Organic Thin-film Solar Cell Characterization

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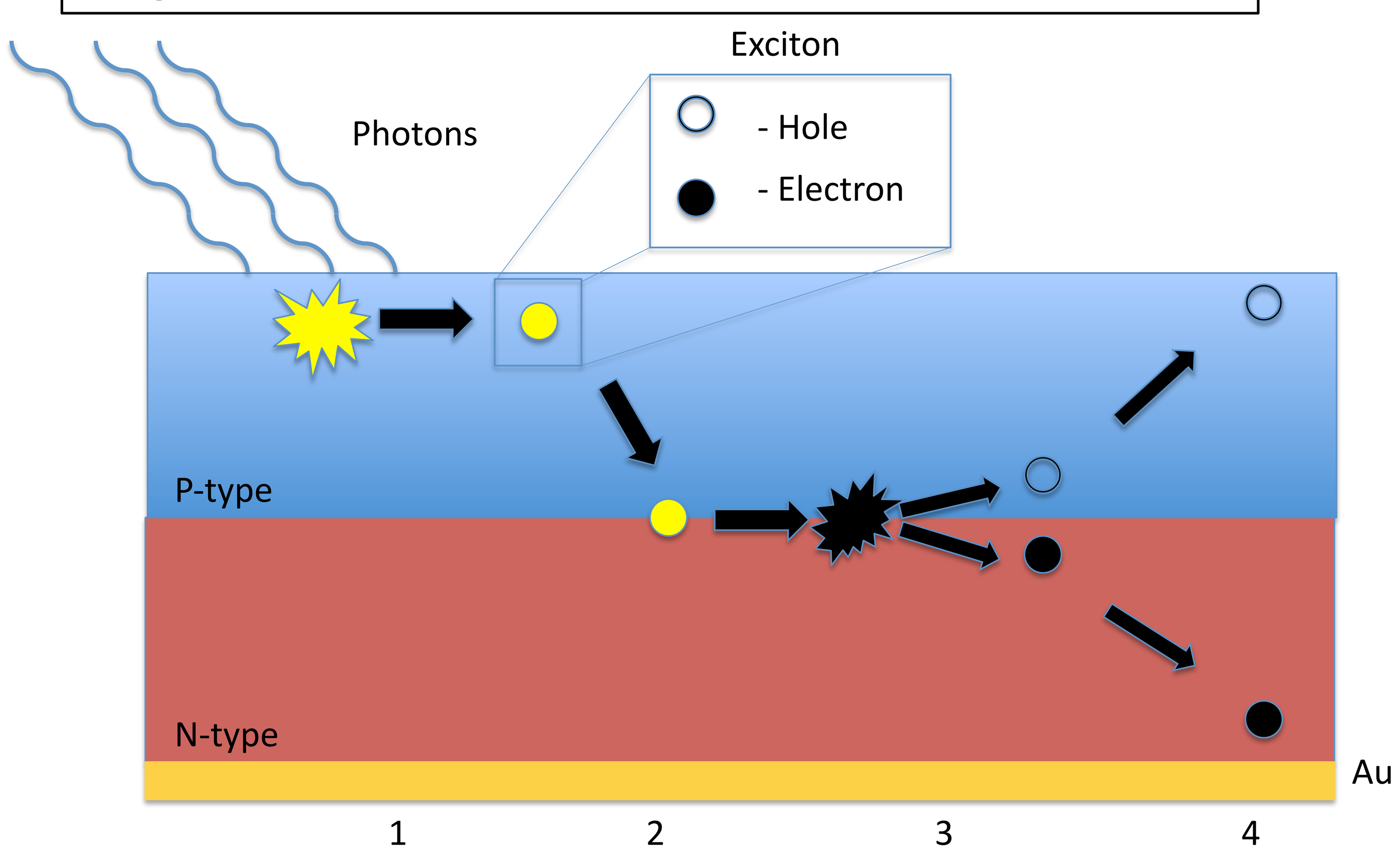
Why Organic materials?

