Charge Carrier Generation at Organic Semiconductor Donor-Acceptor Interfaces

Kyoto Univ., °Richard Murdey, Kazuto Nakao, Naoki Sato

E-mail: rmurdey@e.kuicr.kyoto-u.ac.jp

Charge carrier generation yields at the interface of donor/acceptor organic semiconductor thin films were estimated from current-voltage measurements. A new analysis technique was developed which can be applied even when the power conversion efficiency and output current of the device is vanishingly small. One such case arises where overlapped thin films isolate the donor/acceptor junction some distance from the electrodes (see Fig. 1.). Though inefficient, this configuration is desirable as it allows full experimental access to the junction area independently of the cathode and anode. As an example, two pentacene-fullerene devices were compared where the deposition order of the donor and acceptor films was reversed. Junction currents in both devices were determined to be linear with the incident light intensity, and charge generation in the fullerene-on-pentacene device (Fig. 1. ①) was found to be over ten times more efficient than in the pentacene-on-fullerene device (Fig. 1. ②).

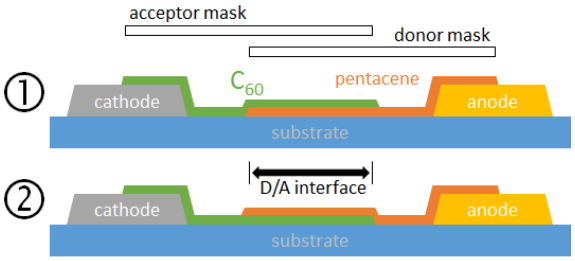

Fig. 1. Thin film device structures with overlapped donor/acceptor interfaces. Each film 10 nm thick.

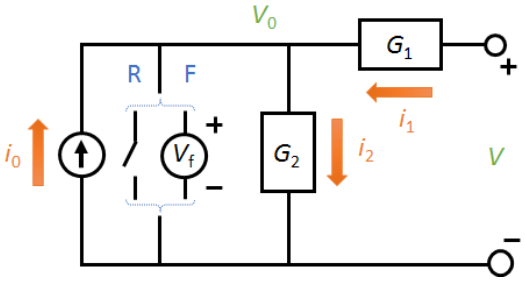

Fig. 2. Equivalent circuit used to analyze the current-voltage data of the thin film D/A devices.

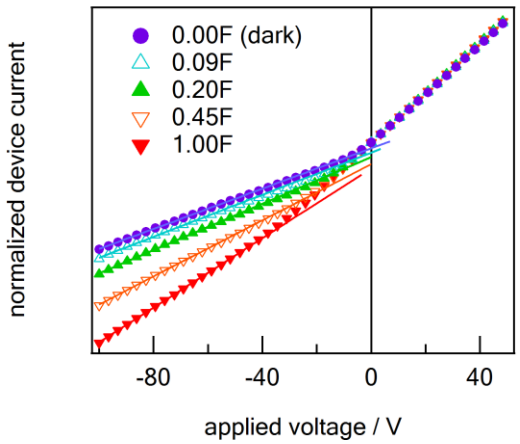

Fig. 3. I-V data for device structure ① in Fig 1 as the intensity of 680 nm light is varied. F=1.4×1019 ph m^{-2} s^{-1} through the donor mask, measured at 50 °C.

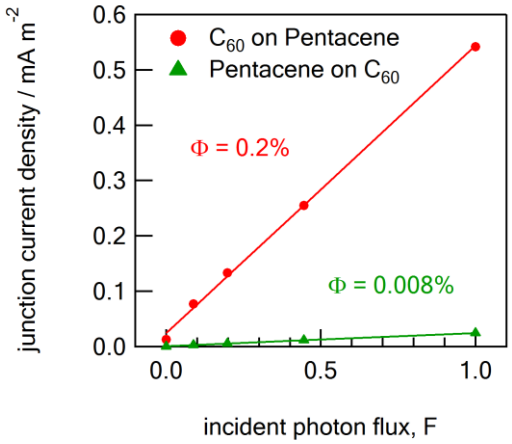

Fig. 4. Junction current, i_0, as derived from the data in Fig. 3 using the equivalent circuit in Fig. 2. The charge carrier generation yields are indicated.

[1] A. Moliton, J.-M. Nunzi, *Polym. Int.* **55**, 583 (2006).