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# 2008 Solar Annual Review Meeting

**Session: Seed Fund**

**Organization: NREL**

**Funding Opportunity: National Laboratory**

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# Budget and Solar America Initiative Alignment



<i><b>NREL</b></i>			
<b>Project Beginning Date</b>	<b>FY07 Budget</b>	<b>FY08 Budget</b>	<b>Total Budget</b>
not defined	\$0.65 millions	\$1.87 millions	\$2.52 millions

- This project supports the Solar America Initiative by:
  - Exploring new ideas that have the potential to make a real difference
  - Portfolio of ideas including some that bring a new twist to a proven approach and some that are entirely new



- NREL projects
  - Multiple-exciton generation (Ellingson, \$300k)
  - Carbon nanotubes (Blackburn, \$300k)
  - Junction OPV cells (Gregg, \$300k)
  - Multifunctional barriers (Simpson, \$150k)
  - Amorphous metal oxide solar cells (Perkins, \$221k)
  - 3rd generation mechanisms for OPV (Ginley, \$200k)
  - Quantum confinement in film silicon (Stradins, \$300k)
- Sandia (joint with NREL) projects will be presented by Jeff Nelson

# Junction OPV cells from doped polymeric molecular semiconductors



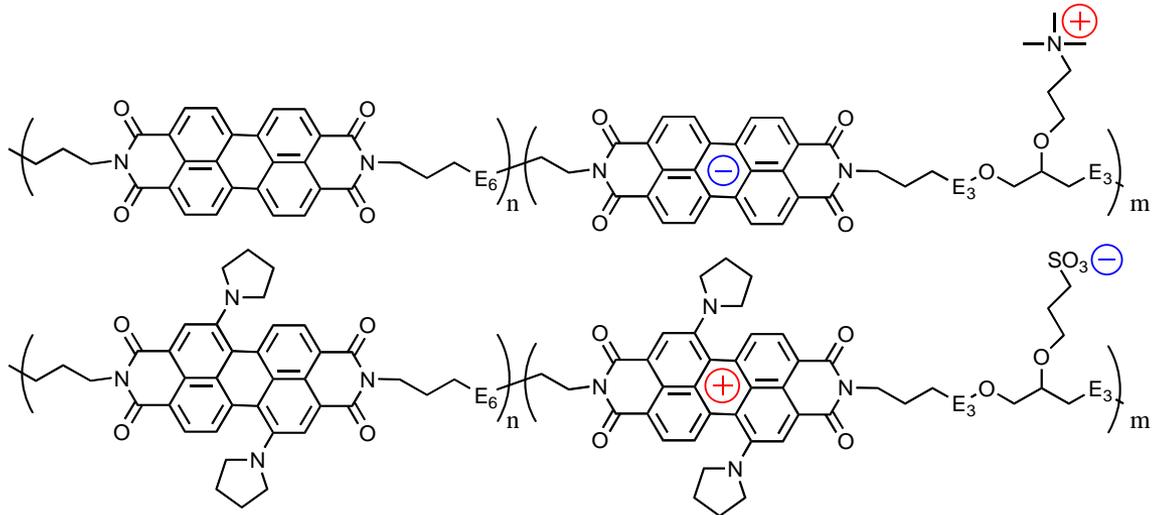
Gregg

## Advantages

- Based on type of materials used for automobile paints
- Stable OPV

## Goals for 1st year

- Synthesis of gram quantities
- First functional device



**Perylene diimides (small oxidized graphene particles) are some of the chemically toughest, most light-stable pigments known**

