Nano Energy Lab

- Photodetectors
- Solar cells
- Water splitting
- LEDs
- Wearable electronics

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Solar cells & photodetectors

**Solar cells**
1. Silicon heterojunction solar cells with hierarchical nano/microstructures
2. Silicon/organic hybrid solar cells with excellent omnidirectionally

**Photodetectors**
1. 1D nanowire photodetectors
2. 2D atomic photodetectors
3. Harsh photodetectors
Light emitting diodes (LEDs)

Nanostructures on LEDs for efficient light extraction

- 532-nm laser
- Optical Power (a.u.)
  - Bare
  - Flat-end NRs
  - Syringe-like NRs

Images show nanostructures with dimensions:
- ~230 ± 200 nm
- ~1.75 ± 0.15 μm
- ~120 ± 20 nm
Water splitting devices

High efficiency Si photocathodes for solar water splitting

<table>
<thead>
<tr>
<th>p type a-Si:H (6 nm)</th>
<th>Ag</th>
<th>ITO</th>
</tr>
</thead>
<tbody>
<tr>
<td>intrinsic a-Si:H (5 nm)</td>
<td>N-type c-Si (200 μm)</td>
<td></td>
</tr>
<tr>
<td>n+ type a-Si:H (10 nm)</td>
<td>Pt coil</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Layer</th>
<th>J_{sc} (mA/cm^2)</th>
<th>V_{oc} (V)</th>
<th>FF (%)</th>
<th>Eff. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 nm</td>
<td>33.39</td>
<td>0.632</td>
<td>52.5</td>
<td>11.08</td>
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<tr>
<td>2 nm</td>
<td>33.49</td>
<td>0.640</td>
<td>61.9</td>
<td>13.26</td>
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<tr>
<td>5 nm</td>
<td>33.49</td>
<td>0.639</td>
<td>56.7</td>
<td>12.13</td>
</tr>
<tr>
<td>10 nm</td>
<td>33.56</td>
<td>0.639</td>
<td>59.8</td>
<td>12.82</td>
</tr>
</tbody>
</table>

WE: Working Electrode
CE: Counter Electrode
H\textsubscript{2} bubbles
O\textsubscript{2} bubbles

Epoxy
Electrolyte
Wearable electronics

1. Paper memory by all-printed technologies
   - Paper
   - Screen-printed C
   - Ink-printed TiO₂
   - Ink-printed Ag

2. Self-powered cloth for electromagnetic and infrared stealth
   - Self-powered cloth
   - EM shielding

3. Origami photodetectors with super stretchability
   - Origami photodetectors
   - Photocurrent vs. Strain
   - Variation of PDCR vs. Incident angle
   - Photocurrent vs. Voltage
   - J (mA/cm²) vs. Wavenumber
   - Shielding effectiveness vs. Frequency
   - IR invisible

- Photovoltaic
- EM shielding
- Photocurrent
- Variation of PDCR
- IR invisible
- Photovoltaic