Electronic Supplementary Information (ESI)

High-Performance Ternary Polymer Solar Cells from a Structural Similar Polymer Alloy

Wenfei Shen, Weichao Chen,* Dangqiang Zhu, Jidong Zhang, Xiaofeng Xu, Huanxiang Jiang, Ting Wang, Ergang Wang * and Renqiang Yang *

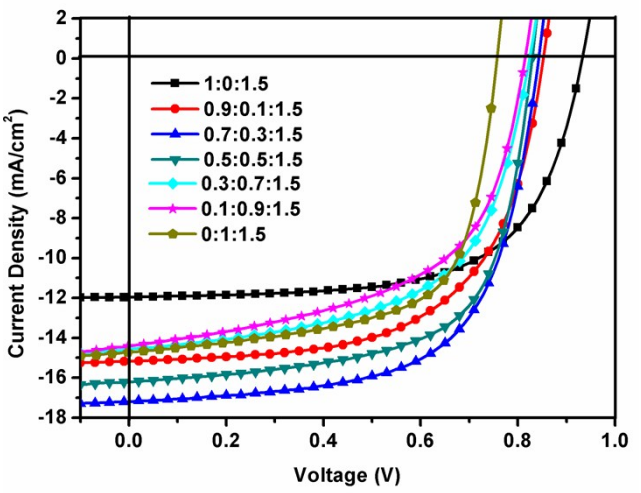

Figure S1. *J*−*V* curves of the solar cells with different PBDTTPD:PBDTTT-C-T:$PC_{71}BM$ weight ratios.

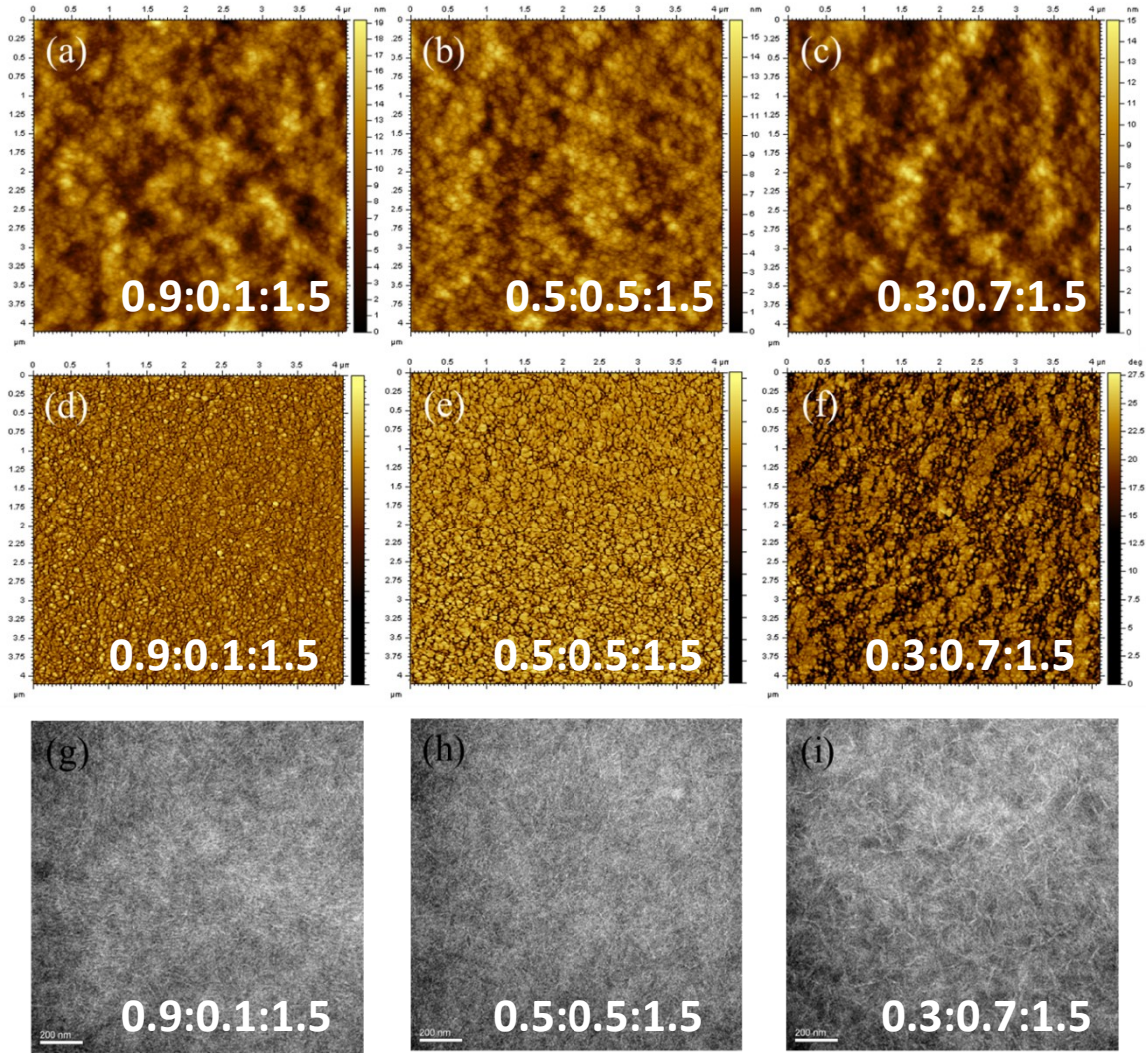

Figure S2. AFM height images of a) PBDTTPD: PBDTTT-C-T:$PC_{71}BM$ (0.9:0.1:1.5) blend film, b) PBDTTPD:PBDTTT-C-T: $PC_{71}BM$ (0.5:0.5:1.5) blend film and c) PBDTTPD: PBDTTT-C-T:$PC_{71}BM$ (0.3:0.7:1.5) blend flim; d), e), f) are the corresponding phase images, respectively; g), h), i) are the corresponding TEM images, respectively.

1. UPS calculation.

From Figure 7a, the E_{cutoff} values of PBDTTPD film, PBDTTT-C-T film and the 7:3 blend film are 4.2 eV, 4.38 eV and 4.33 eV, respectively. And the E_{onset} values of PBDTTPD film, PBDTTT-C-T film and the 7:3 blend film are 1.15 eV, 0.7 eV and 0.88 eV, respectively. Hence, the ionization potential of PBDTTPD film, PBDTTT-C-T film and the 7:3 blend film (IPs is the absolute value of the HOMO energy level relative to the vacuum level) can be calculated according the equation IP = – (E_{cutoff} + E_{onset}).

2. Hole and electron mobility characterization.

The hole and electron carrier mobility of active layers in the ternary devices were investigated according to the trap-free space-charge-limited-current (SCLC) model. The devices with structures of ITO/PEDOT:PSS/active layer/Au for hole and ITO/ZnO/active layer/Ca/Al for electron were prepared. All these device fabrication processes were same to the normal OPVs devices as above other than the differences in electrodes.[1] The equation of the model is stated as: $J_{SCLC} = (9/8)\ \varepsilon_0\varepsilon_r\mu\ (V^2)/(L^3)$, where J_{SCLC} is the current density, ε_0 is the dielectric constant of free space, ε_r is the relative permittivity of the transport medium, μ is the hole (μ_h) or electron (μ_e) mobility, V is the applied voltage and L is the thickness of the active layer.

References

[1] W. Chen, M. Xiao, L. Han, J. Zhang, H. Jiang, C. Gu, W. Shen, R. Yang, *ACS Appl. Mater. Interfaces* 2016, **8**, 19665.