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 Novel Materials and Device Concepts

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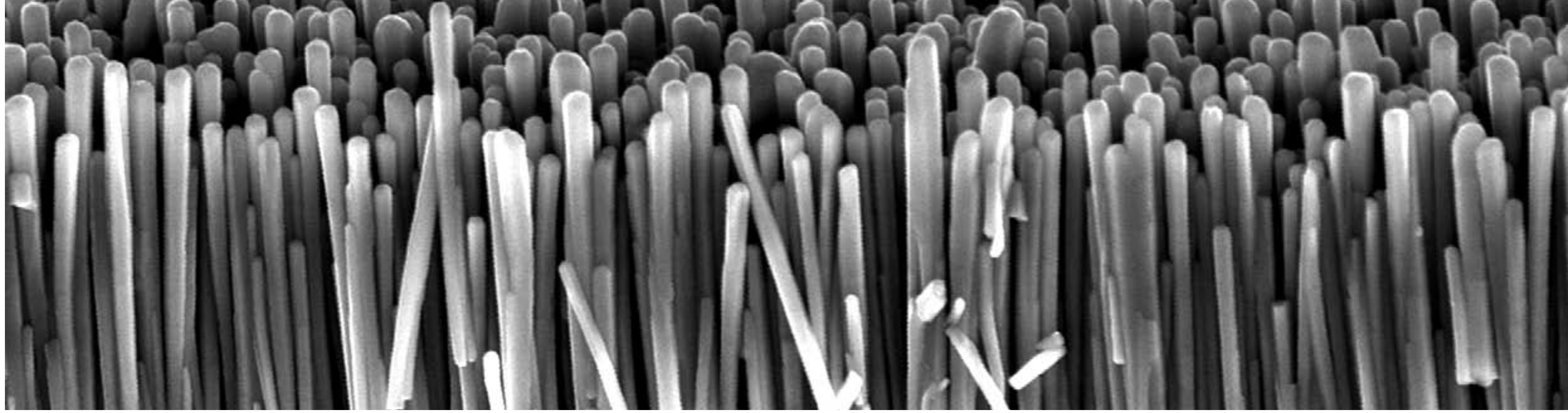
HZB Helmholtz Zentrum Berlin

NOVEL MATERIALS AND DEVICE CONCEPTS

Solar Energy Research

NOVEL MATERIALS AND DEVICE CONCEPTS

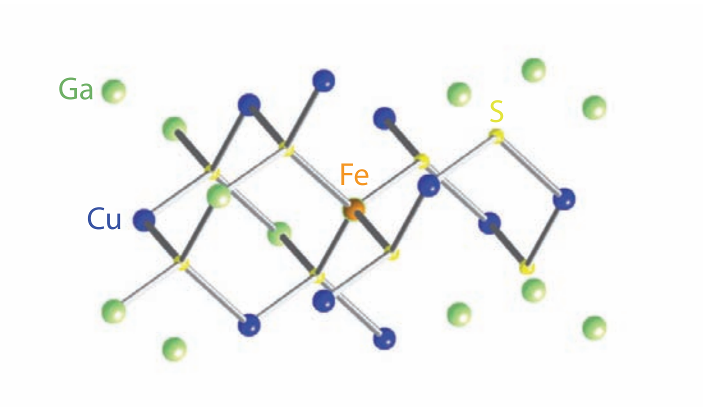


Research in Novel Materials and Device Concepts is directed toward the long-term goal of producing cost-effective and more efficient devices. As an example, solar cell concepts based on nanoparticles promise to provide extended chemical flexibility and exploit quantum-size and optical coherence effects. The aim is to generate the scientific knowledge needed to create photovoltaic devices beyond the present cost and efficiency limitations.

Efficiencies beyond the Shockley-Queisser limit for single band gap materials have so far only been observed for multijunction devices using stacks of III-V materials with different band gap energies.

In recent years, a wide variety of theoretical concepts have been discussed to make use of novel photovoltaic concepts to exceed fundamental efficiency limits by minimising spectral and thermalisation losses without using multijunction cells.

Scientific approaches are employed to systematically overcome fundamental challenges governing efficiency limits as well as addressing practical requirements such as the desire to use low-cost materials. For this purpose we make use of a combination of materials that are already in an advanced stage of development (in particular materials for advanced thin-film devices) and of materials and concepts (such as hybrid devices) that up to now have been investigated primarily on fundamental levels.



Crystal lattice of $CuGaS_2$ with partial substitution of Fe for Ga

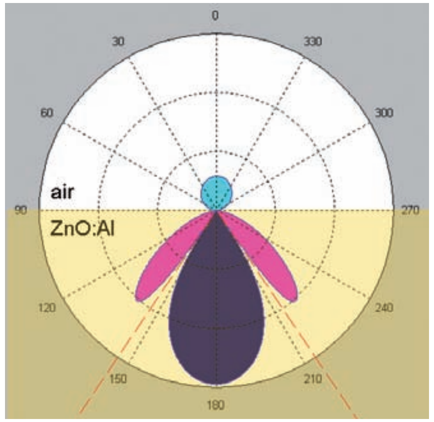
Research Topics

Materials

- New photovoltaic materials (e.g. kesterite (CZTS), Cd-free buffer layer for chalcopyrite solar cells)
- Materials for intermediate-bandgap solar cells
- Organic layers for the passivation of Si surfaces
- Evaporated hybrid solar cells

Devices

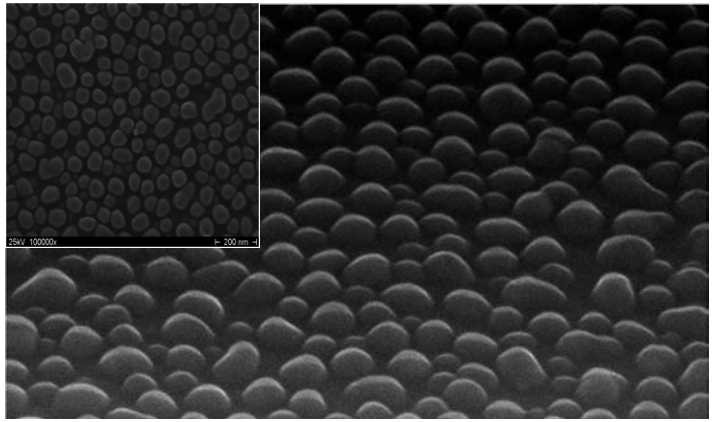
- High-efficiency tandem chalcopyrite-type devices
- (Nano-) point contacts for chalcopyrite devices
- Enhanced absorption through plasmonic light coupling
- Intermediate band-gap solar cells
- Quantum-dot structures for solar cells based on Si



Cross section of the angular power distribution of light radiated by a dipole at the interface air - ZnO:Al

Projects & Co-Operations (selection)

- IBPower – thin-film materials for intermediate band solar cells (EU)
- NanoPV - Nanomaterials and nanotechnology for advanced Photovoltaics (EU)
- NanoPV - Nanopartikuläre Dünnschicht-Solarzellen - Grundlagen & Prozesstechnologie (BMBF)
- Nanoskalige III-V Silizium Heterostrukturen für hocheffiziente Solarzellen (BMBF Innovationsallianz)
- Neukosolar – Neuartige Kontaktsysteme für Solarzellen (IBB/EFRE)
- Pinet – PIN- Solar cells based on alternative absorber and contact materials (BMBF)
- SINOVA – Siliziumbasierte nanostrukturierte Dünnschichtmaterialien (BMBF)



Silicon nanodots grown on an oxidised Si-wafer (large picture taken at 30° angle, small picture at 90°)