Supplementary Information

High-Performance Electrofluorochromic Devices Based on Aromatic Polyamides with AIE-active Tetr phenylethene and Electro-active Triphenylamine Moieties

Shun-Wen Cheng, Ting Han, Teng-Yung Huang, Ben-Zhong Tang* and Guey-Sheng Liou*

S. W. Cheng, T. Y. Huang, Prof. G. S. Liou.
Functional Polymeric Materials Laboratory, Institute of Polymer Science and Engineering, National Taiwan University, 1 Roosevelt Road, 4th Sec., Taipei City 10617, Taiwan
E-mail: gsliou@ntu.edu.tw

Dr. T. Han, Prof. B. Z. Tang.
Department of Chemistry, The Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong, China
E-mail: tangbenz@ust.hk

List of Contents for Supplementary Information:

Preparation of the polyamide TPA-OMe-TPE .................................................................2
Scheme S1. Synthetic scheme of polyamide TPA-OMe-TPE. ........................................2
Table S1 Thermal Properties of TPA-OMe-TPE ..........................................................3
Table S2 Inherent viscosity and molecular weight of TPA-OMe-TPE .........................4
Table S3 Solubility behavior of TPA-OMe-TPE .........................................................5
Figure S1 IR spectrum of TPA-OMe-TPE. ....................................................................6
Figure S2 1H NMR spectrum of TPA-OMe-TPE. ......................................................7
Figure S3 TGA traces of TPA-OMe-TPE in N2 and in air.............................................8
Figure S4 DSC trace of TPA-OMe-TPE. ....................................................................9
Figure S5 Photographs of the NMP solutions and solid films of the prepared polyamides taken under illumination of 365 nm UV light.................................10
**Preparation of polyamide (TPA-OMe-TPE)**

A mixture of 0.31 g (1.0 mmol) of 4,4'-diamino-4''-methoxytriphenylamine, 0.42 g (1.0 mmol) of 4,4'-(1,2-diphenylethene-1,2-diyl)dibenzoic acid, 0.13 g of calcium chloride, 1.0 mL of triphenyl phosphite (TPP), 0.3 mL of pyridine, and 1.0 mL of NMP was heated with stirring at 105 °C for 3 h. The polymer solution was then poured slowly into 300 mL of stirring methanol. The resulting stringy and fiber-like precipitates were collected by filtration, washed thoroughly with hot water and methanol successively, and dried under vacuum at 100 °C. Reprecipitation was carried out twice by pouring the DMAc solution of the polymer product into stirring methanol for further purification. The inherent viscosity, weight-average molecular weights ($M_w$), and polydispersity index (PDI) of the obtained polyamide TPA-OMe-TPE were 0.31 dL/g (measured at a concentration of 0.5 g/dL in DMAc at 30 °C), 19,000 daltons, and 1.96, respectively. The FT-IR spectrum of TPA-OMe-TPE (film) exhibited characteristic amide absorption bands at 3320 cm$^{-1}$ (N-H stretching) and 1500 cm$^{-1}$ (N-H bending), 1657 cm$^{-1}$ (amide carbonyl), 2920 cm$^{-1}$ (C-H stretching), and 1240 cm$^{-1}$ (C-N stretching). $^1$H NMR (400 MHz, DMSO-d$_6$, δ, ppm): 10.13-10.06 (s, 2H), 7.81-7.69 (d, 4H), 7.66-7.56 (d, 4H), 7.23-7.07 (m, 10H), 7.07-6.92 (d, 4H), 6.90-6.82 (m, 8H), 3.77-3.67 (s, 3H).

![Scheme S1. Synthetic scheme of polyamide TPA-OMe-TPE.](image-url)
Table S1. Thermal Properties of TPA-OMe-TPE\(^a\)

<table>
<thead>
<tr>
<th>Polymer(^a)</th>
<th>(T_g)(^b) (°C)</th>
<th>(T_d) at 5 % weight loss (°C)(^c)</th>
<th>(T_d) at 10 % weight loss (°C)(^c)</th>
<th>Char yield (%)(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPA-OMe-TPE</td>
<td>230</td>
<td>455</td>
<td>430</td>
<td>505</td>
</tr>
</tbody>
</table>

\(^a\) The polymer film samples were heated at 250 °C for 1 h prior to all the thermal analyses.

\(^b\) Midpoint temperature of baseline shift on the second DSC heating trace (rate: 20 °C /min) of the sample after quenching from 400 °C to 50 °C (rate: 200 °C /min) under nitrogen.

\(^c\) Temperature at which 5 % and 10% weight loss occurred, respectively, recorded by TGA at a heating rate of 20 °C/min and a gas flow rate of 20 cm\(^3\)/min.

\(^d\) Residual weight percentages at 800 °C under nitrogen flow.
Table S2. Inherent Viscosity and Molecular Weight of TPA-OMe-TPE

<table>
<thead>
<tr>
<th>Polymer</th>
<th>( \eta_{\text{inh}}^a ) (dL/g)</th>
<th>( M_w^b )</th>
<th>( M_n^b )</th>
<th>PDI(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPA-OMe-TPE</td>
<td>0.31</td>
<td>19000</td>
<td>9700</td>
<td>1.96</td>
</tr>
</tbody>
</table>

\(^a\) Measured at a polymer concentration of 0.5 g/dL in DMAc at 30 °C.

\(^b\) Calibrated with polystyrene standards, using NMP as the eluent at a constant flow rate of 0.5 mL/min at 40 °C.

\(^c\) Polydispersity Index (\( M_w/M_n \)).
Table S3. Solubility Behavior of TPA-OMe-TPE

<table>
<thead>
<tr>
<th>Polymer</th>
<th>NMP</th>
<th>DMAc</th>
<th>DMF</th>
<th>THF</th>
<th>CHCl₃</th>
<th>DMSO</th>
<th>m-cresol</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPA-OMe-TPE</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
</tbody>
</table>

* Qualitative solubility was tested with 10 mg of a sample in 1 mL of solvent. ++, soluble at room temperature; +, soluble on heating; -, insoluble even on heating.
Figure S1 IR spectrum of TPA-OMe-TPE.
Figure S2 $^1$H NMR spectrum of TPA-OMe-TPE.
Figure S3 TGA traces of TPA-OMe-TPE in N₂ and in air.
Figure S4 DSC trace of TPA-OMe-TPE.
Figure S5 Photographs of the NMP solutions and solid films of the prepared polyamides taken under illumination of 365 nm UV light.