Physics of Electronic Polymers

Lecture 5.5:
Stretchable Organic Photovoltaic Devices

Learning Objectives
By the Conclusion of this Lecture, You Should be Able to:

1. **Describe** the balance between tensile modulus and device performance in poly(3-alkylthiophene)-based OPV devices as a function of alkyl chain length.

2. **Relate** the value of the crack onset strain to the likelihood that a given material will work well in a wearable OPV device.

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Polythiophene Can Be Used in Stretchable OPV Devices

OPVs with Unique Form Factors

Reasonable Performance Metrics

Correlating P3AT Molecular Design with Mechanical Properties

**Correlating P3AT Molecular Design with Performance Properties**

Cracking is a Huge Issue in Stretchable and Flexible OPV Devices

**Crack Formation Greatly Influences Device Performance upon Stretching**

<table>
<thead>
<tr>
<th>Device</th>
<th>$V_{OC}$ [V]</th>
<th>$J_{SC}$ [mA cm$^{-2}$]</th>
<th>FF [%]</th>
<th>PCE [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3HT:PCBM (0%)</td>
<td>0.37 ± 0.005</td>
<td>5.52 ± 1.14</td>
<td>28.7 ± 3.02</td>
<td>0.594 ± 0.119</td>
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<tr>
<td>P3HT:PCBM (10%)</td>
<td>0.04 ± 0.003</td>
<td>0.66 ± 0.06</td>
<td>22.1 ± 4.91</td>
<td>0.008 ± 0.011</td>
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<tr>
<td>P3DDT:PCBM (0%)</td>
<td>0.50 ± 0.001</td>
<td>2.10 ± 0.57</td>
<td>27.7 ± 1.55</td>
<td>0.291 ± 0.088</td>
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<tr>
<td>P3DDT:PCBM (10%)</td>
<td>0.58 ± 0.034</td>
<td>1.88 ± 0.47</td>
<td>29.8 ± 3.66</td>
<td>0.381 ± 0.029</td>
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</tbody>
</table>

Stretchable Organic Electronics Allow for Wearable Devices


Next Time: Introduction to Polymer-based Bioelectronic Sensing