- **Thinner**
  - An advantage with OPV's is that they can be applied via solution leaving a very thin film that can convert sunlight into electricity.
- **Biodegradable**
  - Materials used in OPV's could be able to be recycled into more solar cells or made biodegrade thus limiting environmental side-effects.
- **Inexpensive instillation**
  - Roll to Roll production could make the fabrication and instillation more cost efficient.
- **Flexible**
  - Material properties allow casting onto flexible substrates.
- **Light weight**
  - Using a thin film OPV's gives you an improved Watt/Kg ratio, which is a primary concern for many space travel.

Physics of Solar Cells



When stuck by light these devices generate electricity in four steps.

1. Photon absorbed by material, electron-hole pair formed
2. Excitation diffuses to P-N interface
3. Excitation dissociates to an electron and hole
4. Charges move to electrodes, powering devices

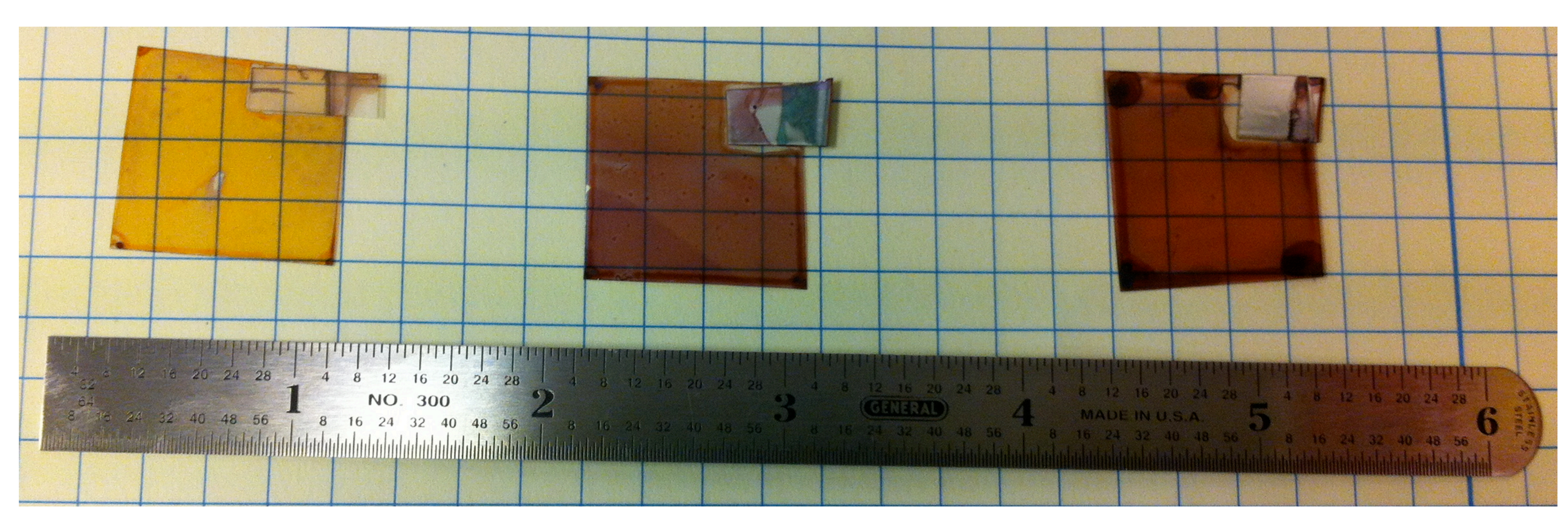
Applications of Organic Solar Cells

- **Solar Fabrics**
  - The need for every light equipment has led to the use of OPV's integration into frabic like material which can be applied to spacesuits and clothing
- **Environmental Building Materials: Solar Window Film**
  - OPV plastic films applied onto windows would allow most light to be transmitted but also harness energy to power the building.
- **Solar Paint**
  - Developments in the solution deposition process are leading to efficient solar paint that could be applied to a variety of surface.

