

Organic Solar Cells



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Presentation Overview

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright yellow on the right. To the right of the bar is a 3D arrow shape pointing to the right, with a brown-to-yellow gradient and a shadow effect.

- I. Introduction
- II. Physics
- III. Structure and Fabrication
- IV. Comparison
- V. Conclusion

Introduction

- Why Solar Cells?
 - Depletion of conventional energy sources
 - Environmental Issues

Energy Source	SO_x (gSO_x/kWh)	NO_x (gNO_x/kWh)	C in CO₂ (gC/kWh)	C in CO₂ From non-generating portion of the fuel cycle* (gC/kWh)
Coal	3.400	1.800	332.8	50.00
Oil	1.700	0.880	258.5	50.00
Natural Gas	0.001	0.900	178.0	30.00
Nuclear	0.030	0.003	7.800	7.800
PhotoVoltaics	0.020	0.007	5.300	5.300

Pollutant emission factors for the total and non-generating portion of the fuel cycle

[continued...]



- Solar Energy
 - Free
 - Unlimited
 - Not Localized
 - Environmentally Friendly

*Interesting fact: One hour of the sun's energy received by the Earth's surface is sufficient for the entire human population's need for one year !!!

So why isn't it a dominant energy source??

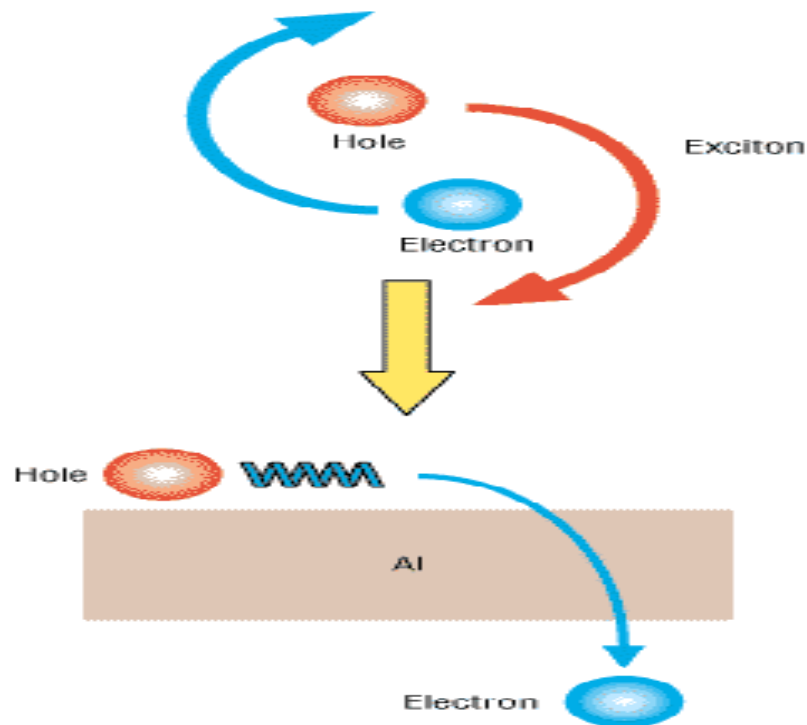
Costs



- Ways to lower costs.
 - Cheaper materials
 - Greater throughput
 - Higher power conversion efficiency

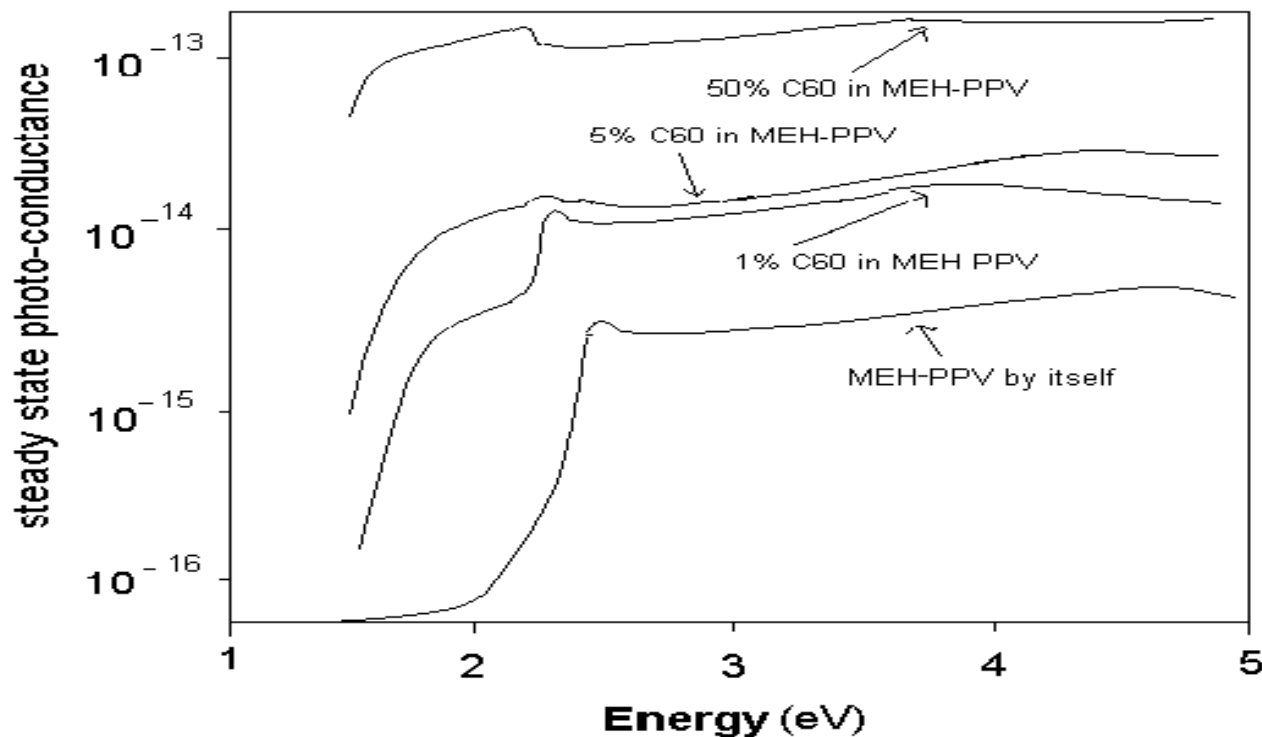
Alternative to Silicon Based Solar Cells:
Organic Solar Cells

How does it work?



