CRSP Center for Revolutionary Solar Photoconversion

Discovery • Innovation • Development • Third Generation Solar Photon Conversion

Shared Research Program Awards

2008, 2009, 2010

Colorado Renewable Energy Collaboratory
Partners for Clean Energy

Colorado State University

University of Colorado Boulder

MINES

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

CRSP Shared Research Program Thrust Areas

As the word *Revolutionary* in our name suggests, CRSP targets research that is potentially transformative compared to current technologies for solar energy conversion to electricity and fuels. Research projects also contain a credible pathway for achieving significant market penetration by ultimately meeting appropriate cost, efficiency and reliability targets.

Photoconversion into Electricity

1. Inorganic materials and novel device architectures for advanced solar cells

   Thin film Si, new low cost Si substrates, nanocrystalline semiconductors, CdTe, CIGS and CZTS solar cells, new polycrystalline thin films, new transparent conductors, new multijunction and other novel device concepts, plasmonics, high quality films at high deposition rates, novel light-trapping structures, wet processes and printing methods for solar cell fabrication

2. Novel organic/polymeric/hybrid inorganic-organic solar cells

   Molecular semiconductor and polymeric solar cells, nanocrystalline dye-sensitized solar cells

3. Third Generation PV

   Quantum-confined structures for solar cells (quantum dots, quantum films/wells, quantum wires/rods), improved QD size distribution, intermediate-band solar cells, up-and down-conversion of incident photons, thermophotonics, increased cell efficiencies due to MEG and/or hot carrier injection

Photoconversion into Fuels (Solar Fuels)

4. New materials and approaches for efficient solar water splitting

   Bioinspired materials, novel thermal chemical processes (lower temperature; less corrosive chemicals), novel photoelectrochemical processes (coupling light harvesting with efficient catalysts; improved water oxidation component durability), buried junction photoelectric catalysis

5. Photoreduction of CO_2 with water to fuel (artificial photosynthesis)

   New catalysts for CO_2 reduction and water oxidation based on abundant elements, increased catalyst durability, light-harvesting units with catalytic site, biological assemblies; and system integration and analysis.

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CRSP 2008 Shared Research Program Awarded Seed Research Grants ($1.2 million)

Inorganic materials and novel device architectures for advanced solar cells

- Integrated Electrical and Optical Characterization of Silicon Thin Films – NREL and CSM
- Optimizing Cu_2ZnSnS_4-based Photovoltaic Devices for Thin Films – CSU and University of Wyoming
- Nanoscale Engineering of Functional Metal Oxides for Photocatalysts and Photovoltaics – CSM

Novel organic/polymeric/hybrid inorganic-organic solar cells

- Redox-Tunable Polymers for OPV Active Layers – NREL and CSU
- Plasma Processing for Improved Understanding and Control of Film Properties and Interfaces with Organic/Polymeric/Hybrid Solar Cells – CSU

Third Generation PV

- Group IV Nanowire Photovoltaics – CSM
- Group IV Quantum Dots for 3rd-Generation Photovoltaics – NREL and CU
- Probing Critical Interfaces in 2nd- and 3rd-Generation Photovolaics with Nonlinear Optics – NREL and CU
- Spatially Resolved Spectroscopic Studies of Small Ordered Crystals of Semiconductor Nanocrystals – NREL and CSU

Solar Fuels

- InVitro Evolution of RNA-Inorganic Catalysts for the Conversion of CO_2 to Alcohols – CU
- Fundamental Studies of Polyoxometallage-Based Nano-Materials for Photoelectrochemical Water Splitting – NREL and CSM
- Development of an Economical Catalyst for Water Oxidation (solar fuels) – CU.

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CRSP 2009 Shared Research Program Awarded Seed Research Grants ($800,000)

Inorganic materials and novel device architectures for advanced solar cells

- Transparent Back Contacts to Enable Novel Architectures in Advanced CdTe and Cu(In,Ga)Se_2 Solar Cells – CSM and NREL
- Optimizing Cu_2ZnSnS_4-based Photovoltaic Devices: Characterizing Films Made From Nanoparticle Inks for their Application in Inexpensive and Scalable Thin Film Photovoltaics – CSU
- 3D Plasmonic Nanostructures for Novel Electromagnetic Energy Conversion Devices and Systems – CU

Novel organic/polymeric/hybrid inorganic-organic solar cells

- Gas Diffusion Barriers for Thin Film Solar Devices Using Atmospheric Atomic Layer Deposition – CU
- Boron-Based Polymers (new hole conducting polymers for DSSC) – CU

Third Generation PV

- New Materials and Time Resolved Measurements for Optimizing Hole-Transfer Photochemistry – CU and CSU
- Novel Nanoparticle Superlattices for Space-Separated Quantum Cutting – CSM and NREL
- Multiexcitons in Quantum Nanostructures: From Theory to Design – CU

Solar Fuels

- Synthesis of Nanoscale Oxy(nitrides) for Solar Water Splitting – CU
- Electrochemical Synthesis of Catalysts for Photoelectrolysis and Conformal TCO Deposition – CSM

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CRSP 2010 Shared Research Program Awarded Seed Research Grants ($600,000)

Inorganic materials and novel device architectures for advanced solar cells

- Optimized Metal-Insulator-Metal Diodes for Solar Energy Conversion by Rectennas – CSM and NREL
- Non-Toxic, Earth Abundant Photovoltaic Devices: Characterizing Thin Films Made from Nanocrystalline Cu_2ZnSnS_4 and FeS_2 – CSU
- Accelerating reliability transparent conductor development by mechanical property screening – CSM
- Integrated, High Photovoltaic Performance, Nanorod-based, Anti-reflection Coatings – CSM and NREL

Novel organic/polymeric/hybrid inorganic-organic solar cells

- Efficient Organic Photovoltaics: Singlet Fission in Conjugated Organic Molecular Crystals – CU
- Controlling Plastic PV Cell Morphology by Macromolecular Recognition and Self-Assembly – CSU and NREL

Third Generation PV

- The effect of blinking and switching of individual chromophores on the efficiency of quantum dot solar cells – CSU and NREL
- Direct Gap Germanium-Tin Alloy Nanoparticles for Efficient Light Absorption in Third Generation Photovoltaics – CSM

Solar Fuels

- Mesoporous $BiVO_4$ and its modification with W based nanomaterials for efficient solar water splitting – CSM and NREL

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