DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

DLR's mission comprises the exploration of Earth and the Solar System and research for protecting the environment. This includes the development of environment-friendly technologies for energy supply and future mobility, as well as for communications and security. DLR's research portfolio ranges from fundamental research to the development of products for tomorrow. In this way, DLR contributes the scientific and technical expertise that it has acquired to the enhancement of Germany as a location for industry and technology. DLR operates major research facilities for its own projects and as a service for clients and partners. It also fosters the development of the next generation of researchers, provides expert advisory services to government and is a driving force in the regions where its facilities are located.

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Institute of Solar Research
Directors: Prof. Dr.-Ing. Robert Pitz-Paal
Prof. Dr.-Ing. Bernhard Hoffschmidt

Linder Höhe
51147 Köln

Contact:
Dr.-Ing. Hans-Gerd Dibowski
Telefon: +49 2203 601-3211
E-Mail: gerd.dibowski@dlr.de

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Institute of Solar Research

High-flux Solar Furnace **SOF**

Xenon High-flux Solar Simulator **HFSS**

DLR

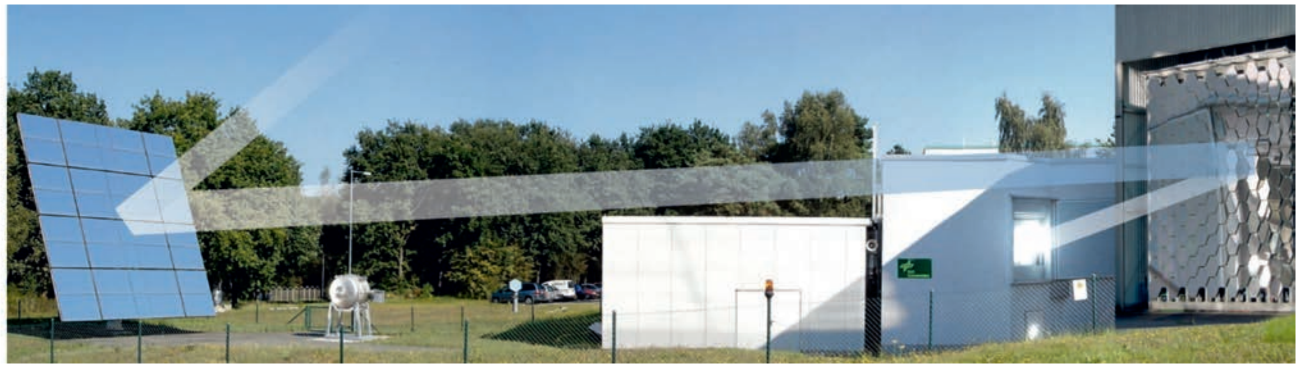

Image: DLR

Beam path of the High-flux solar furnace (fotomontage)

At the DLR Institute of Solar Research, a high-flux solar furnace (SOF) and a xenon high-flux solar simulator (HFSS) are used to generate highly concentrated sunlight and artificial light for the investigation and testing of new technologies and materials.

At irradiances of up to 5 MW/m² and temperatures exceeding 2000 °C, experiments may be run that range from producing hydrogen and testing receiver components for solar-thermal power plants to irradiation tests of materials designed for use in space.

Fields of Application

The high-flux solar furnace and the high-flux solar simulator provide researchers and users from science and industry with a wide range of opportunities to run experiments involving highly concentrated sunlight. Of primary importance are experiments for the fields solar process technology and solar power plant technology.

Experiments in the SOF demonstrated, that concentrated sunlight may be used to produce hydrogen. Moreover, scientists here examine the thermal shock resistance of ceramic receiver elements for solar tower power plants.

Space research is yet another field of application, in which the solar simulator is used to test the suitability of materials for use in space.

The material is exposed to highly concentrated solar radiation under high-vacuum conditions resembling those prevailing in space. Certification-level tests of materials and components complete the range of applications of the DLR solar furnace.

The setup and parameters of an experiment are developed depending on the nature of the problem in close consultation with the customer. Similarly, irradiation durations and frequencies are guided by the customer's individual requirements.

The facility is equipped to meet all requirements for running experiments ranging from short-time tests to irradiations lasting several months under stable conditions.

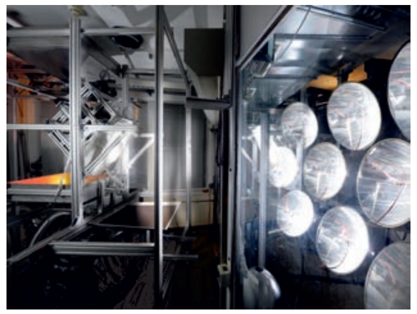

Image: DLR

Xenon high-flux solar simulator (HFSS)

Design and operation mode of the solar furnace:

A plane mirror (heliostat) reflects impinging solar radiation on to a concentrator. Arranged in a honeycomb pattern, these mirrors bundle radiation in a focal zone within the experimental setup inside the laboratory building.

