

Catalyzing Innovation in PV Manufacturing



An NSF Workshop

May 6-7th, 2010

Golden, CO



Highlights and Summary of Facilitated Discussion

Session II – OPV/DSC Manufacturing

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Dr. Sean Shaheen, University of Denver

[Research and Development Issues for Organic Photovoltaics](#)

Current Status & Recent Advances

- OPV Prototypes on the Market
- Improved standardization in measurements
- Nanoscale resolution of donor–acceptor structure (3D tomography)
- Advanced Electrical Characterization: Transient photovoltage/conductivity, Impedance spectroscopy

Strategies to Reach Near-term Efficiency (11%): Note each of the below has been achieved individually

- Fabrication of low band gap absorbers to improve J_{sc}
- Need improved band gap alignment to improve V_{oc}
- Reduce series resistance to improve fill factor

Pathways to Higher Efficiency (15%)

- Most likely require tandem, simultaneous optimization of components
- $>10^{13}$ materials combinations: Need for combinatorial experimentation
- Great Computational Opportunities: Both in materials design and device modeling

Dr. Darin Laird, Plextronics

[Printed Organic Solar Cells: Pathway and Challenges to Competitive LCOE](#)

Keys to Reducing LCOE

- Low cost materials, which dominate cost at high volume
- High throughput, simple R2R compatible processing (inverted structures)
- Improvements needed in efficiency: low band gap, improved hole transport

Goal: < \$0.50/W

- Need > 10%, translate lab records into module performance
- Need >10 year lifetimes: Improved contacts, reduced sensitivity to O_2/H_2O , mitigate photochemical degradation process
- Low cost materials: Scale to multi-kg production, High throughput production techniques

Current Status & Recent Advances

- Record Cell 11.1%, Module 8.5%
- Advantages: Low costs, R2R, lightweight, semi-transparent, colored. Candidate for BIPV
- Efficiency values essentially unchanged for ~ 15 years

Challenges and Opportunities

- Increase current: Need better dyes for absorption in red, near IR
- Voltage: Iodine over potential ~550 mV, ideal would be 200 mV, however only Iodine has slow recombination kinetics
- Combination of above could take efficiency to 17%
- Stability: liquid electrolyte concern, dye must withstand 10^8 turnover for 20 years, Iodine corrosive
- Needs: New sensitizers, new redox couples, new electrolyte
- Need for simultaneous optimization of the above

Session II: OPV/DSSC – Panel Discussion

Comment #1: What will be the role of OPV/DSC in the overall PV market? The optimistic case for champion cells is only ~15%. Satisfactory stability remains an open question (particularly without glass). Module efficiency will be less. Can these technologies ever compete with Si/CdTe for primary power generation? Answer probably no if glass is required as an encapsulating layer. Roll may be limited to passive power, indoor applications?

Comment #2: On the positive side: The success of OLEDs for lighting applications provides confidence to go forward. Sustainability will require renewables in all sectors. Consumer goods, portable products may be very significant markets not easily served by crystalline products.

