

Organic Solar Cells

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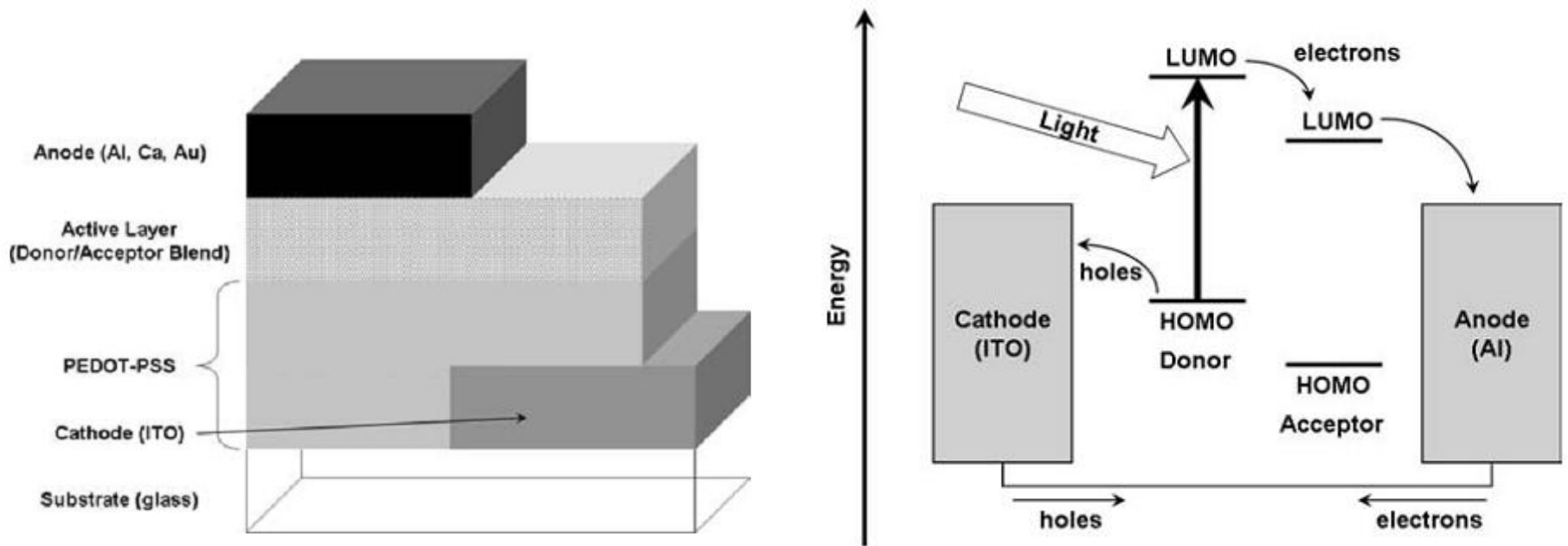
MSE 395 Final Presentation

