Solar Energy Research

Solare Energetik

direction: Prof. Helmut Tributsch

The department Solare Energetik is working on the development of new materials and material combinations for solar energy generation (production) and (photo)electro-catalysis. Knowledge of molecular mechanisms on interfaces by photovoltaic energy conversion is gained by means of chemical-oriented material research as well as adapted measurement techniques.

With the aid of all that knowledge, photovoltaic and (photo)electrocatalytical interfaces of a new type of material groups can be modified and optimized for their application.

The departments research strategy aims at selecting themes which are not only scientifically superior but also promise technological relevant results (projects/cooperation).

Since we are dealing with the development of energy technologies of the future, the staff of the department SE-5 are, besides their scientifical activities, actively committed to the education of creative young people.

last update: 13.11.2003 , webmaster SE5

Solar Energy Research
Solare Energetik

Themes:

1 Characterization and optimization of materials and heterostructures (in german)

2 (Photo) electrochemical and (photo) electrocatalytical processes (in german)

3 New energy systems (in german)

4 Interface engineering (in german)

Methods and Measurement Techniques

Location

Solar Energy Research
Solare Energetik

work fields

The scientific activities of the department Solare Energetik are consist of 4 interdisciplinary work fields

Laboratory

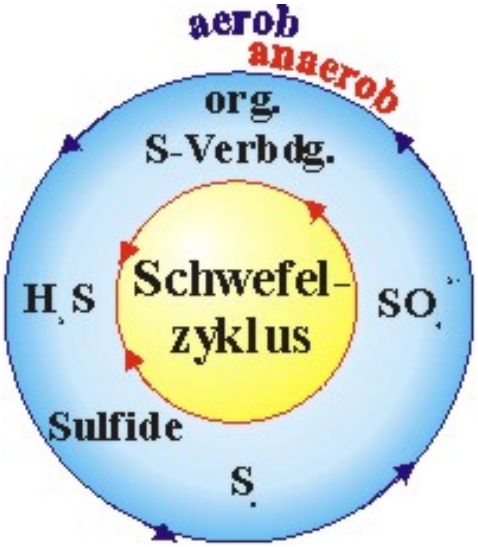
Characterization and optimization of materials and heterostructures

This work field aims at the development of new materials and interfaces for the solar energy conversion. Especially the materials WS_2 and MoS_2 are investigated for their possible use in solar cells. Intelligent characterization techniques (amongst others: space resolved measurements of photocurrents and microwave conductivity) are used for expedition of experimental science.

Laboratory

(Photo)electrochemical and (photo) electrocatalytical processes

The center of attention is the development of new electrode materials and structures for energy conversion in (photo) electrochemical cells. Main focus are transition metal chalcogenide compounds (amongst others: RuS_2, Ru_xSe_y) which are used as electro-catalysts for the oxygen reduction (cathodes for fuel cells) and the (photo)electrooxidation of water (preparation of hydrogen) as well as the photooxidation of organic pollution.



Sulfur-energy-cycle

New energy systems

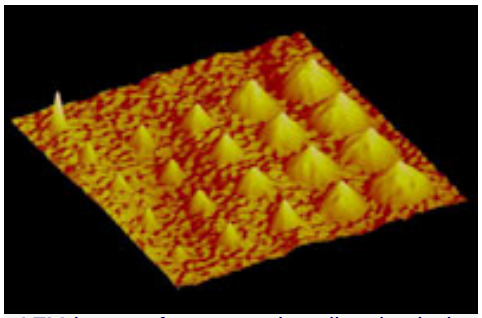
New types of mechanisms for the conversion of light into chemical and electrical energy are investigated. The following explorative research plans are in work:

a) sulfur-energy-cycle for the CO_2 fixation

b) mobilization of hydromechanical forces in a mesoscopical system

c) bionics of solar energy systems

d) sensibilization solar cell



AFM-image of rastersondenmikroskopisch induced Oxide islands onto Si(1oo) (ρ =1Ω cm)

Interface engineering

Electrochemical surface modification. Analysis and optimization of technically relevant photovoltaic materials in situ and under vacuum conditions also under utilization of synchrotron radiation. Main focus is the electrochemical amelioration of interfaces of $CuInS_2$. Silicon is investigated as model system.

