SOLAR ENERGY RESEARCH AT HELMHOLTZ-ZENTRUM BERLIN

The main goal is the development of future generations of cost-effective thin-film solar cells and of systems to produce fuels such as hydrogen by direct photoelectrochemical conversion of solar radiation into chemical energy. To reach this objective, research is focused on achieving high efficiencies and substantial reductions in the costs of solar power generation. Translating the fundamental research results at HZB into industrial applications is the purview of PVcomB. PVcomB‘s main goal is to support worldwide growth of thin-film photovoltaic technologies and products by providing top level technology transfer.

Three Key-Missions

- Keeping the balance between improving existing thin-film technologies to a stage where industrial applications can follow as the next step while also exploring new materials and new concepts for future devices for solar cells.
- Basing scientific and technological progress upon both empirical work and basic research, taking into account fundamental aspects which are becoming increasingly important for the design of innovative nano-technological materials and devices.
- Applying outstanding analytical tools for investigating materials, cells and modules. The combination of two large-scale facilities – the Berlin Synchrotron Radiation Source (BESSY II) and the Berlin Neutron Research Reactor (BER II) - make the Helmholtz-Zentrum Berlin für Materialien und Energie (HZB) a unique research partner within the scientific community.

www.helmholtz-berlin.de/forschung/enma

HELMHOLTZ-ZENTRUM BERLIN (HZB)

Besides the particular competence in Solar Energy Research, HZB is one of the few centres world-wide to offer the whole range of instruments for neutron and synchrotron radiation within one laboratory structure. The HZB operates two scientific large scale facilities for investigating the structure and function of matter: the research reactor BER II for experiments with neutrons and the synchrotron radiation source BESSY II, producing an ultrabright photon beam ranging from Terahertz to hard X-rays.

HZB Quick Facts

- Approximately 1,100 staff (800 at Wannsee and 300 at Adlershof)
- Total budget of about 110 million Euros
- About 100 doctoral candidates from neighbouring universities
- HZB cooperates with more than 400 partners at German and international universities, research institutions and in companies.

Contact Advanced Thin-Film Devices

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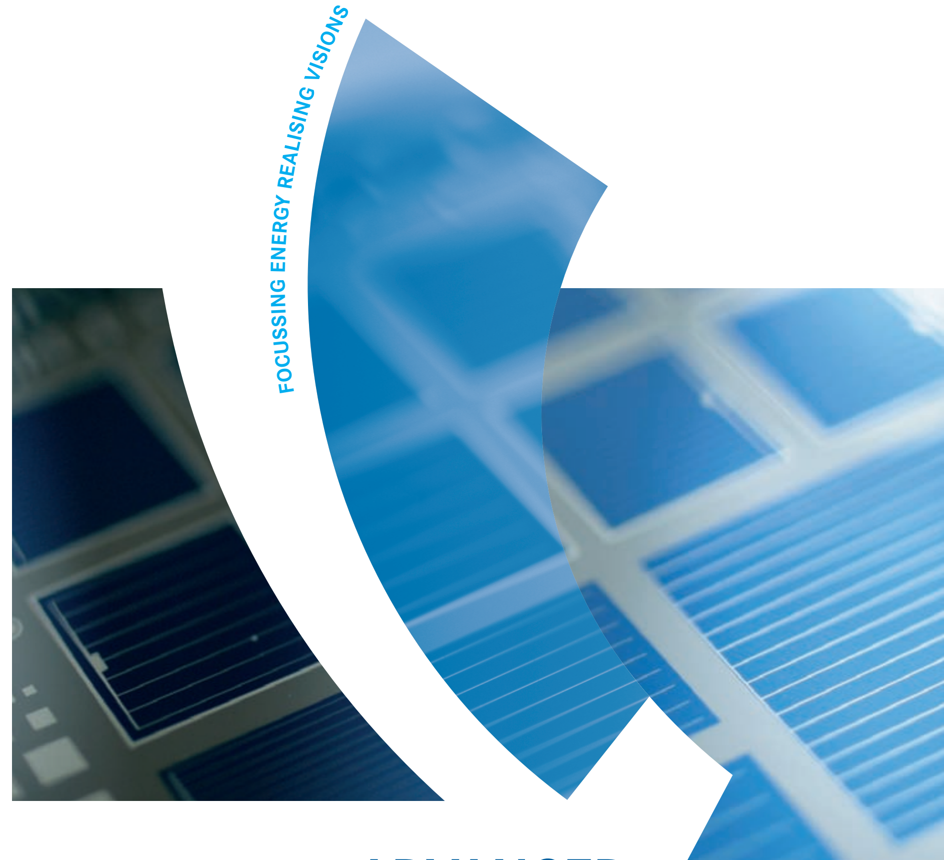
HZB Helmholtz Zentrum Berlin



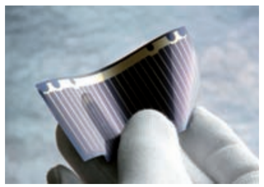
ADVANCED THIN-FILM DEVICES

Solar Energy Research

ADVANCED THIN-FILM DEVICES

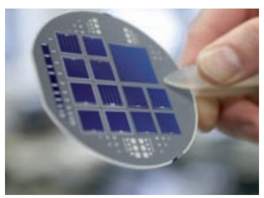
The goal within this research area is to use HZB's unique technological and analytical capabilities to develop new devices and processes with relevance to the PV industry. On one hand this involves helping thin-film PV industry to meet their long-term efficiency and cost-reduction goals. On the other hand the research at HZB extends beyond established technologies, toward developing materials based on abundant and nontoxic elements for use in future efficient thin-film photovoltaic devices and using and exploiting synergies between different thin-film technologies.

