Supplementary information to:

Synthesis and Characterization of Low Bandgap Conjugated Donor-Acceptor Polymers for Polymer:PCBM Solar Cells

Guoli Tu[1,3†], Sylvain Massip[2†], Philipp M. Oberhumer[2†], Ximin He[1], Richard H. Friend[2], Neil C. Greenham[2] and Wilhelm T. S. Huck[1]*

[1]Melville Laboratory for Polymer Synthesis, Department of Chemistry, University of Cambridge, Lensfield Road, Cambridge,CB2 1 EW, United Kingdom

[2]Cavendish Laboratory, Department of Physics, University of Cambridge, J J Thomson Ave., Cambridge, CB3 0HE, United Kingdom

[3]Present address: Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Luoyu Road, Wuhan, 430074, China

1. Blend morphology

The morphology of the three blends as observed by atomic force microscopy (AFM) seems to be very similar for the three polymers (Figure S1). In all three cases, we observe a very flat and uniform morphology indicating that no large phase separation is taking place in these blends. We therefore conclude that if morphology plays a role, it is beyond our instrument resolution and sensitivity.

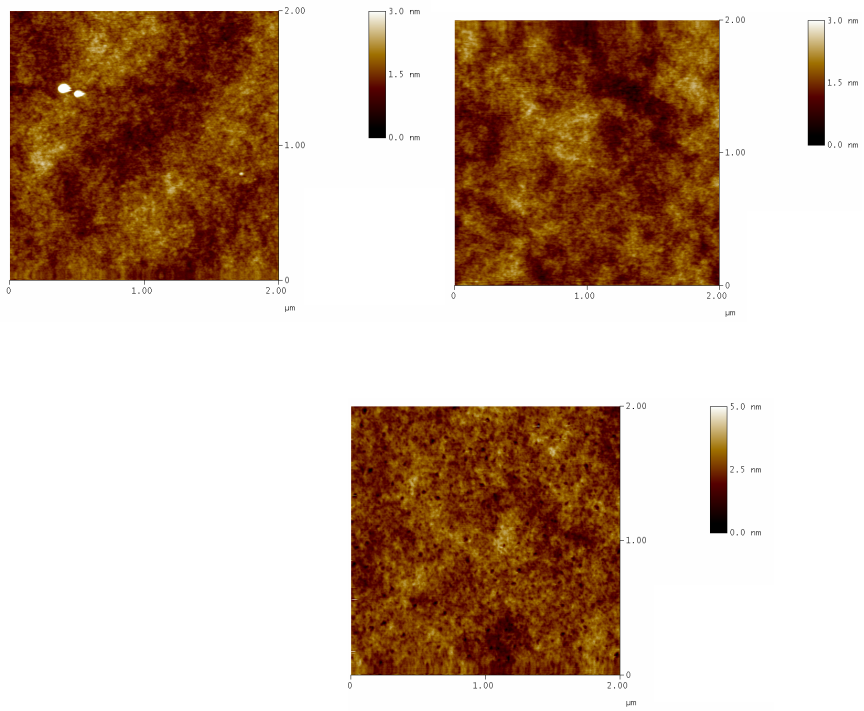

Figure S1: AFM height images of the three best performing blends: T8TBT:PCBM blends: (a) T8TBT-0:PCBM 1:3 spun from chloroform, (b) T8TBT-out:PCBM 1:3 and (c) T8TBT-in:PCBM 1:3 both spun from chlorobenzene.

2. Light absorption in devices

In order to take into account the optical interferences in the thin film devices[1], the absorbance in the blends were estimated by comparing the light reflected out of the devices with the light reflected out of a "blank" device without active layer. As the transmission of the device, including the aluminium electrode, is zero, we can compute the absorption of the device. This method is not precise enough to compute the internal quantum efficiencies (IQE), but Figure S2 clearly shows that the absorption is stronger in the thicker blend despite the interference effects. This difference in absorption (20-30 %) is too large to be explained by changes in the optical losses elsewhere in the device: According to the optical simulations by Moulé and Meerholz[1], absorption in the ITO, in the PEDOT:PSS or in the aluminium electrode are all below 10 % and only slightly vary. In addition, the shape of the absorption correlates well with the shape of the EQE (Figure 4).

This method is therefore suitable to estimate qualitatively the difference in absorption between the two active layers and we conclude that the difference in EQE is not due to optical effects but attribute it to the difference in electric field, which is higher in the thinner film.

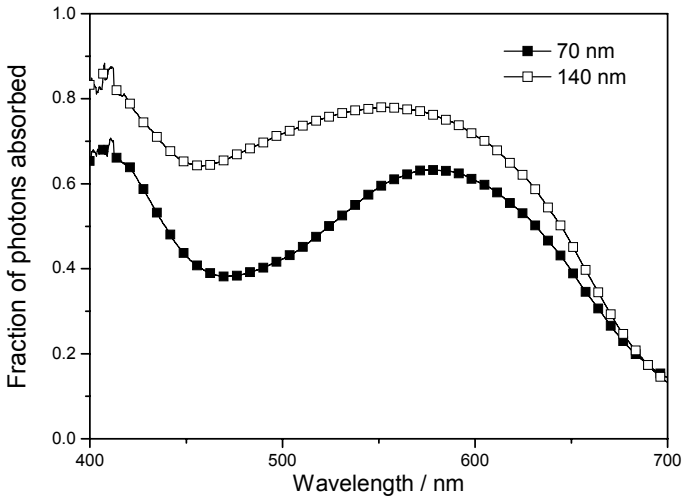

Figure S2: Relative absorption spectrum obtained by measuring the light reflected out of the device for optimal T8TBT-0:PCBM devices. The active layer thickness was varied from 70 nm (full squares) to 140 nm (empty squares). The fraction of photons absorbed is obtained by dividing by the reference spectrum from a device without any active layer.

References

1. A. Moulé and K. Meerholz, *Appl. Phys. B: Lasers Opt*., 2007, 86, 721–727.