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Solarenergieforschung
Solare Energetik

Arbeitsgebiete:

- Charakterisierung und Optimierung von Materialien und Heterostrukturen
  - Herstellung von Einkristallen u. dünnen Schichten
  - Züchtung von Einkristallen
  - Ladungsträger-Kinetik
  - Analyse-Techniken:
    - SMSC
    - Mikrowellen-Scan.
  - Magnetron-Sputtern
- (Photo) elektrochemische und -katalytische Prozesse
- Neue Energie- Systeme
- Grenzflächen- Engineering

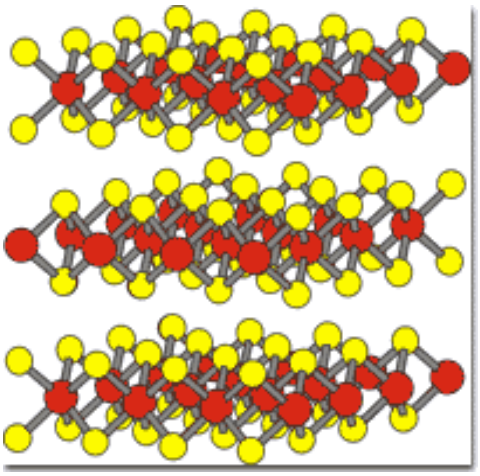
Verfahren und Messtechniken

Standort

Solarenergieforschung — Solare Energetik — SE5

Charakterisierung und Optimierung von neuen Materialien und Hetereostrukturen

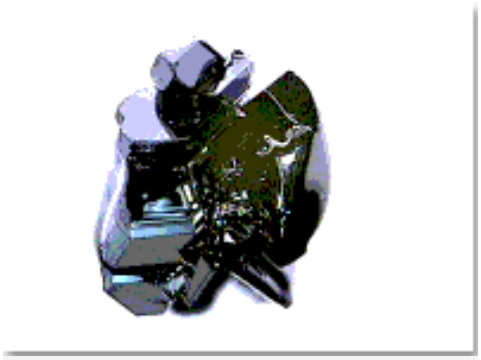
Das Arbeitsgebiet unterteilt sich in folgende fünf Projekte:



Kristallstruktur von WS_2. Die Ebenen der W-Atome (rot) sind von Schwefellagen (gelb) umgeben.

1. Herstellung von WS_2 und MoS_2 Einkristallen sowie dünnen Schichten und deren elektrochemische Modifizierung

Federführend:
Dr. Klaus Ellmer
Dr. Sebastian Fiechter



CdTe-Kristall

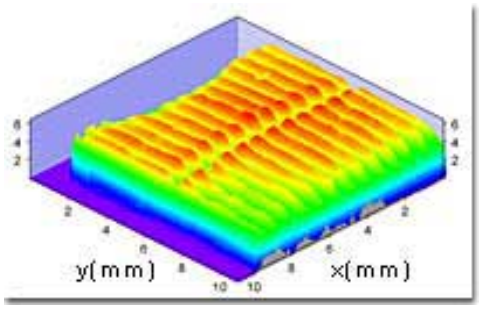
2. Züchtung von Einkristallen für die Photovoltaik und Photokatalyse

Federführend:
Dr. Sebastian Fiechter

Mikrowellenmesstand zur kontaktlosen Messung der Photoleitfähigkeit

3. Ladungsträger-Kinetik in Raumladungszonen

Federführend:
Dr. Marinus Kunst



Photostrommessung an einer Farbstoffzelle nach Belichtung einer Gitter-Maske

4. Bildgebende Analyse-Techniken für die Anwendung in der Photoelektrochemie und Photovoltaik

Federführend:
Prof. Helmut Tributsch

Argon-Magnetron-Plasmaentladung über einem Zinkoxid-Target

5. Reaktives Magnetron-Sputtern von Schichten für Dünnschichtsolarzellen

Federführend:
Dr. Klaus Ellmer

zurück zu "Arbeitsgebiete der Abteilung"

Letzte Änderung: 13.11.2003 , Verantwortlich: Webmaster SE5

Solar Energy Research

Solare Energetik

Themes:

1 Characterization and optimization of materials and heterostructures (in german)

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Methods and Measurement Techniques

Location

Methods and Measurement Techniques

Thin Layer Laboratories:
Dr. K. Ellmer

- Sputtering systems
- Evaporation system
- Seebeck coefficient measurement set-up
- Optical plasma emission monitor
- Energy resolved plasma mass spectrometer
- Rest gas mass spectrometer
- 4-point resistivity probe
- Chemical vapor deposition (CVD)

Material Preparation:
Dr. S. Fiechter

- Annealing furnaces
- Multiple zone furnaces for crystal growth
- X-ray powder diffractometer (XRD)
- Thermocalorimetry and thermogravimetry coupled with mass spectroscopy
- Glove box (Ar-Atm., H2O-free)
- High pressure crystal growth system

(Photo)-Electrochemical Laboratories
Dr. P. Bogdanoff

- Photoelectrochemical set-ups
- Differential electrochemical mass spectrometer
- Impedance spektroscopy
- Polarography
- Rotating ring disc electrode set-up
- FT-infrared spectroscopy
- Sunlight simulator
- Fuel cell test station

(Opto)electronical Characterization:
Dr. M. Kunst

- Absorption spectroscopy for electrochemical cells
- Hall effect measurement set-up
- Harmonic modulated microwave photoconductivity
- Time resolved conductivity of microwave
- Microwave scanner (in german)
- Spectrophotometer

- SMSC (Scanning Microscope for Semiconductor Characterisation) (in german)

Interface-Engineering
Prof. H. J. Lewerenz

- Scanning probe microscopy (AFM, STM)
- Combined electrochemistry / UHV surface analysis system
- Electrochemical characterization (Voltammetry, RDE, Impedance)

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Solar Energy Research
Solare Energetik

Projects / Cooperations:
Cooperations
Industrie firms
Patents
Grants
Establishment of new firms

Projects / Cooperations

The scientific work of the department Solare Energetic is characterized by a number of national and international cooperation. Even though the major scientific aims are long-term ones, the department is careful to integrate its results into as many technological applications as possible. This technological transfer is achieved by joint cooperation with industrial firms (partners) as well as the filing of patents. Some coworkers have taken the opportunity to establish their own new firms to translate their innovative ideas into marketable products.

Cooperations

- FU Berlin (Development of combinatory measurement techniques)
- BAM (Single crystal structure analysis of new catalysts)
- CNRS (Nanostructural silicon)
- FHI (Selforganized structure formation)
- CSIC (Development of imaging measurement procedure)
- North Carolina State University, Raleigh, USA (Chalcopyrite und Silicon)
- Uni. Bath (Electrochemistry and silicon)
- Uni. Cape Town (Bionic structures)
- Universities of Liverpool, England; Padua, Italy; Portsmouth; Rabat, Marokko
- Uni. Osaka, Japan (Photoeffect and structured surfaces)
- Universität Brno, Czech Republic (Water transport in trees)
- Exchange program HMI / TU Berlin and NCSU (Development and optical measurements on semiconductors)
- Technion, Haifa (Israel), (Efficient solar water splitting)

Cooperation with industrial firms

- Daimler Chrysler (Catalysts for fuel cells)
- INAP Gelsenkirchen (Stability of sensibilization solar cells)
- Appl. Films (Sputtering techniques for thin layers)
- Rhône-Poulenc (Characterization of TiO_2, terminated for the time being)
- Salzgitter-Stahl-AG (Biocorrosion of steal, terminated for the time being)
- BIONIC-SYSTEMS management: Dr. Küppers
  Alternative packaging techniques

Grants

- BMBF-project (Pt-free catalysts for the oxygen reduction)
- Scanning-tunneling microscopical nanostructuring of silicon

Establishment of new firms

- AMECON management: Dr. Sroka Imaging microwave techniques
- HELIOCENTRIS management: Dr. Bronold, Dr. Collel
  Fuel cell systems
- SOLARC management: Dr. Lang
  Solar operated small equipment

Additional information is available at the page of the technology transfer:
Projects of the Solar Energetic

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Solar Energy Research
Solare Energetik

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Year 2002
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Year 1998
Year 1997

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