Chalcopyrite-Type Semiconductors

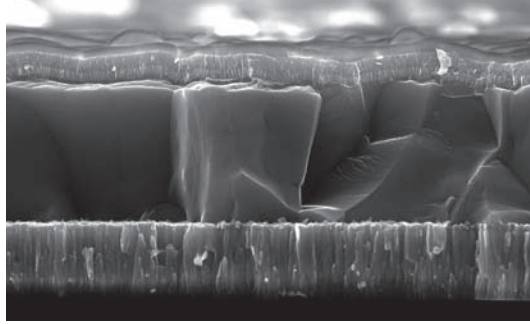


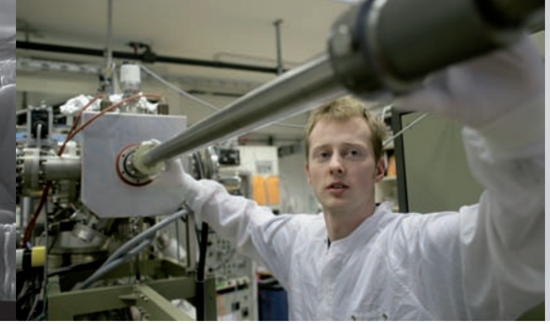
This research field aims at further developing the potential of chalcopyrite-type semiconductors as a high efficiency option for thin-film devices. One main goal is to develop very high-efficiency devices (in the 20% range) using high-throughput deposition processes for the semiconducting layers. The use of flexible substrates is another key goal. Alternative multinary absorber materials based on abundant and nontoxic elements are under investigation, and novel device structures are being developed as an alternative to the conventional n+-p heterojunction devices.

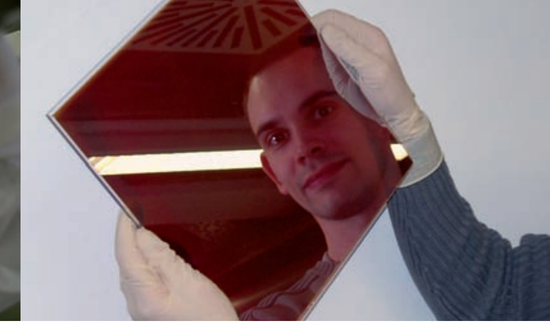
Silicon Photovoltaics



In this field, the scientific and technological foundations for applications in crystalline silicon thin-film photovoltaics are investigated. Thin-film crystalline silicon solar cells grown on an inexpensive substrate combine the advantages of traditional silicon wafer technology - such as high material quality - with the high productivity, energy efficient production, electrical interconnectivity, and the low materials consumption of thin-film technology. The investigation of solar cell concepts based on silicon heterostructures, in which heteroemitters are deposited as thin layers, targets a process simplification which may be applied to thin-film solar cell structures as well as silicon bulk solar cells.







Chalcopyrite-Type Semiconductors

Research Topics
- High-efficiency thin-film solar cells based on chalcopyrites
- Alternative absorber materials, eg. kesterite (CZTS)
- Novel concepts for junction formation
- Wide-gap absorbers and transparent top cells for tandem photovoltaic cells

Thin-film Processes
- Multisource coevaporation (PVD)
- Rapid Thermal Processing (RTP)
- Low-temperature processes
- Ion Layer Gas Reaction (ILGAR™)
- Chemical Bath Deposition (CBD)
- Sputtering

Technology Related Analytics
- Standard and temperature-dependent device characterisation (AM1.5)
- Defect spectroscopy (admittance, luminescence)
- Imaging techniques (thermography, electroluminescence)
- Microscopy (SEM, TEM, STM, AFM, KPFM)
- Grazing incidence XRD analysis
- Surface and interface characterisation
- Synchrotron-based in-situ characterisation

Projects & Cooperations
- comCIGS - computational materials science and efficiency optimisation (BMU)
- NeuMAS – scaling of Cd-free buffers (BMBF Innovationsallianz)
- PIPV – CIGSe solar cells on polyimide (BMBF)

Silicon Photovoltaics

Research Topics
- Crystalline silicon thin-film solar cells
- Silicon heteroemitter solar cells

Technological Processes
- High-rate physical vapour deposition of Si
- Plasma deposition of Si
- Sputtering of high-mobility TCOs
- Electron-beam-, laser- & solid phase crystallisation of Si

Analytical Methods (selection)
- Advanced defect analysis (ESR)
- Electrical characterisation (photoluminescence, surface photovoltage methods, photoelectron spectroscopy, quantum efficiency,...)
- Structural characterisation by Raman spectroscopy
- Interface analysis with synchrotron radiation

Projects & Co-Operations (selection)
- PolySiMode - Improved Polycrystalline-Silicon Modules on Glass Substrates (EU)
- SISSY – Solar Cell In-situ Lab at the Synchrotron (BMBF Innovationsallianz)
- TopShot - Technology & Operating Principles of Silicon-based Heterojunction Solar Cells (BMBF Verbund)