Outline

- Mechanism
- Materials
- Morphology
- Processing
- Efficiency

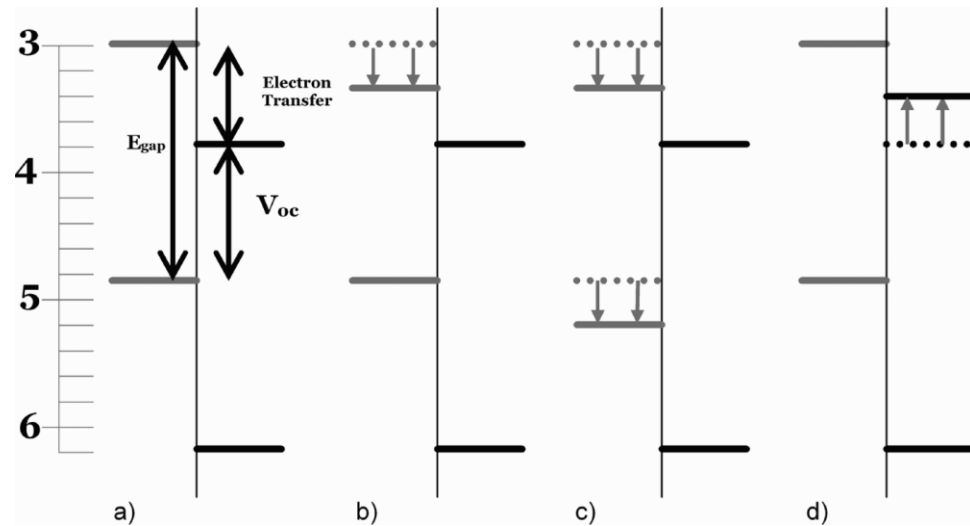
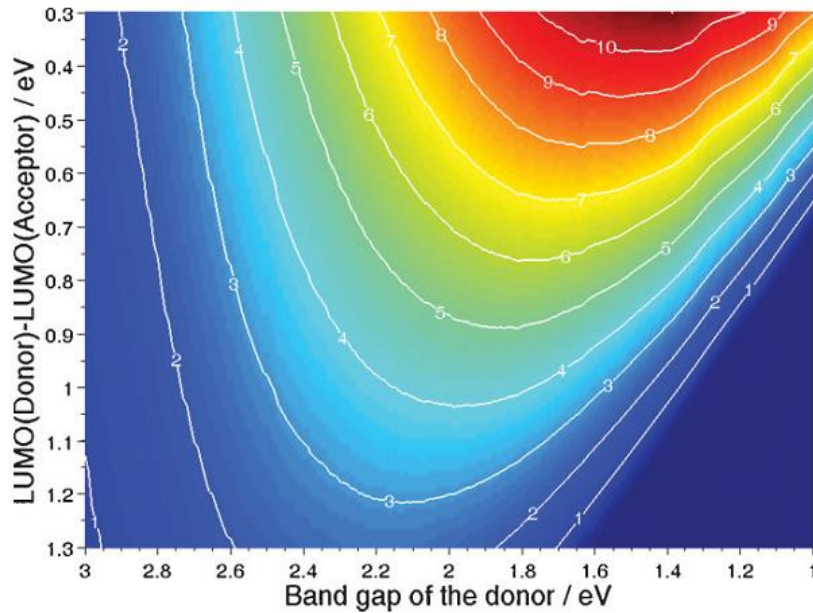
Mechanism

- Excitons are formed which separate at the donor/acceptor interface
- Losses result from exciton recombination and thermalization of charge carriers