**This idea combines the best properties of polymer and small molecule OPV along with a patented doping process.**

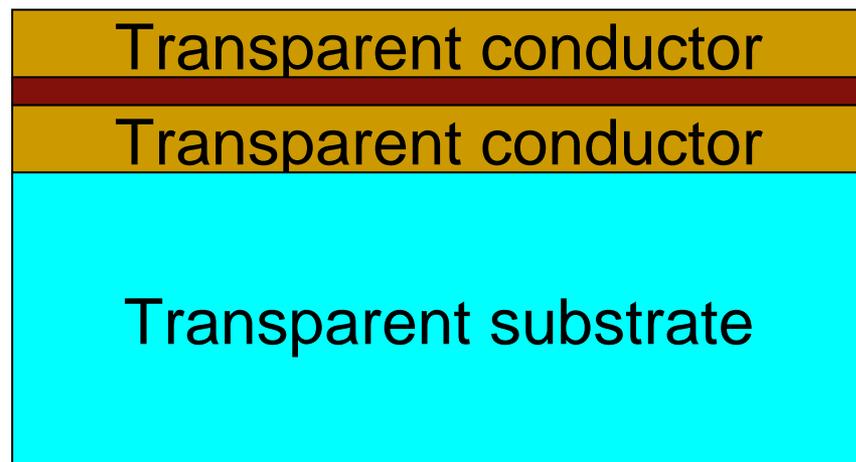
# Multifunctional transparent conducting and self-healing impermeable barriers



Simpson

## Advantages

- Lower cost than ITO
- High conductance
- High transparency
- Barrier
- Low temperature process



## Goals for 1st year

- Multilayer films with:
  - 80% transmission,
  - <10 ohm/sq,
  - <10<sup>-2</sup> g/m<sup>2</sup>/day O<sub>2</sub>/H<sub>2</sub>O impermeability

Novel coating will be sandwiched between ZnO or other transparent, conducting layers



# Amorphous oxide semiconductors for ambient-temperature-deposited photovoltaics

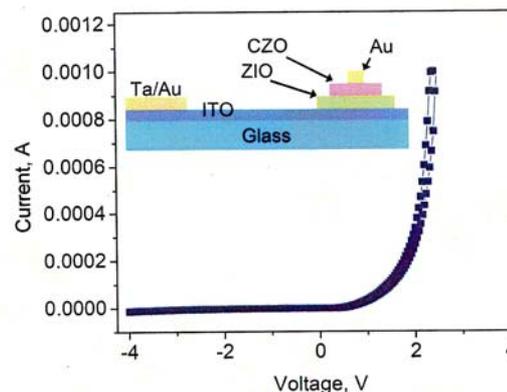
Perkins

## Advantages

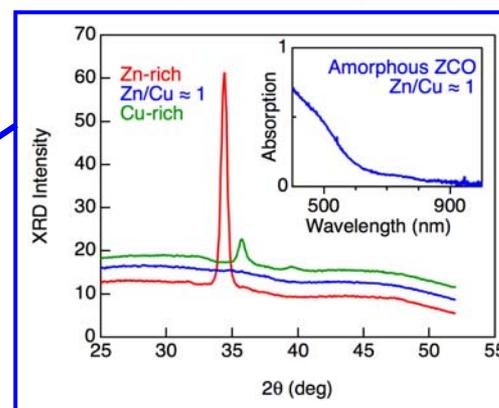
- Low-cost metal-oxide solar cell
- Deposition at low (ambient) temperature

## Goals for 1st year

- Zn-Cu-O material libraries
- Demonstrate amorphous metal oxide p-n diode with photo-active response



ZnCuO - InZnO  
p-n junction  
@ HP (2006).



Sputtered  
amorphous  
ZnCuO  
@ NREL

To Date: Successful identification of amorphous region through combinatorial study

