Supporting Information

Multiparameter investigation of bulk heterojunction organic photovoltaics

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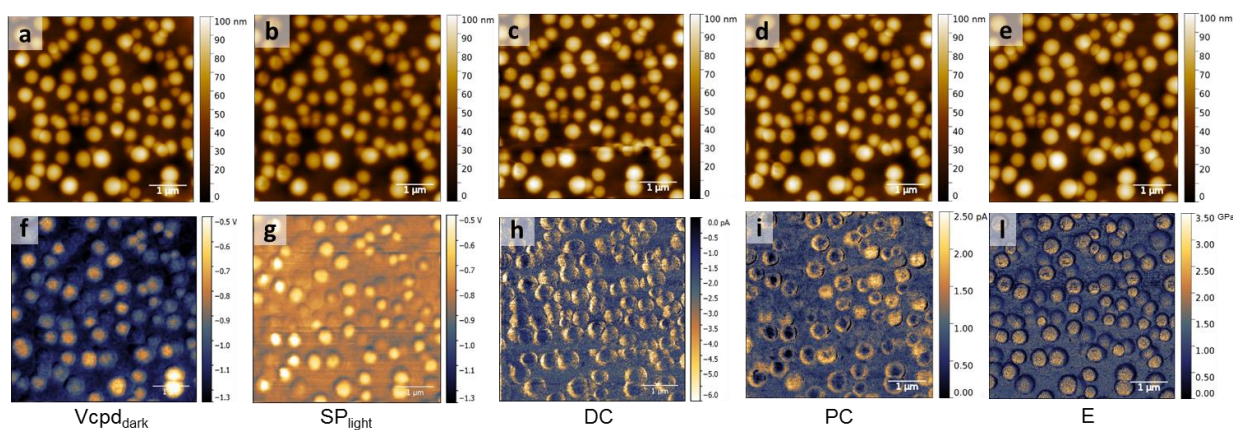
Comparison of multiple quantities

Figure S1. Comparison of multiple quantities measured on the same area of a TQ1:PCBM blend deposited on ZnO/ITO from toluene: (a-e) height images; (f) contact potential in dark and (g) in light; (h) dark current measured at a bias of-2V applied to the ITO electrode; (i) photocurrent measured at 0V bias; (l) elastic modulus map.

Determination of contact area

The contact area between tip and sample was determined based on Hertz model describing the contact between a sphere and a half-space.

For small indentations the contact area is[1]:

$$A = 2\pi r_{tip}\left(r_{tip} - \sqrt{r_{tip}^2 - r_c^2}\right),$$

where r_{tip} is the probe radius, r_c the contact radius, and $\left(r_{tip} - \sqrt{r_{tip}^2 - r_c^2}\right) = \frac{r_c^2}{r_{tip}} = h$ is the indentation depth.

The contact radius is:

$$r_c = \sqrt[3]{\frac{3}{4}\frac{F\cdot r_{tip}}{E^*}},$$

being F the load force and the reduced modulus $E^* = \left(\frac{1-v_s^2}{E_s} + \frac{1-v_{tip}^2}{E_{tip}}\right)^{-1}$, with v_s and v_{tip} the Poisson ratios and E_s and E_{tip} the elastic modulus of sample and tip, respectively.

Assuming $E_{tip} \to \infty$ and a Poisson ratio of 0.35,[2] we estimate the following contact areas corresponding to the current maps in Fig 2 and Fig 5 for applied load forces of 10 nN.

Probe (Figure)	r_{tip}	r_c	A
ElectriCont-G (Figure 2)	25 nm	5.2 nm	167 nm^2
HQ:DPE-XSC11/C (Figure 5)	40 nm	6.0 nm	228 nm^2

Table S1. Tip radius (r$_{tip}$), contact radius (r$_c$) and contact area (A) of the different probes used for current mapping in C- and QI-mode.
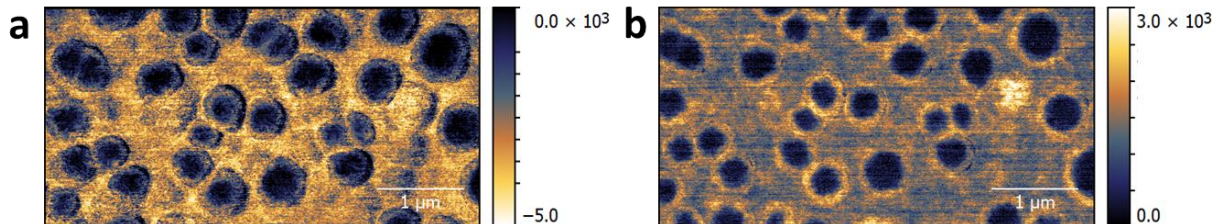
Current density maps

Figure S2. Current density maps (mA/cm^2) in dark (a) and upon light irradiation (b) calculated from the current maps in Figure 2, considering a tip-sample contact area of 167 nm^2.
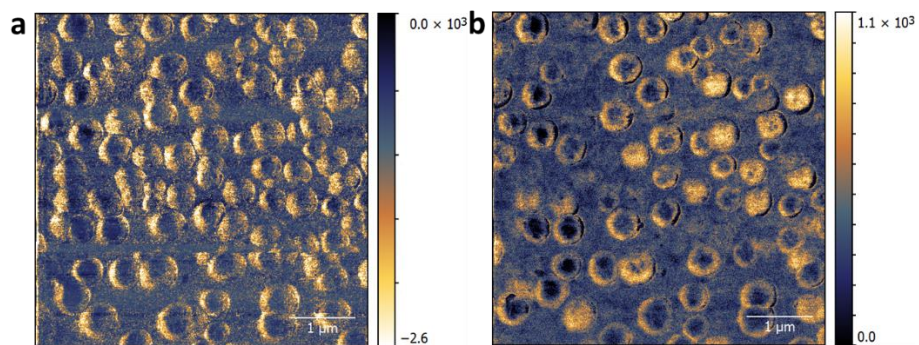
Figure S3. Current density maps (mA/cm^2) in dark (a) and upon light irradiation (b) calculated from the current maps in Figure 5, considering a tip-sample contact area of 228 nm^2.

References

1. D. Moerman, N. Sebaihi, S. E. Kaviyil, P. Leclere, R. Lazzaroni and O. Douheret, *Nanoscale*, 2014, **6**, 10596-10603.
2. S. E. Root, S. Savagatrup, C. J. Pais, G. Arya and D. J. Lipomi, *Macromolecules*, 2016, **49**, 2886-2894.