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Understanding of Photophysical Processes in DIO Additive-Treated PTB7:$PC_{71}BM$ Solar Cells

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Citation: Su, X.; Hu, R.; Wen, G.; Zou, X.; Qing, M.; Peng, J.; He, X.; Zhang, W. Understanding of Photophysical Processes in DIO Additive-Treated PTB7:$PC_{71}BM$ Solar Cells. *Crystals* **2021**, *11*, 1139. https://doi.org/10.3390/cryst11091139

Academic Editors: M. Ajmal Khan, Nrup Balar, Pratik Sen

Received: 30 August 2021
Accepted: 13 September 2021
Published: 18 September 2021

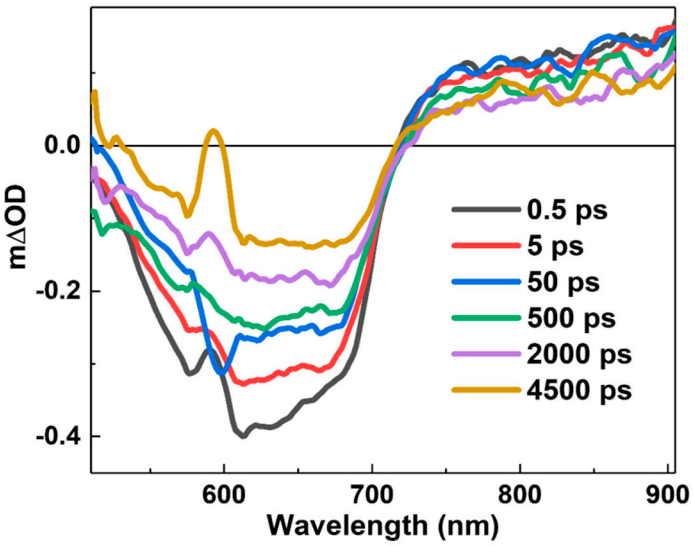

Figure S1. TA spectrum of PTB7:$PC_{71}BM$ film without DIO treatment at indicated delay times after 600 nm excitation with an excitation fluency of 1.16×10^{13} photon·cm^{-2}·$pulse^{-1}$.

Table S1. Fitting parameters of TA kinetics traces in Figure 7c.

Sample	A	τ (ps)
PTB7:$PC_{71}BM$	0.62	7793.11± 920.99
DIO-treated PTB7:$PC_{71}BM$	0.66	24891.16 ± 6002.03

S1. Calculation of Coulomb binding energy

The electric field can be calculated by considering the thickness of active layer in neat PTB7 device (~90 nm) and external bias (10 V):

$$E = \frac{U}{d} = \frac{10}{90}\left(\frac{\mathrm{V}}{\mathrm{nm}}\right) = 1.11 \times 10^{8}\left(\frac{\mathrm{V}}{\mathrm{m}}\right). \quad (1)$$

Assuming the external electric field just overcomes the Coulomb attraction between the positive and negative charge of the charge pairs:

$$E = \frac{\mathrm{e}}{4\pi\varepsilon_0\varepsilon_{\mathrm{r}}r^2} \quad (2)$$

where E is the external electric field, e is the elementary charge, ε_0 is the vacuum permittivity constant (8.85×10^{-12} F/m), and ε_r is the ensemble-averaged dielectric constant of the film ($\varepsilon_r = 3$) [1]. The distance between electron-hole r can be calculated as 2.1 nm.

Coulomb binding energy of PTB7 exciton, E_b, can be the estimated as:

$$E_{\mathrm{b}} = \frac{\mathrm{e}^2}{4\pi\varepsilon_0\varepsilon_r r} = 0.23\ (\mathrm{eV}). \quad (3)$$

Reference

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