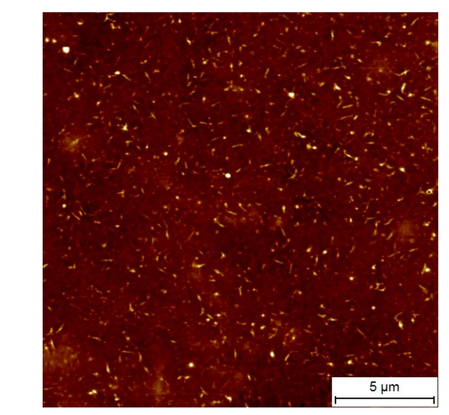
Konarka Power Plastic

Professor Sir Richard Friend at the Cavendish Laboratory in the Department of Physics

Solar Cells Fabrication



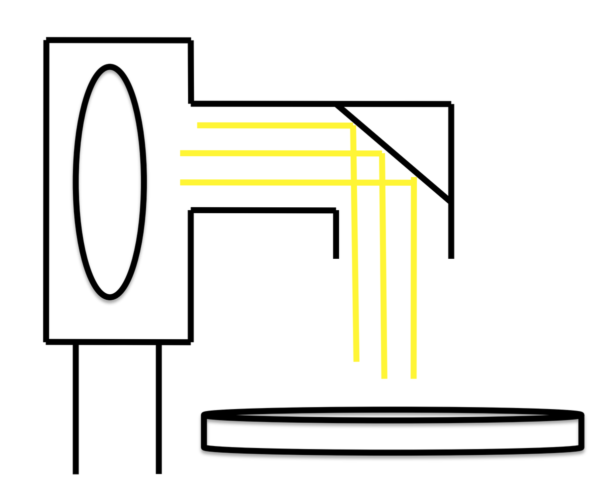
- **Solar Active Materials**
  - P3HT (poly(3-hexylthiophene-2,5-diyl) and C_{60} in a bulk heterojunction solution dissolved in a dichlorobenzene (DCB)
- **Spin Coating**
  - P3HT:C_{60} deposited onto indium tin oxide (ITO) coated quartz and plastic substrates via a Laurell spin coater programmed with several spin routines.
- **Metal evaporation**
  - Aluminum layer thermally evaporated to provide an upper contact



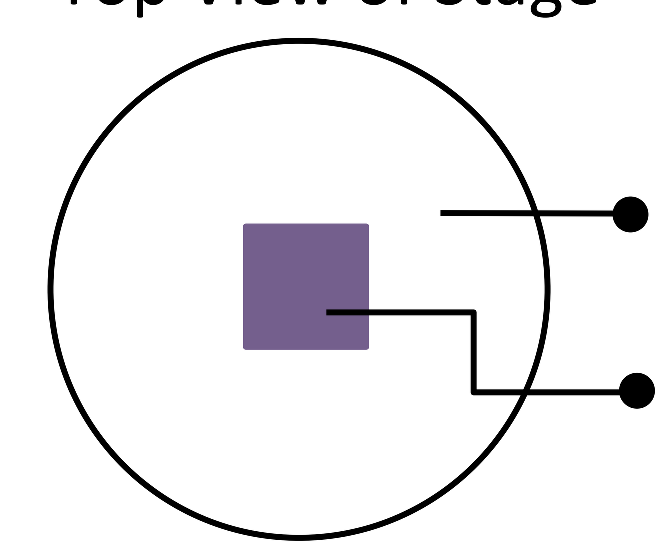
Solar Cell Testing Center

- **Solar Simulator**
  - A Xenon 150W lamp installed in the Newport 150 W Low Cost Solar Simulator lamp housing
- **Stage and Probes**
  - Copper Plate with a vacuum chuck
  - Fine point tungsten electronic probes used to source voltage and measure current
- **Performance Charaterization**
  - An in house Labview program was developed to control the lamp as well as the measurement probes

Side View of Lamp



Top View of Stage



Conclusion

- **Fabrication Development**
  - A fabrication process was developed and adapted for small scale P3HT:C_{60} organic solar cells.
- **Performance Characterization**
  - To determine the effecencies of the solar cells, a solar simulator device characterization apparatus was constructed.