Supporting Information

**Light Intensity Dependence of Current Density–Voltage Characteristics of an Organic Solar Cell and Dominance Switching between Shockley-Read-Hall and Radiative Recombination Losses**

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Figure S1. Simulated Shockley-Read-Hall (*J*SRH) and radiative (*J*rad) recombination-loss currents with respect to bias voltages:



Figure S2. Comparison of light-intensity dependence of power conversion efficiency (PCE), open-circuit voltage (Voc), fill factor (FF), and fractions of SRH (*J*SRH/Jrec) and radiative recombination (*J*rad/Jrec) components in recombination-loss currents at defect densities of 5.00 × 1010, 5.00 × 1011, 5.00 × 1013, and 5.00 × 1013 cm-3.



Figure S3. Upper row: Comparison of light-intensity dependence of short-circuit currents (*J*sc) at defect densities of 5.00 × 1010, 5.00 × 1011, 5.00 × 1012, and 5.00 × 1013 cm-3. Lower row: Comparison of light-intensity dependence of current components *J*sc, *J*SRH, and *J*rad normalized by generation currents *J*gen at the same four defect densities.

Table S1. Parameter values for electric simulations. We used the following parameter values for all OSC-operation simulations corresponding to different light-intensity conditions.

|  |  |  |  |
| --- | --- | --- | --- |
|  | ***ETL*** | ***AL*** | ***HTL*** |
| Thickness (nm) | 40 | 90 | 10 |
| Band gap (eV) | 3.300 [1] | 1.290 [2] | 3.00 0[5] |
| Electron affinity (eV) | 4.000 [1] | 4.100[2] | 2.500 [5] |
| Conduction band effective density of states, Nc (cm-3) | 2.20×$10^{18} $[4] | 1.0×$10^{20}$ [2] | 2.20×$10^{18}$ [5] |
| Valance band effective density of states, Nv (cm-3) | 1.80×$10^{19 }$[4] | 1.0×$10^{20}$ [2] | 1.80×$10^{19}$ [5] |
| Electron thermal velocity(cm sec-1) | 1.00×$10^{7}$ [4] | 1.0×$10^{7}$ | 1.00×$10^{7}$ [5] |
| Hole thermal velocity(cm sec-1) | 1.00×$10^{7}$ [4] | 1.0×$10^{7}$ | 1.00×$10^{7}$ [5] |
| Electron mobility (cm V-1 sec-1) | 1.00×$10^{2}$ [4] | 3.2×$10^{-3}$ [2] | 2.50×$10^{1}$ [5] |
| Hole mobility (cm V-1 sec-1) | 2.50×$10^{1}$ [4] | 2.7×$10^{-4}$ [2] | 1.00×$10^{2}$ [5] |
| Bimolecular recombination coefficient, ϒ (cm3sec-1) |  | 3.0×$10^{-11}$ [2] |  |
| Defect density (cm-3) |  | 5.0×$10^{12}$ [3] |  |

**References**

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