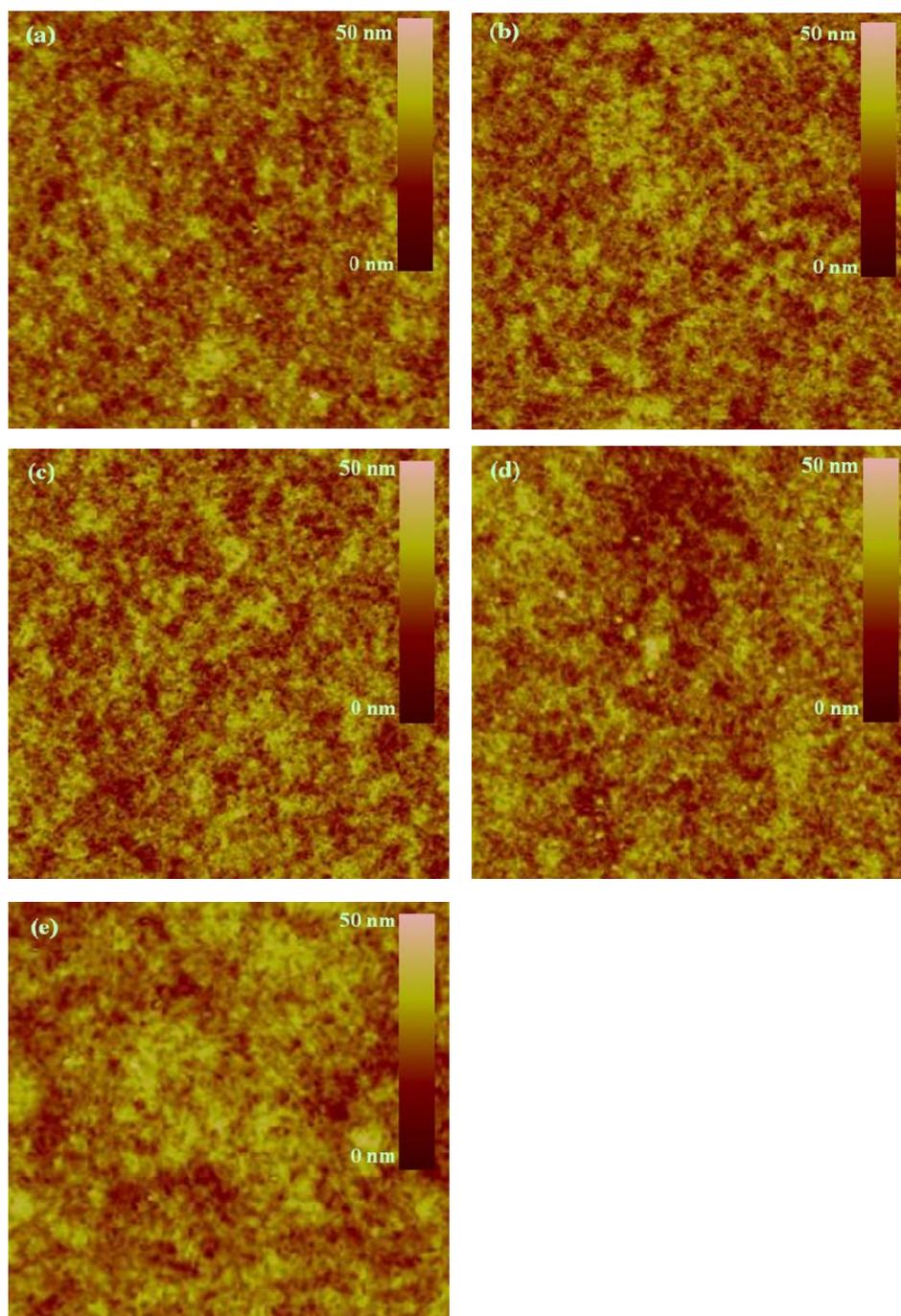


Figure S5. Typical AFM images of the P3HT:PCBM active layer on ITO/PEDOT:PSS with the ITO eroded for (a) 0 min (RMS roughness of 0.82 nm); (b) 2.0 min (RMS roughness of 0.87 nm); (c) 2.5 min (RMS roughness of 0.90 nm); (d) 3.0 min (RMS roughness of 0.88 nm); (e) 3.5 min (RMS roughness of 0.84 nm). The scanning size of the images is $5\ \mu\text{m} \times 5\ \mu\text{m}$.