Band Gap Selection

- Decrease loss of energy during electron transfer



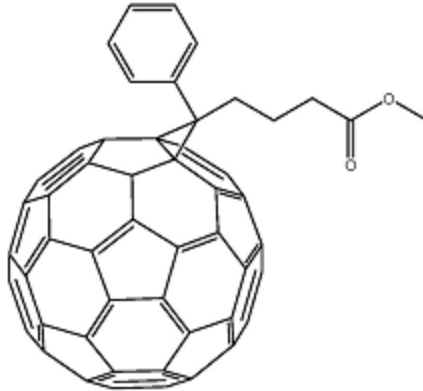
Acceptors/Electron Conducting Materials

fullerenes

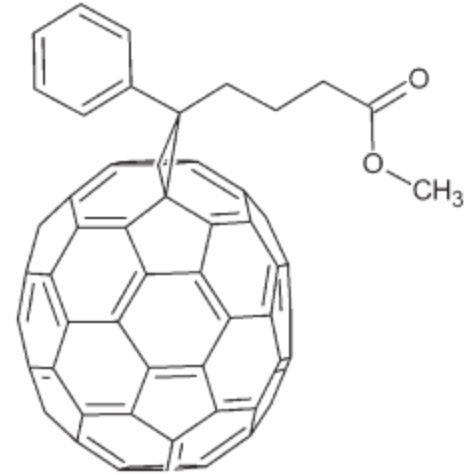
C_{60}



PC₆₁BM



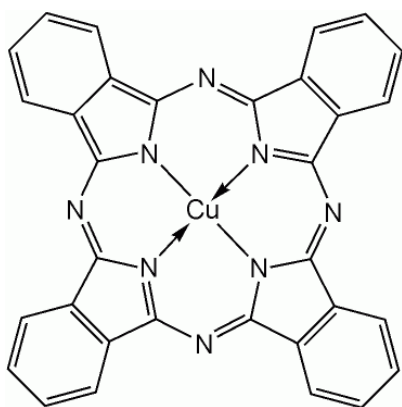
PC₇₁BM



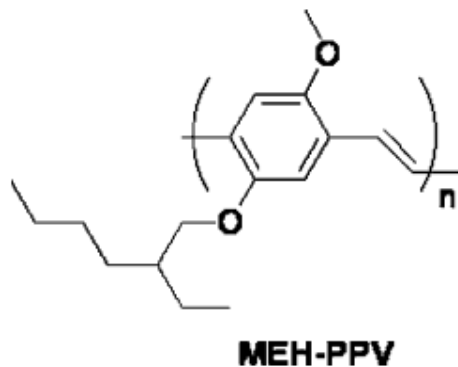
Donors/Hole Conducting Materials

phthalocyanines

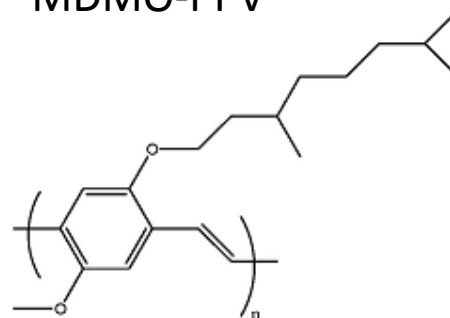
CuPc



poly(p-phenylene vinylenes)