# Exploration of 3rd generation mechanisms for OPV devices

Ginley

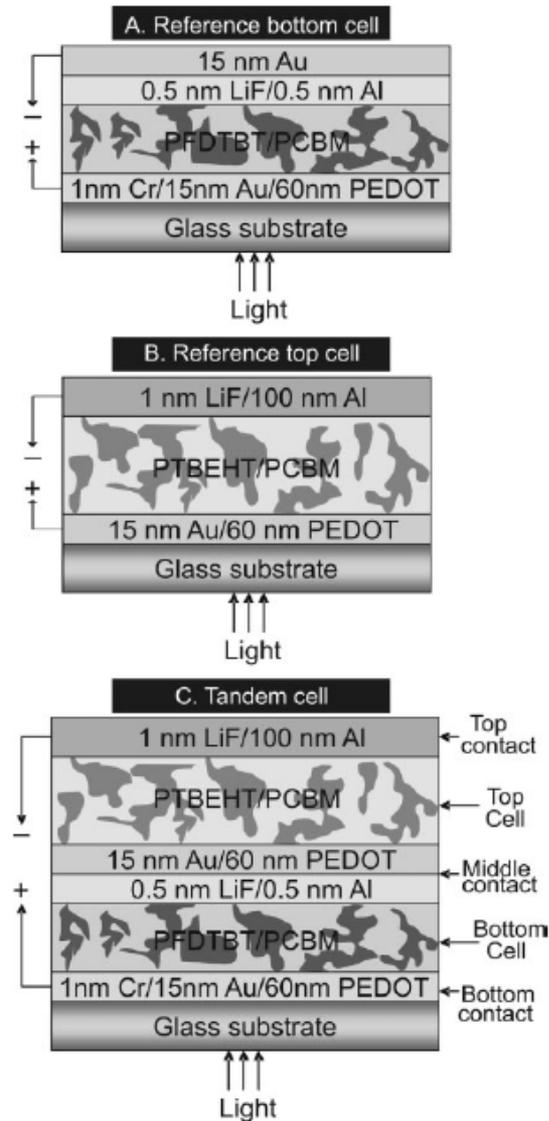
## Advantages

- Higher OPV efficiency

## Goals for 1st year

- Demonstrate a single-junction QD/polymer device
- Publication

QDs can tune absorption to provide pathway to higher efficiency multijunction OPV



# Application of quantum confinement in film silicon Stradins



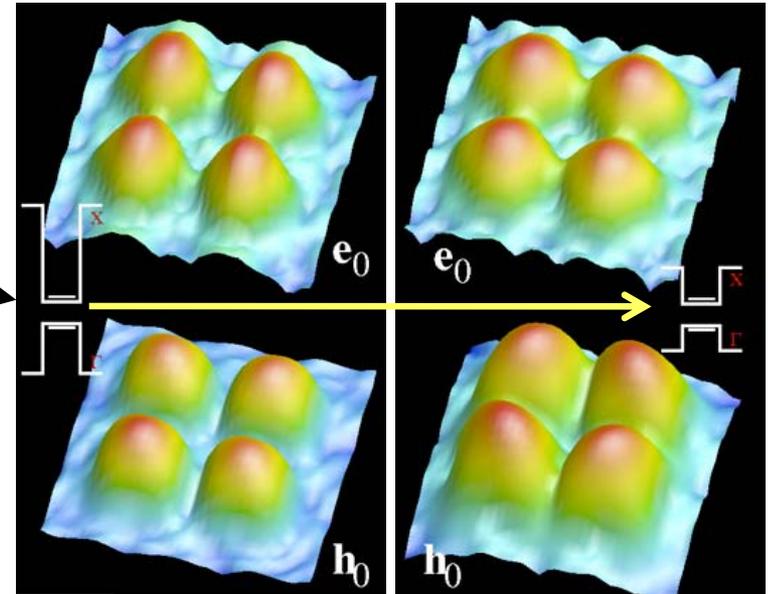
## Advantages

- Higher Si cell efficiency (use QDs to create a multijunction cell)

## Goals for 1st year

- Create simulations package to calculate the properties of Si QD in matrix
- Select most promising growth method of QD structures

Dot/matrix band offset decreases:  
**Stronger communication between QDs**



Wavefunctions provide tools to address key issues: transport and absorption

# Project Update



Work plan	Date
Funding announced	Jan-08
Reviews	Quarterly
Solicit and select new projects; Proposals for year 2 of current projects	April-June 08
Peer Review (Year 2 funding decisions will be based on external peer review inputs)	Jan-09

# Obstacle Discussion



- Barriers encountered or anticipated that may inhibit success of programs
  - Continuing resolution and need to hire post docs delayed start of all of the projects, so the one-year milestones are scheduled for December
- Other notes:
  - High-risk projects are included intentionally
  - Collaborations with universities and industry are encouraged but take time to cultivate