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

Highly Efficient Polymer Solar Cells Based on Low-Temperature Processed ZnO: Application of A Bifunctional Au@CNTs Nanocomposites

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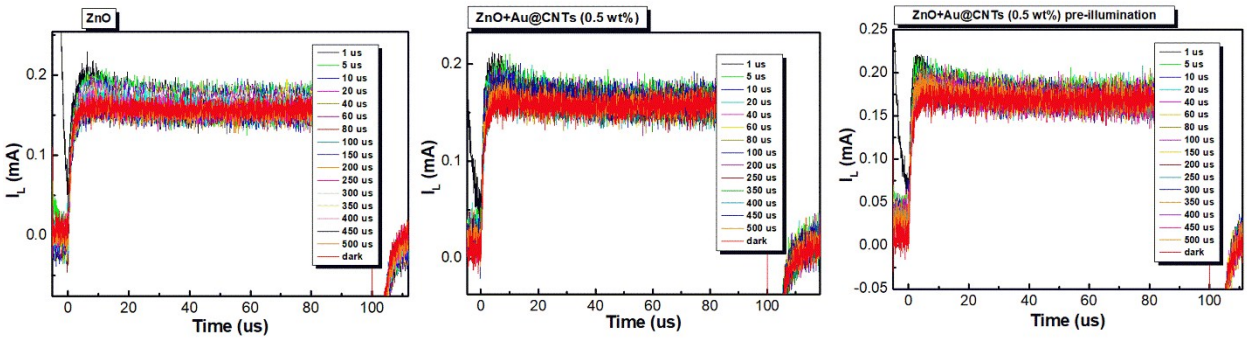

Figure S1. The typical photo-CELIV curves based on device using ZnO and ZnO+Au@CNTs ETL.

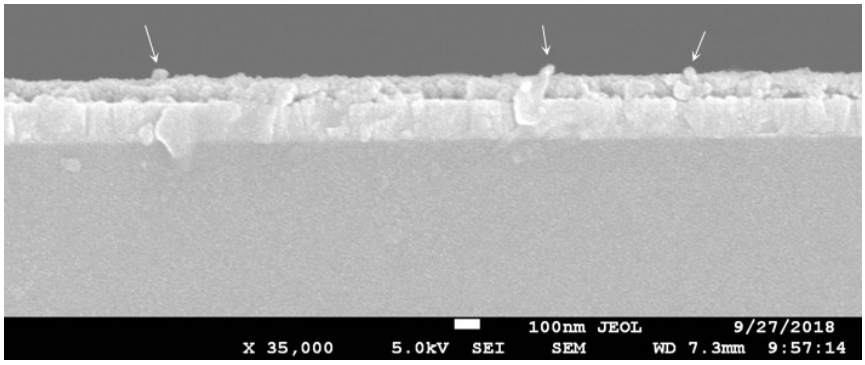

Figure S2. SEM cross-section image of Au@CNTs-doped ZnO on ITO substrate.

we calculated the IQE spectra of devices based on sol-gel ZnO and Au@CNTs+ZnO nanocomposite layer. The IQE determination follow such procedures which is also an often-used methodology in reported works:[1-3] we firstly measured the reflectance (R) spectra of real devices configuring ITO/ZnO(or ZnO+Au@CNTs with different weight ratio)/PTB7-Th:$PC_{71}BM$/MoO_3/Ag(100 nm). Total absorption (A) is derived by 1-R-T in which T is assumed to be zero considering the thick Ag electrode. Then we calculated IQE spectra by EQE/(1-R-T).