By regulating the intensity of the incoming concentrated radiation, a shutter permits controlling the temperature and/or power as the sun moves on.

The figure shows the beam path. The positions of the concentrator and the laboratory window have been changed in the drawing so that the beam path might be shown more clearly.

Design and operation mode of the xenon high-flux solar simulator:

Featuring short-arc xenon lamps mounted in elliptical reflectors, the high-flux solar simulator is mainly used in winter and in long-term experiments.

It generates highly concentrated light which, having an irradiance of around 4.0 MW/m² closely resembles natural sunlight. The radiation emitted impinges on a target area at a distance of three metres whence it can be channelled on for a variety of experiments.

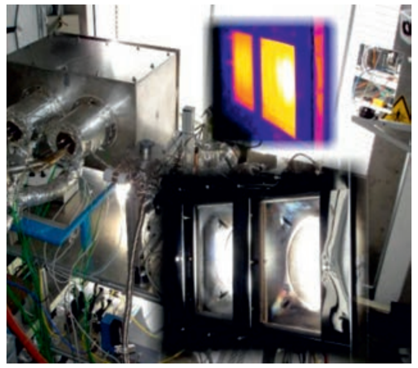

Image: DLR

Solar-powered hydrogen production in a hydrosol reactor with the aid of ceramic honeycombs with a reactive coating

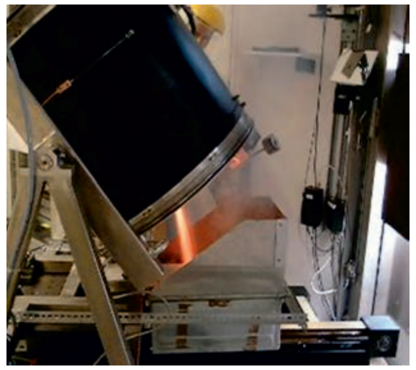

Image: DLR

Aluminium being recycled in a rotating reactor

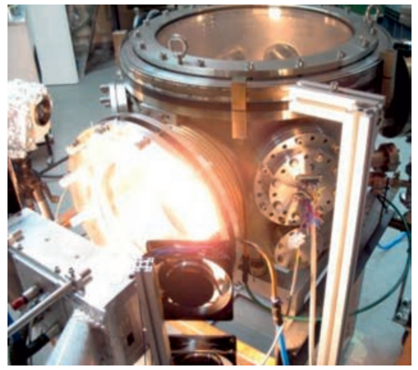

Image: DLR

Radiation being coupled into a vacuum chamber to simulate thermal exposure in space

Facilities

The laboratory building of the solar furnace houses a test room for running experiments, a measuring room for controlling and monitoring experimental operations, a workshop for preparing and supporting work on test setups, and chemical and material laboratories.

Pyrometers and an infrared camera are used for contact-free temperature measurements. Different systems for measuring radiation power and irradiance are used to determine the radiation intensity received and its distribution in a given target area.

If desired, users may employ specially-made equipment in their experiments including, for example, deflecting mirrors, beam shapers, diverse shutter constructions, or various vacuum chambers for tests under space-like conditions.

Conceivable Applications

Solar process technology

- Solar-powered hydrogen production
- Solar-photochemical synthesis of fine chemicals
- Employing highly concentrated solar radiation in recycling light-metal scrap

Solar power-generation technology and materials testing

- Thermal endurance tests of receiver components for solar-thermal power plants
- Tests of components for space applications
- High-temperature smelting

Services for Research and Industry

The team of the DLR solar furnace consists of scientists from physics, mechanical engineering, and process technology. Many years of experience, our eagerness to experiment, our curiosity, and our disposition towards perfectionism form the foundation for constructive collaboration with our customers.

In the run-up to a project, each assignment is checked for its feasibility, and we support customers in developing the requisite experimental setup.

Our customers include European research institutes as well as German and international industrial enterprises.

References

- Tests of ceramic absorbers for solar tower power plants
  Saint-Gobain (Rödental);
  Schunk (Willich-Münchheide)
- Tests of satellite components (ESA):
  Thales Alenia Space (France)
- Hydrogen production
  HyGear, Arnhem, Netherlands;
  Empresarios Agrupados, Madrid, Spain

SAINT-GOBAIN

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