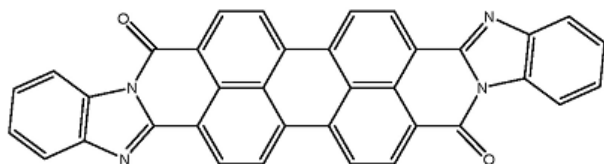


MDMO-PPV

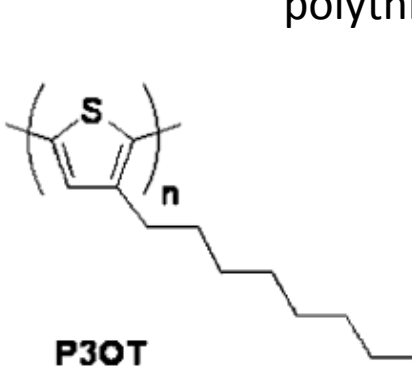


perylene

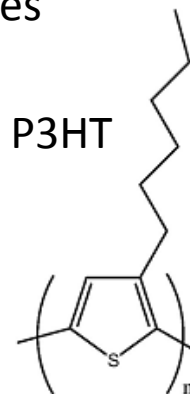
PTCDI



polythiophenes

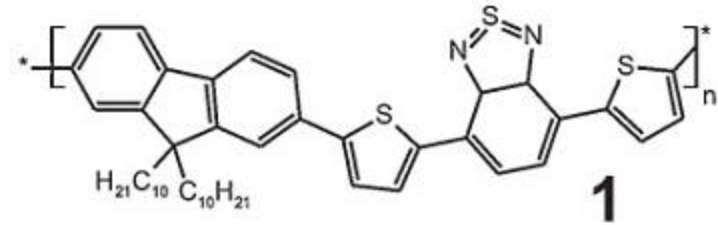


P3HT

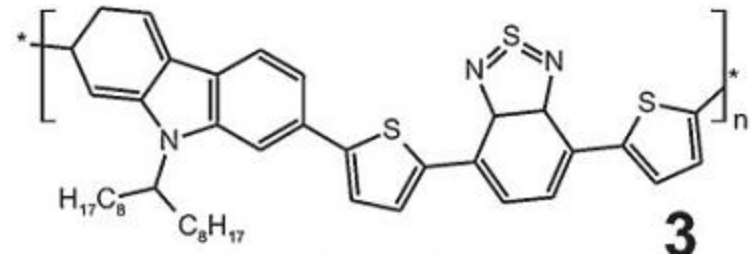


Promising Donor Materials

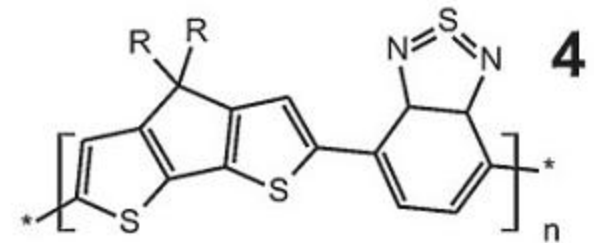
- Fluorene-based copolymers



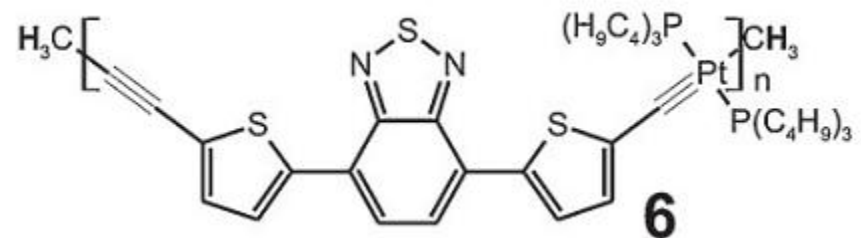
- Carbazolene-based copolymers



- Cyclopentadithiophene-based copolymers: PCPDTBT

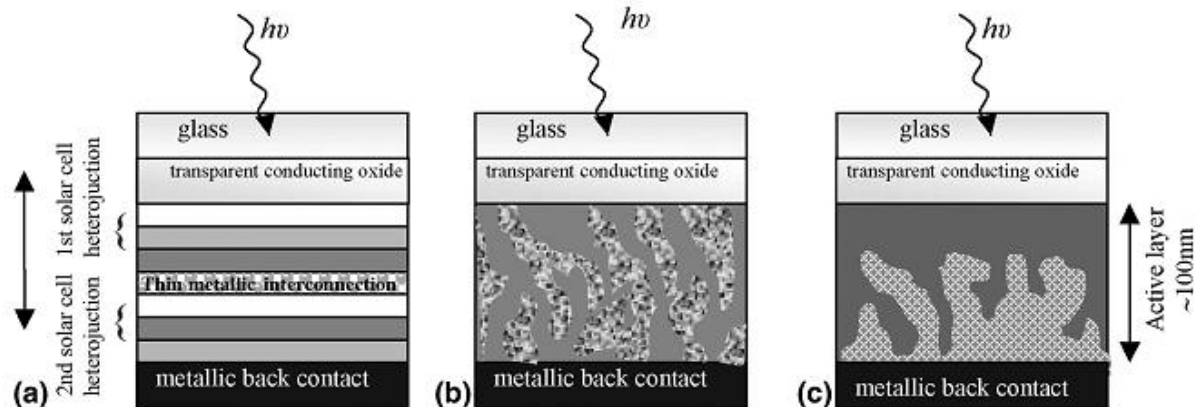


- Metallated conjugated polymers



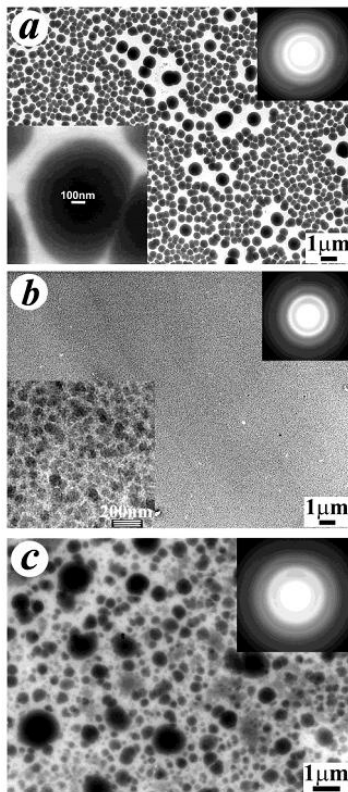
Bulk Heterojunction

- Increase donor/acceptor interface area
- Goal is to make sure excitons form within 1 diffusion length from interface (10-100 nm)
- Types
 - Double-stacked
 - Blended
 - Large surface area

