Supporting Information

High-Performance Organic Field-Effect Transistors with Dielectric and Active Layers Printed Sequentially by Ultrasonic Spraying

Ming Shao,1 Sanjib Das,2 Jihua Chen,1 Jong K. Keum,3 Ilia N. Ivanov,1 Gong Gu,2 William Durant,4 Dawen Li,4 David B. Geohegan,1 Kai Xiao1

1Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, TN 37831
2Department of Electrical Engineering and Computer Sciences, University of Tennessee at Knoxville, Knoxville, TN, 37931
3Neutron Scattering Science Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831
4Department of Electrical and Computer Engineering, University of Alabama, Tuscaloosa, AL 35487
Figure S1. Current-voltage characteristics ($I_{DS}$ versus $V_{GS}$ measured in the saturation regime at $V_{DS} = -40$ V) for TIPS-PEN devices fabricated by drop-casting, spin-coating, and ultrasonic spray-coating processes. The right axis corresponds to the line with empty symbols and represent $I_{d}^{-1/2}$, and the left axis corresponds to the line with solid symbols and shows the log($I_{DS}$).
**Figure S2.** Current-voltage characteristics ($I_{DS}$ versus $V_{GS}$ measured in saturation regime at $V_{DS} = -40 \text{ V}$) for ultrasonic spray-coated TIPS-PEN devices from toluene, chlorobenzene, and dichlorobenzene solutions.

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Mobility (cm$^2$/Vs)</th>
<th>$V_{th}$ (V)</th>
<th>On-off ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>0.143</td>
<td>-0.9</td>
<td>$1.3\times10^5$</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>0.054</td>
<td>-2.8</td>
<td>$8.3\times10^4$</td>
</tr>
<tr>
<td>ODCB</td>
<td>0.032</td>
<td>13.2</td>
<td>$3.1\times10^4$</td>
</tr>
</tbody>
</table>
Figure S3. Variation in the field-effect mobilities of ultrasonic spray-coated TIPS-PEN OFETs on SiO$_2$/Si substrates (a) at different infuse rates while keeping the path speed (8 mm/s) and nozzle height (4.6 cm) fixed, (b) at different nozzle heights while keeping the infuse rate (1.2 ml/min) and path speed (8 mm/s) fixed, (c) at different path speeds while keeping the infuse rate (1.2 ml/min) and nozzle height (4.6 cm) fixed.
**Figure S4.** Optical images of a cross-linked PVP film on glass prepared by ultrasonic spray at (a) room temperature and (b) 50°C, demonstrating the higher uniformity of the spray-coated PVP film prepared at 50°C.
Figure S5. AFM morphologies and corresponding RMS roughnesses of (a) spin-coated and (b) ultrasonic spray-coated PVP films on different length scales.
Figure S6. Voltage-dependent capacitance of the spray-coated PVP film at 200 Hz in metal-insulator-metal structure.
Figure S7. (a) A digital camera image of the OFET devices on a PET substrate in a bent configuration during electrical measurement. (b) No significant change of transfer characteristics of OFET with different bend radius values, R (26 mm, 15 mm, 13 mm, 9 mm). (c) No significant change of transfer characteristics of OFET after 20 cycles bending (R = 9 mm) are observed (before: black line, after: red line). The transfer curves are measured in the saturation regime at a drain bias of -40 V.