Excitons dissociate at interfaces between materials having different ionization energies and electron affinities.

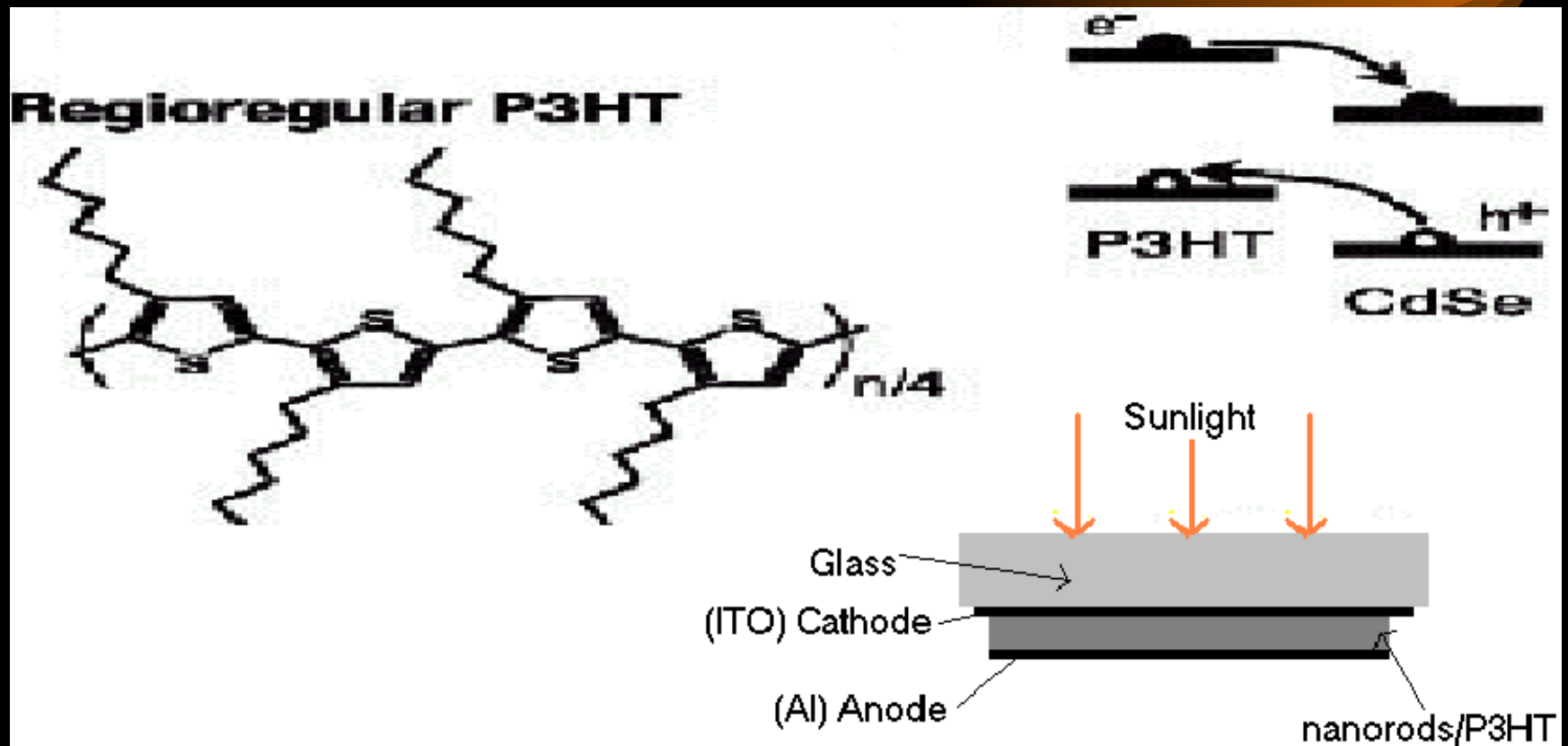
Improvements on the previous model



Spectral response of the steady-state photo-conductivity of MEH-PPV alone and MEH-PPV/C60 for several concentrations at 300K and biasing field of 104 V/cm.

Source:
Plastic Solar Cells: From basic Research to Devices
by, Christopher J. Brabec, David Comoretto, Ivana Moggio and Giovanna Dellepiane
RICHMAC Magazine - December 1998

Recent Developments...



Source: Lawrence Berkeley National Laboratory

Comparisons

- **Advantages**
 - High absorption co-efficient of the organic materials, so only thin layers needed
 - Light weight and flexible
 - Optically tunable
 - Large area
 - Can be processed at room temperature
 - Low cost of fabrication
 - Less toxic manufacturing techniques
- **Disadvantages**
 - Excitons have short recombination lifetimes
 - Low electron/hole mobility

Conclusion



- Current Organic/Hybrid cell efficiency below 3%
- Further optimization of device performance can be achieved by optimization of device physics.
 - Optimize choice of metallic electrodes
 - Optimize choice of donor-acceptor pair
 - Optimize network morphology for the composite materials for enhanced transport and carrier generation.