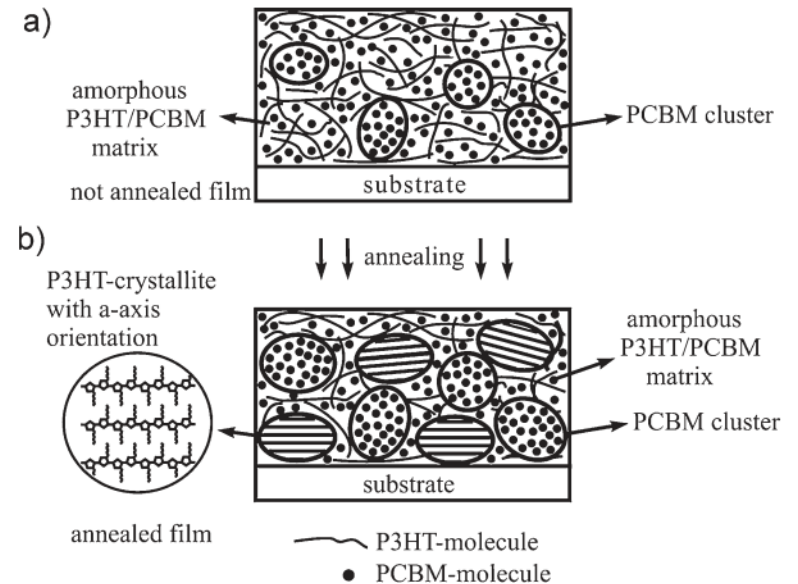


Processing

- Chlorobenzene instead of toluene results in smaller feature size and improved charge carrier transport
- Spin coating instead of drop casting



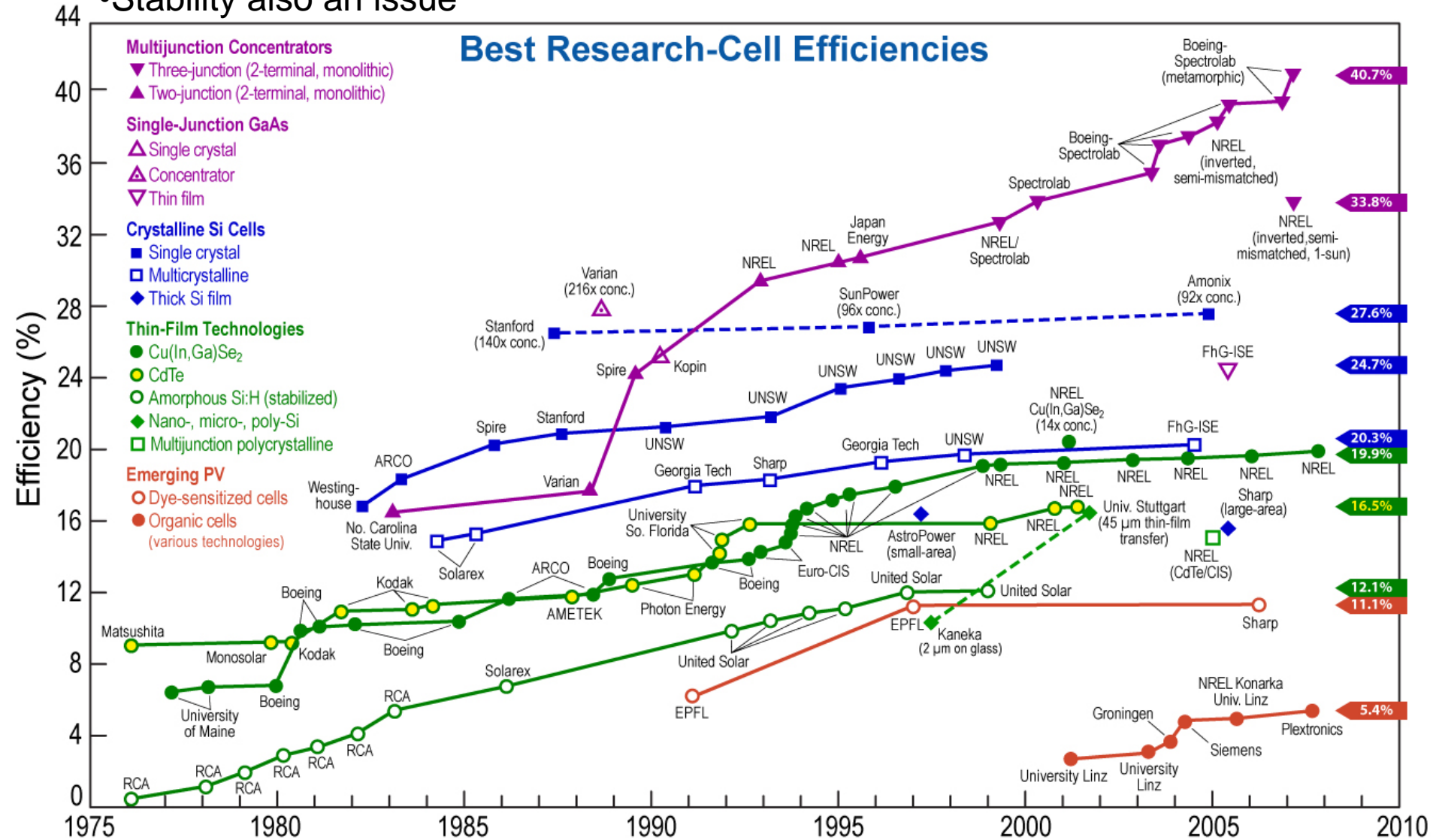
- Annealing improves morphology and charge carrier transport



