Synthesis and Characterization of Amide-bridged Colorless Polyimide Films with Low CTE and High Optical Performance for Flexible OLED Displays

Zhenghui Yang\textsuperscript{a,b}, Haiquan Guo\textsuperscript{*}, Chuanqing Kang\textsuperscript{a,b} and Lianxun Gao\textsuperscript{a}

\textsuperscript{a} State Key Laboratory of Polymer Physics and Chemistry, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun 130022, China.

\textsuperscript{b} University of Science and Technology of China, Hefei 230026, China.

E-mail: hguo@ciac.ac.cn

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1. Structure characterization of dianhydride monomer. ($^1$HNMR, $^{13}$CNMR, MS)

Figure S1. Mass spectrum of AMDA.

Figure S2. $^1$H NMR spectrum of AMDA.
Figure S3. $^{13}$C NMR spectrum of AMDA.

Figure S4. Mass spectrum of IAMDA.
Figure S5. $^1$H NMR spectrum of IAMDA.

Figure S6. $^{13}$C NMR spectrum of IAMDA.
Figure S7. Mass spectrum of p-DAMDA.

Figure S8. $^1$H NMR spectrum of p-DAMDA.
2. The inherent viscosity and molecular weight of cPIs.

Table S1 The inherent viscosity and molecular weight of cPI films.

| Polyimide       | \( \eta_{\text{inh}} \) (dL g\(^{-1}\))
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AMDA/TFDB</td>
<td>1.93</td>
</tr>
<tr>
<td>IAMDA/TFDB</td>
<td>1.80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polyimide</th>
<th>( M_n ) (10(^4) g mol(^{-1}))</th>
<th>( M_w ) (10(^4) g mol(^{-1}))</th>
<th>PDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMDA/TFDB</td>
<td>25.5</td>
<td>36.0</td>
<td>1.40</td>
</tr>
<tr>
<td>IAMDA/TFDB</td>
<td>22.1</td>
<td>32.9</td>
<td>1.48</td>
</tr>
</tbody>
</table>

\( a \) Measured at a concentration of 0.5 g dL\(^{-1}\) in DMAc at 30 °C.

\( b \) Measured in DMF by GPC.

Table S2 The inherent viscosity of poly (amic acid)s for insoluble cPI films.

<table>
<thead>
<tr>
<th>Poly (amic acid)</th>
<th>AMDA/t-CHDA</th>
<th>p-DAMDA/TFDB</th>
<th>IAMDA/t-CHDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \eta_{\text{inh}} ) (dL g(^{-1}))</td>
<td>1.20</td>
<td>0.56</td>
<td>0.94</td>
</tr>
</tbody>
</table>

\( a \) Measured at a concentration of 0.5 g dL\(^{-1}\) in DMAc at 30 °C.

![Figure S10](image)

**Figure S10.** (a) dimension change of PAHP/TFDB as a function of temperature; (b) XRD pattern of PAHP/TFDB.

Table S3 Optical and thermal properties of Co-PIs.

<table>
<thead>
<tr>
<th>Polymer</th>
<th>Molar ratio of AMDA/6FDA/TFDB</th>
<th>( \lambda_{\text{cut-off}} ) (nm)</th>
<th>( T_{550\text{nm}} ) (%)</th>
<th>YI</th>
<th>Haze</th>
<th>( T_d\text{5%} ) (°C)</th>
<th>( T_g ) (°C)</th>
<th>CTE (ppm K(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>6FDA/TFDB</td>
<td>0:100:100</td>
<td>346</td>
<td>90</td>
<td>2.46</td>
<td>0.54</td>
<td>540</td>
<td>342</td>
<td>56</td>
</tr>
<tr>
<td>Co-PI-1</td>
<td>25:75:100</td>
<td>383</td>
<td>89</td>
<td>3.44</td>
<td>0.67</td>
<td>523</td>
<td>353</td>
<td>47</td>
</tr>
<tr>
<td>Co-PI-2</td>
<td>50:50:100</td>
<td>388</td>
<td>88</td>
<td>3.20</td>
<td>0.39</td>
<td>515</td>
<td>358</td>
<td>36</td>
</tr>
<tr>
<td>Co-PI-3</td>
<td>75:25:100</td>
<td>391</td>
<td>87</td>
<td>3.37</td>
<td>0.52</td>
<td>508</td>
<td>348</td>
<td>19</td>
</tr>
<tr>
<td>Co-PI-4</td>
<td>85:15:100</td>
<td>393</td>
<td>87</td>
<td>4.11</td>
<td>0.56</td>
<td>506</td>
<td>340</td>
<td>15</td>
</tr>
<tr>
<td>AMDA/TFDB</td>
<td>100:0:100</td>
<td>386</td>
<td>87</td>
<td>4.29</td>
<td>0.71</td>
<td>502</td>
<td>333</td>
<td>5.2</td>
</tr>
</tbody>
</table>
Figure S11. UV-Vis spectra of co-PI films.

Figure S12. Tanδ value of cPI films as a function of temperature.

Figure S13. TGA curves of cPI films.
Figure S14. WAXD patterns of cPI films.

Figure S15. The stress-strain curves of cPI films.

Figure S16. FTIR spectra of dianhydride monomers: (a) AMDA; (b) IAMDA; (c) p-DAMDA.