2008 Solar Annual Review Meeting

Session: Seed Fund
Organization: NREL
Funding Opportunity: National Laboratory

Sarah Kurtz
National Renewable Energy Laboratory

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Presented at the Solar Energy Technologies Program (SETP) Annual Program Review Meeting held April 22-24, 2008 in Austin, Texas
Budget and Solar America Initiative Alignment

<table>
<thead>
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<th>NREL</th>
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<tr>
<td>Project Beginning Date</td>
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- 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
Individual projects

- **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^{-2} g/m^2/day O_2/H_2O 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

To Date: Successful identification of amorphous region through combinatorial study

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

Sputtered amorphous ZnCuO @ NREL

Zn-rich
Zn/Cu = 1
Cu-rich

XRD Intensity

2θ (deg)

Wavelength (nm)

Absorption
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

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