Degradable and Renewably-sourced Poly(ester-thioethers) by Photo-initiated Thiol-ene Polymerization

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Introduction

Degradable materials are of great importance for a sustainable future! Glucarodiactone (GDL), a rigid glucose-derivative, can impart enhanced degradability when incorporated into the backbone of polymeric materials.

Previous Route:
Ru-Catalyzed ADMET Polymerization
✓ Exciting Mechanical Performance
✓ Hydrolytic Degradability
✗ Expensive Ru Catalyst
✗ Highly Discolored

This Work:
Photoinitiated Thiol-ene Polymerization
✓ Exciting Mechanical Performance
✓ Hydrolytic Degradability
✓ Low-cost Photoinitiator
✓ Colorless Materials
✓ Minimal Odor

Thiol-ene Photopolymerization

Poly(ester-thioethers) by Photo-initiated Thiol-ene Polymerization

Tensile Performance

<table>
<thead>
<tr>
<th>P(GDLU-x) Where x =</th>
<th>Mn (kg/mol)</th>
<th>D</th>
<th>Tg (°C)</th>
<th>Tm (°C)</th>
<th>TL5% (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P(GDLU-ETDT)</td>
<td>29</td>
<td>1.6</td>
<td>16</td>
<td>49 &amp; 64</td>
<td>200</td>
</tr>
<tr>
<td>P(GDLU-DODT)</td>
<td>24</td>
<td>1.9</td>
<td>-8.7</td>
<td>44</td>
<td>208</td>
</tr>
<tr>
<td>P(GDLU-I2DT)</td>
<td>49</td>
<td>1.6</td>
<td>19</td>
<td>Am.</td>
<td>246</td>
</tr>
<tr>
<td>P(GDLU-I3DT)</td>
<td>17</td>
<td>2.0</td>
<td>-1.3</td>
<td>Am.</td>
<td>216</td>
</tr>
<tr>
<td>P(GDLU-DHLA)</td>
<td>16</td>
<td>1.4</td>
<td>3.8</td>
<td>Am.</td>
<td>234</td>
</tr>
<tr>
<td>P(GDLP-ETDT)</td>
<td>14</td>
<td>1.1</td>
<td>12</td>
<td>28</td>
<td>Am.</td>
</tr>
</tbody>
</table>

References and Acknowledgments

• Lillie, L. M.; Tolman, W. B.; Reineke, T. M., Submitted.
• Lillie, L. M.; Tolman, W. B.; Reineke, T. M., Polymer Chemistry 2017, 8 (24), 3746-3754.

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Hydrolytic Degradability

• Rapid degradation in basic aqueous conditions
• Thiol-ene chemistry does not impact GDL-induced degradability