

Center for Revolutionary Solar Photoconversion



CRSP is a research center of the Colorado Renewable Energy Collaboratory. The Collaboratory is a unique research partnership between the National Renewable Energy Laboratory (NREL) and Colorado's premier research universities—the University of Colorado at Boulder (CU), Colorado State University (CSU), and Colorado School of Mines (CSM).

CRSP Founding Members:

Applied Materials
Ascent Solar Technologies
DuPont
Evident Technologies
Konarka
Lockheed Martin
Motech Industries
Sharp

CRSP New Members:

Abengoa Solar
G24 Innovations
General Motors
Tokyo Electron
Toyota

CRSP is dedicated to the basic and applied research necessary to create revolutionary new solar energy technologies as well as educational and training opportunities. The research underpins renewable energy technologies, commonly called third-generation solar photon conversion, for the highly efficient and cost-competitive production of both electricity and fuels via direct solar processes.

CRSP institutions make available their capabilities for shared and sponsored research projects with CRSP members as well as for federally funded research. CRSP is a joint effort among the four Collaboratory research institutions and other research institutions that may be added in the future. Membership in CRSP allows companies and other organizations to learn about and participate in advances in solar cell science and technology and to guide shared research programs. The areas of research being pursued include:

- Photovoltaics (inorganic and organic)
- Photochemistry
- Photophysics
- Photobiology
- Photoelectrochemistry
- Nanoscience

CRSP research is divided among three programs:

- *Shared Research.* CRSP members help select precompetitive shared research projects and receive nonexclusive licenses to the resulting technologies. Shared research projects are supported by a pool of funds created from membership fees, funding from the Colorado Renewable Energy Authority, and potentially other sources.
- *Sponsored Research.* Any member may contract with one or more of the CRSP institutions for an independently funded sponsored research project that focuses on specific areas of interest, including results of shared research projects. In addition, exclusive licensing is available.
- *Federally Funded Research.* The CRSP institutions may receive funding from the U.S. Department of Energy (DOE) to conduct basic research on novel approaches to solar photon conversion. For example, CRSP is part of a 5-year federal research grant under a DOE Office of Science-awarded Energy Frontier Research Center.



CRSP is a research center of the

Colorado Renewable Energy Collaboratory

Partners for Clean Energy

The ultimate and ambitious long-term goal of CRSP is to produce electricity and liquid and gaseous fuels at costs competitive with energy produced from coal. CRSP researchers see these technologies grouped into various categories including:

- **Electricity Production (Photovoltaics):** Photoconversion processes yield electricity, as in solid-state photovoltaic solar cells based on bulk semiconductor p-n junctions, but also include technologies based on the absorption of solar photons in molecular or polymeric chromophores, or in semiconductors in contact with electrochemical redox systems.
- **Photoconversion into Liquid and Gaseous Fuels:** This is a one-step direct process in which the fuel (for example hydrogen, hydrocarbons, or alcohols) is the initial product of a direct photoelectrochemical, photochemical, or photobiological process driven by solar photons.
- **Novel Nanostructures and Advances in Nanoscience:** These technologies play a major role in the science of third-generation solar photon conversion.

Advances in basic and applied science at CRSP will be readily and efficiently transferred into marketable solar technologies. This will occur through NREL's strong renewable energy relationships with industry and the three research universities' commitments and strong track records in technology transfer.

CRSP is uniquely positioned to support the research that will revolutionize solar energy technologies. NREL houses both the applied and near-term solar R&D programs supported by the DOE Office of Energy Efficiency and Renewable Energy and longer-term basic solar research programs supported by the DOE Office of Science. The three Colorado research universities offer internationally recognized faculties and world-class research facilities.

The scientific skills and market understanding of CRSP's private-sector partners will combine with the resources of the four Collaboratory institutions to focus CRSP's research efforts in areas that will truly impact global solar energy utilization.

CRSP Shared Research Thrust Areas for 2010:

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 and CIGS solar cells, new polycrystalline thin films, new transparent conductors, new multijunction and other novel device concepts, high-quality films at high deposition rates, novel light-trapping structures, wet processes and printing methods for solar cell fabrication.

2. Novel organic and hybrid inorganic-organic solar cells

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

3. Third-Generation Photovoltaics

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 multiple-exciton generation and/or hot carrier injection.

Photoconversion into Fuels

4. New materials and approaches for efficient solar water splitting for hydrogen production

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 CO₂ with water to fuel (artificial photosynthesis)

New catalysts for CO₂ reduction and water oxidation based on abundant elements, increased catalyst durability, light-harvesting units with catalytic site and biological assemblies; system integration and analysis.

The operations of CRSP are administered by its Executive Board and Advisory Panel. At present, the CRSP Executive Board includes:

Scientific Director: Dr. Craig Taylor at CSM.

Co-Directors: John Benner at NREL, Dr. David Jonas at CU, Dr. Mike Elliott at CSU, and Dr. Colin Wolden at CSM.

Managing Director: John Benner at NREL.

The CRSP Advisory Panel is composed of one representative from each of the member companies. Among other roles and duties, CRSP member companies play a key role in identifying shared research thrust areas and selecting projects for funding. Founding members are those companies that joined CRSP by March 31, 2008. Additional companies and other organizations now have the opportunity to join CRSP.

Dr. Thomas J. Meyer, Arey Professor of Chemistry at the University of North Carolina at Chapel Hill, chairs the CRSP Scientific Advisory Board. The board, which comprises scientists external to CRSP, is responsible for evaluating and monitoring the quality of the science performed by CRSP researchers.

For more information about CRSP or to learn about CRSP membership, visit this Web site:

www.ColoradoCollaboratory.org/crsp

Revised April 2010