Electronic Supplementary Information

Effect of Donor Units in Methylated DPP-Based Polymers on Performance of Organic Field-Effect Transistors

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Fig. S1 The TGA of the synthesized polymers.
Fig. S2 Cyclic voltammograms of the polymers (reduction part).
Fig. S3 The transfer and output characteristics of the OFETs based on PMDPP-BT, PMDPP-TVT, and PMDPP-TAT with and without the FeCl₃ interlayer at their optimized thermal annealing temperatures.
Table S1 Solid-state packing parameters for the polymer thin films.

<table>
<thead>
<tr>
<th>Polymer</th>
<th>Annealing Temperature (°C)</th>
<th>Lamellar Stacking</th>
<th>π-π Stacking</th>
<th>FWHM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>q (Å⁻¹)</td>
<td>d (Å)</td>
<td>q (Å)</td>
</tr>
<tr>
<td>PMDPP50-BT</td>
<td>200</td>
<td>0.2413</td>
<td>26.03</td>
<td>1.689</td>
</tr>
<tr>
<td>PMDPP50-TV T</td>
<td>250</td>
<td>0.2591</td>
<td>24.25</td>
<td>1.759</td>
</tr>
<tr>
<td>PMDPP66-TAT</td>
<td>150</td>
<td>0.2254</td>
<td>27.87</td>
<td>1.740</td>
</tr>
</tbody>
</table>
Fig. S4 AFM height images of the (a) PMDPP50-BT, (b) PMDPP50-TVT, and c) PMDPP66-TAT films deposited at their optimal annealing temperatures. The scale bar is 500 nm.
The method to evaluate OFET parameters: field-effect mobility, $\mu$, and threshold voltage, $V_{th}$, is the classical metal-oxide–semiconductor field-effect transistor (MOSFET) model. This method is described for the two extreme modes of operation above threshold, $|V_{GS}| > |V_{th}|$, in equations (1) and (2). For linear mode, $|V_{DS}| < |V_{GS} - V_{th}|$,

$$I_D = \mu_{lin} c_{ox} \frac{W}{L} \left[ (V_{GS} - V_{th}) V_{DS} - \frac{V_{DS}^2}{2} \right], \quad (1)$$

and for saturation mode $|V_{DS}| > |V_{GS} - V_{th}|$,

$$I_D = \mu_{sat} c_{ox} \frac{W}{L} (V_{GS} - V_{th})^2, \quad (2)$$

where $V_{GS}$ is the gate voltage, $V_{th}$ is the threshold voltage, $I_D$ is the drain current, $V_{DS}$ is the drain voltage, $\mu_{lin}$ and $\mu_{sat}$ are the linear and saturation mobility, respectively, $W$ and $L$ are the width and length of the transistor channel and $c_{ox}$ is the capacitance per unit area.

$I_D$ shows an abrupt change in slope as a function of $V_{GS}$, $I_D (I_D^{1/2})$ is linear with $V_{GS}$ in the linear (saturation) regime as defined in equations (1) and (2). This slope is used to calculate mobility and extrapolate the threshold voltage.
**Y-function method (YFM):** Y-function method (YFM) is considered as a fast and precise alternative method for obtaining $R_c$ comparing with the traditional transmission line method (TLM). From the transfer characteristics of the OFETs, $I_d$ in the linear regime can be described as in following equation:

$$I_d = \frac{W}{L} C_i (V_g - V_{th}) \frac{\mu_0}{1 + \theta(V_g - V_{th})} \times V_d$$

(1)

where $C_i$ is the dielectric capacitance per unit area, and $\mu_0$ is the low-field mobility. $\theta$ is the mobility attenuation factor, which consists of the extrinsic factors caused by the surface roughness and phonon scattering ($\theta_o$) and contact resistance [$\theta^* = (W/L)\mu_0 C_i R_c$]. Assuming a constant $R_c$, the transconductance ($g_m$) can be expressed as

$$g_m = \frac{\delta I_d}{\delta V_g} = \frac{W}{L} C_i \frac{\mu_0}{[1 + \theta(V_g - V_{th})]^2} \times V_d$$

(2)

$\theta$ can be obtained by plotting $1/g_m^{1/2}$ versus $V_g$ at a strong charge accumulation, where a linear behavior is obtained. Assuming that $\theta_o$ is negligible, $R_c$ can be calculated, as summarized in Table. Note that the negative value of $\theta$, is presumably due to the gate-field enhanced mobility, which is compensated for by the conventional mobility attenuation.