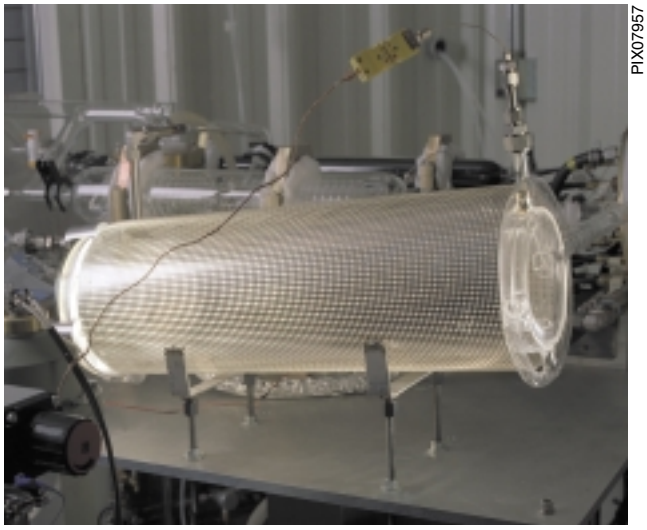

PIX06975

Solar furnace primary concentrator


PIX06635

Accelerated UV concentrator


PIX07957

Experimental high-temperature reactor for on-sun testing

NREL's Concentrated Solar Radiation User Facility

Harnessing the power of the sun today for tomorrow's industrial processes

Researchers at the Concentrated Solar Radiation (CSR) User Facility at the National Renewable Energy Laboratory (NREL) in Golden, Colorado, are discovering new ways to reduce manufacturing costs, increase product quality, and reduce pollution for cleaner, greener industries.

Declared a national user facility in 1993, the CSR User Facility allows industry, government, and university researchers to examine the effects and applications of as much as 50,000 suns of concentrated solar radiation using a High-Flux Solar Furnace and long-term exposure using an ultraviolet (UV) concentrator. Solar furnaces can provide a clean, less expensive alternative power source to the high-cost laser and fossil-fuel furnaces currently used for many of the manufacturing processes in the automotive, aerospace, defense, and electronics industries. In addition, a solar furnace can be used for the destruction of toxic wastes. By using the sun to power its manufacturing processes, industry can reduce both its costs and its environmental impacts.

The CSR User Facility also provides a test area for researchers to conduct experiments with the solar furnace or UV concentrator and collect and analyze the data from those tests. The facility is equipped with computers and data acquisition tools, video monitors for the outside equipment and experiments, sophisticated instruments to monitor solar radiation and other atmospheric data, and automated devices that enable researchers to control the heliostat, primary concentrator, focal point, and the power of the concentrated sunlight.

Private and public partners that have taken advantage of the User Facility's state-of-the-art equipment include Brush Wellman, Clever Fellows Innovation Consortium (CFIC), Colorado School of Mines, Dow Chemical Company, DuPont, EDTEK, Materials and Electrochemical Research (MER) Corporation, Northrop-Grumman, Spectral Engineering Inc., Texas Instruments, and the University of Colorado, among many others. Research conducted at the facility includes:

- Developing a new method to bond metal onto ceramics
- Defining the optimum operating parameters to form spherical silicon crystals
- Developing fullerenes and nanotubes, a stable form of carbon discovered in the 1980s that may have exciting new commercial applications in semiconductors, superconductors, high-performance metals, and medical technologies
- Analyzing the response of optical materials to intense pulses of light
- Producing hydrogen by thermal and thermochemical decomposition of water
- Investigating the potential of solar-pumped lasers
- Analyzing the effects of long-term UV exposure on materials
- Detoxifying hazardous wastes.

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PIX00891

A heliostat tracks the sun and reflects the light to the primary concentrator for the solar furnace at the CSR User Facility.

High-Flux Solar Furnace

The CSR User Facility's 10-kilowatt High-Flux Solar Furnace has been a focal point for research conducted at the facility since 1990. Since then, a wide range of materials processes and production projects have explored the use of highly concentrated sunlight as an alternative energy source for new and existing industrial applications. These applications include:

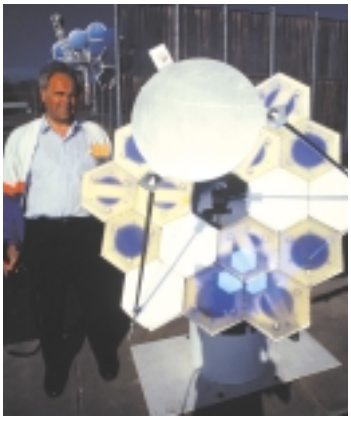
- Surface hardening (phase-transformation hardening)
- Metal cladding
- Ceramics
- Intermetallics
- Cermet coatings on steel
- Solar-induced metalorganic deposition
- Deposition of ceramic superconductor coatings
- Deposition of diamond-like carbon coatings
- Synthesis of fullerenes and nanotubes
- Initiation of combustion synthesis to make ceramics (SiC, TiB_2, TiC)
- Rapid thermal expansion of minerals for industrial applications
- Rapid processing of crystalline silicon (Si) solar cells

PIX00829

The facility control room at the CSR User Facility contains state-of-the-art equipment used by researchers to collect and analyze data produced by experiments.

- Texturing and purification of metallurgical-grade Si
- Crystallization of amorphous Si to make microcrystalline Si
- High-temperature detoxification of hazardous wastes
- Testing the thermal and optical responses of materials exposed to rapid pulses
- Development of measurement technology suited for a high-flux, high-temperature environment.

The high flux and high temperatures that can be achieved with concentrated sunlight provide a unique alternative to the typical fossil-fuel-fired processes of today. To produce this clean power alternative, the solar furnace uses a 32-m^2 mirrored heliostat to track the sun and reflect the light onto a primary collector composed of 25 curved facets. The primary concentrator focuses the light to a 10 cm-diameter circle inside the experiment bay. Under optimal conditions, the focused beam is 2500 times the intensity of normal sunlight. If a reflective secondary concentrator is placed at the beam's focus, the solar flux intensity increases to as much as 20,000 suns. A refractive concentrator can achieve 50,000 suns.



PIX06631

NREL's UV concentrator, designed in cooperation with Russian researchers, can produce 10 years of exposure in just 2 months.

Ultraviolet Concentrator

NREL's UV concentrator was designed to provide a uniform flux distribution for ultra-accelerated weathering applications. The concentrator was developed in 1998 under a cooperative agreement with Astrophysica, an optics design and fabrication company located in Moscow, Russia, through an Initiative for Proliferation Prevention. The concentrator achieves a more uniform flux distribution by reflecting only the UV rays, or most damaging portion of the solar radiation spectrum, to simulate 10 years of damage in just 2 months. Research conducted at the facility demonstrates that the concentrator can help industry develop higher-quality, longer-lasting materials.

Conducting Research at the Facility

The CSR User Facility can accommodate a wide variety of researchers and their experiments. Public and private companies interested in conducting research at the facility can do so through a variety of arrangements, including cost-shared demonstrations, joint research projects, solicitations, Work-For-Others agreements, Analytical Services Agreements, and Cooperative Research and Development Agreements. For more information about the CSR User Facility, contact:

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