Efficiency

- Currently at 5-6%
- Goal to get to 10%
- Stability also an issue

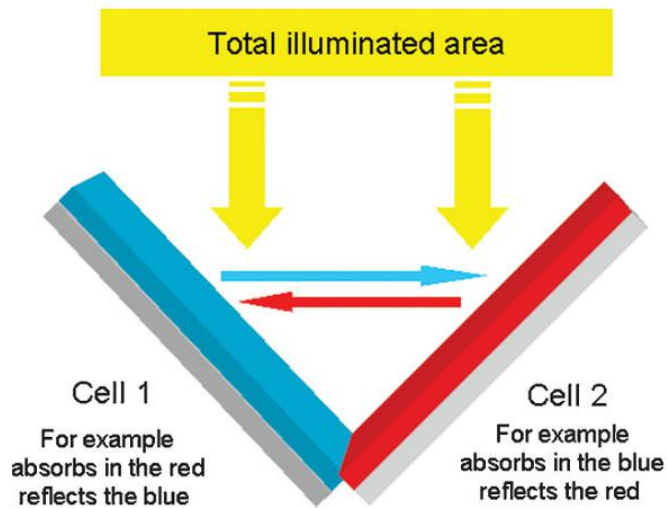
Best Research-Cell Efficiencies



Other Ideas

Tandem Cells

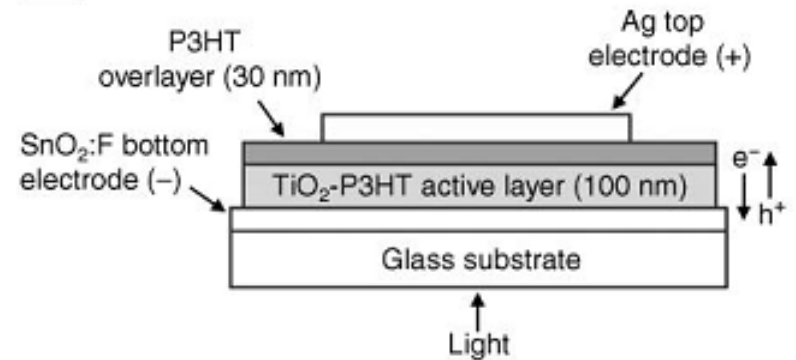
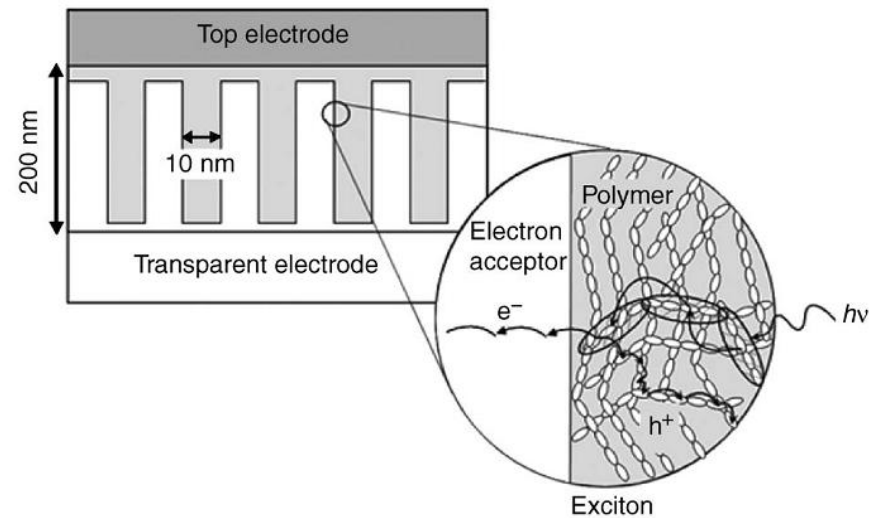
- Increase amount of light absorbed



Dennler et al.

Hybrid Organic-Inorganic Systems

- ordered bulk heterojunction results in straight pathways to electrodes



Coakley et al.

References

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