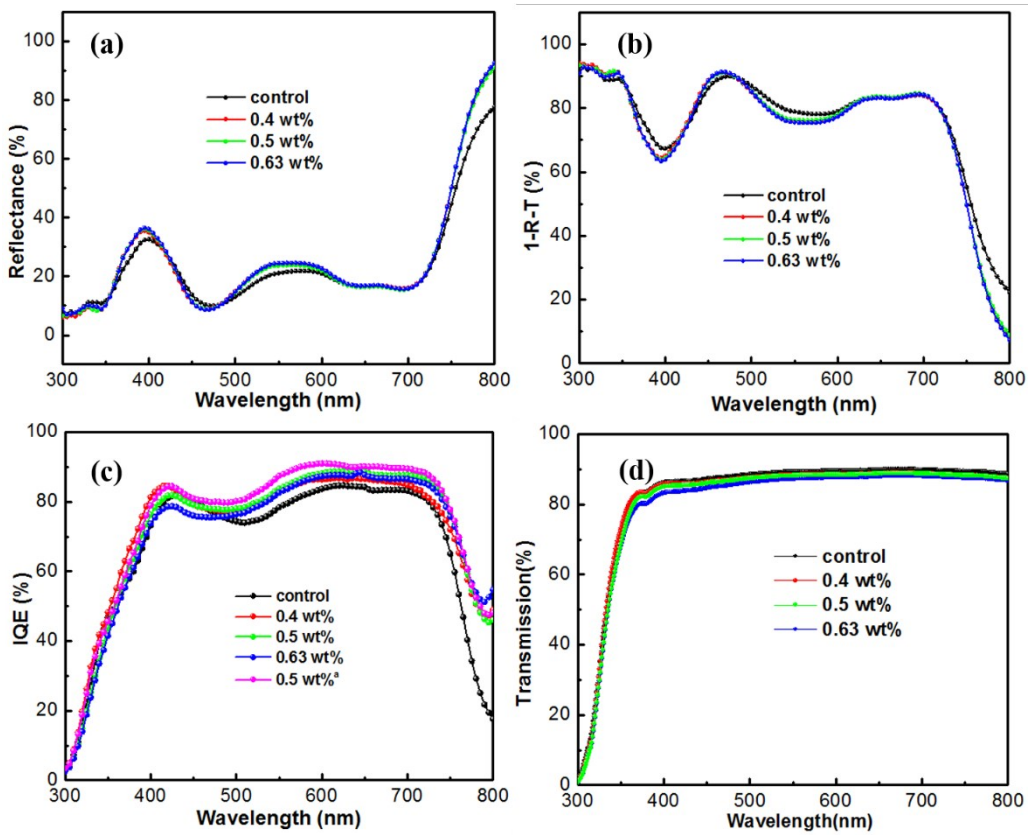

Figure S3. The reflection spectra (a), total absorption spectra (b) and IQE spectra (c) of ZnO and ZnO+Au@CNTs composite layer-based devices; (d) The transmission spectra of ZnO and ZnO+Au@CNTs film.

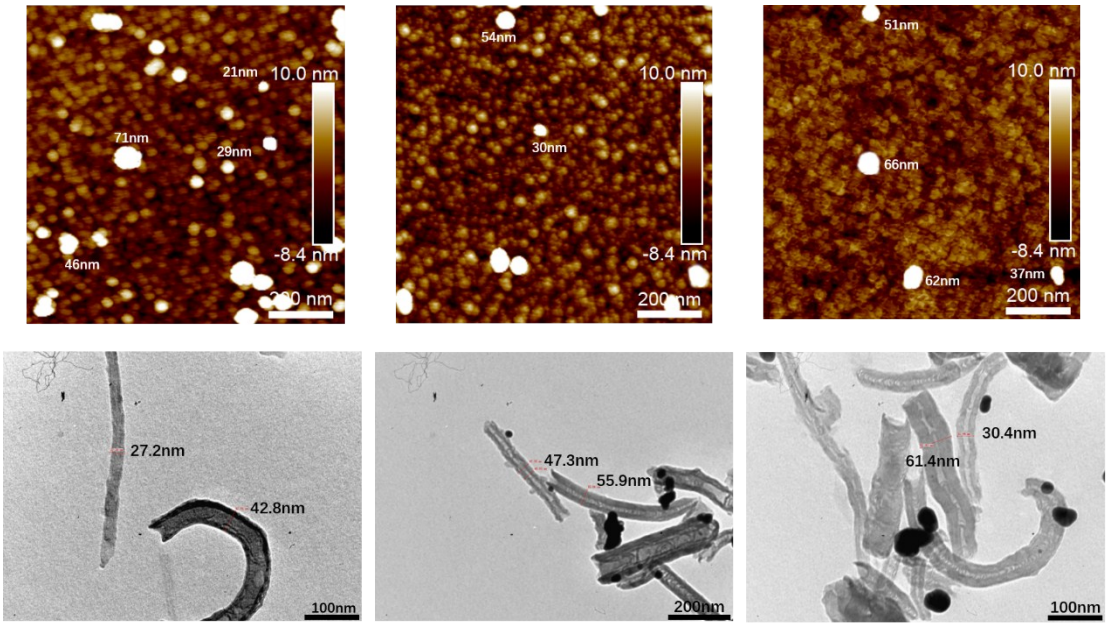

Figure S4. AFM height images of ZnO film with 0.5 wt% Au@CNTs (randomly selected area from different individual sample); TEM images of Au@CNTs composite structure.

Reference

[1] Park, S. H.; Roy, A.; Beaupre, S.; Cho, S.; Coates, N.; Moon, J. S.; Moses, D.; Leclerc, M.; Lee, K.; Heeger, A. J. Bulk heterojunction solar cells with internal quantum efficiency approaching 100%. Nature Photonics 2009, 3, 297-303.

[2] Baek, S.-W.; Noh, J.; Lee, C.-H.; Kim, B.; Seo, M.-K.; Lee, J.-Y. Plasmonic Forward Scattering Effect in Organic Solar Cells: A Powerful Optical Engineering Method. Sci. Rep. 2013, 3, 1726.

[3] Armin, A.; Velusamy, M.; Wolfer, P.; Zhang, Y.; Burn, P. L.; Meredith, P.; Pivrikas A. Quantum Efficiency of Organic Solar Cells: Electro-Optical Cavity Considerations. ACS Photonics, 2014, 1, 173-181.