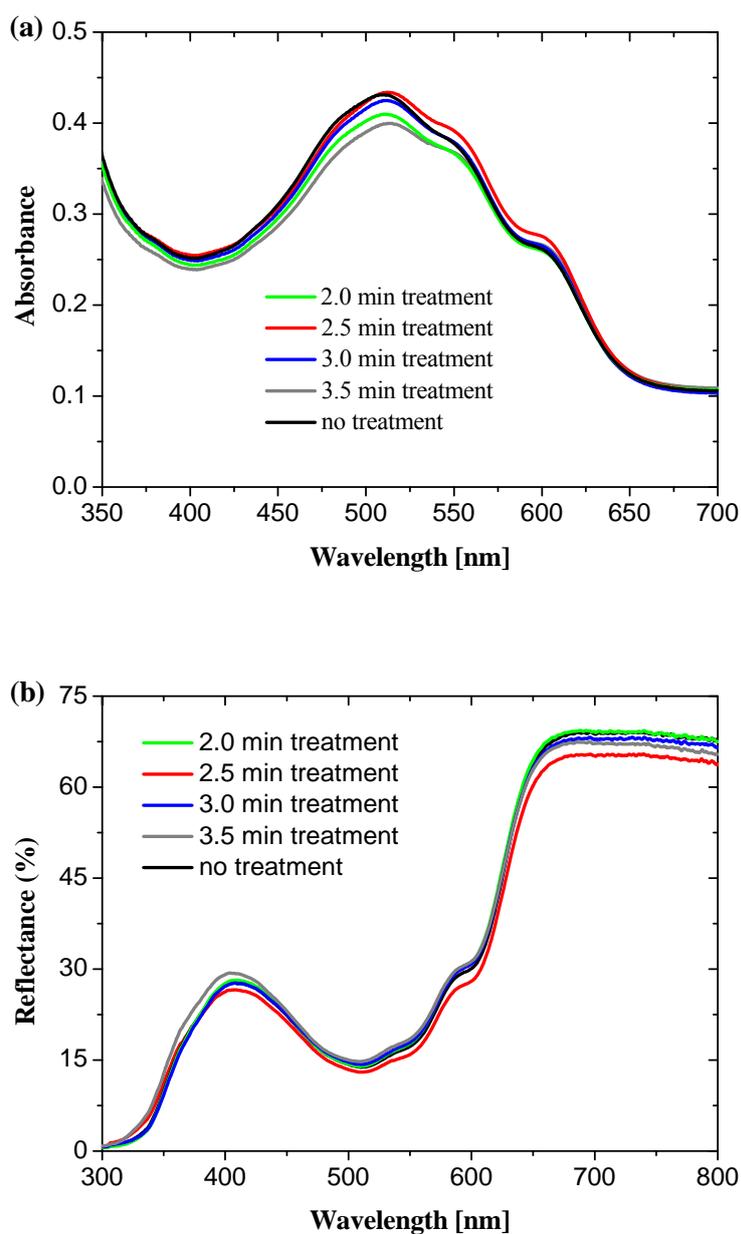


Figure S6. Optical properties of solar cells built on ITO anodes eroded for different times with PEDOT:PSS as anode buffer layer. (a) Absorption spectra of P3HT:PCBM on ITO/PEDOT:PSS with patterned or planar ITO anodes; (b) The full reflectance spectra of ITO/PEDOT:PSS/P3HT:PCBM with patterned or planar ITO anodes.