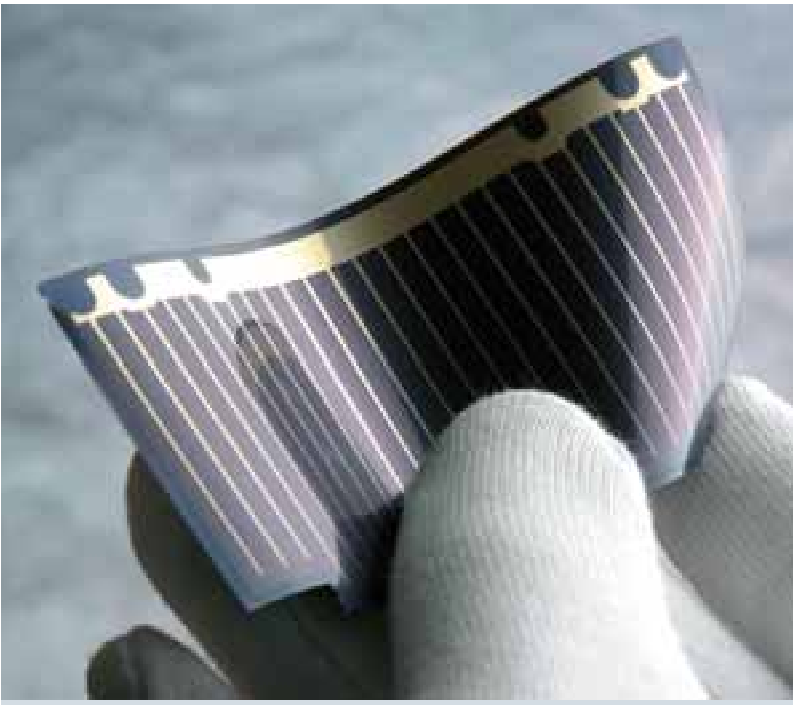
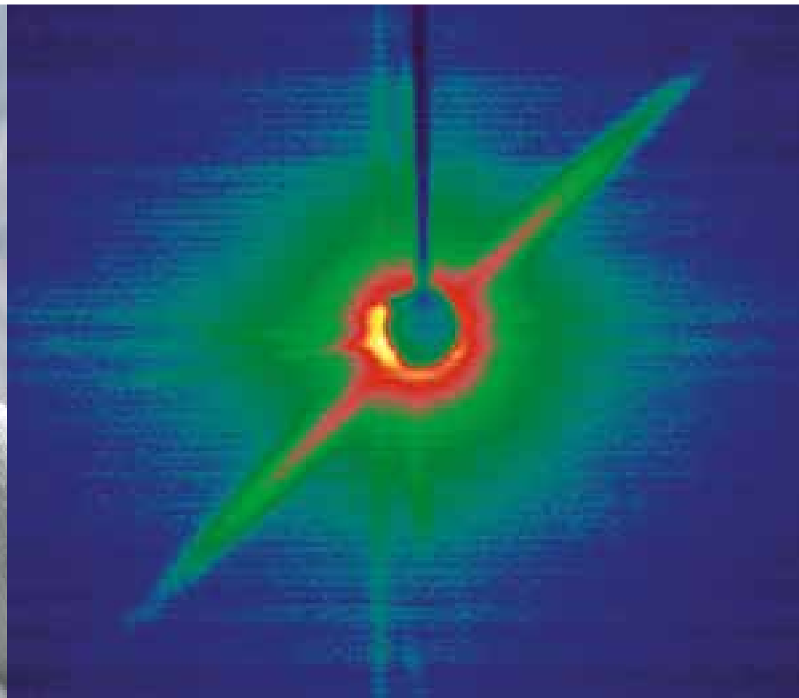
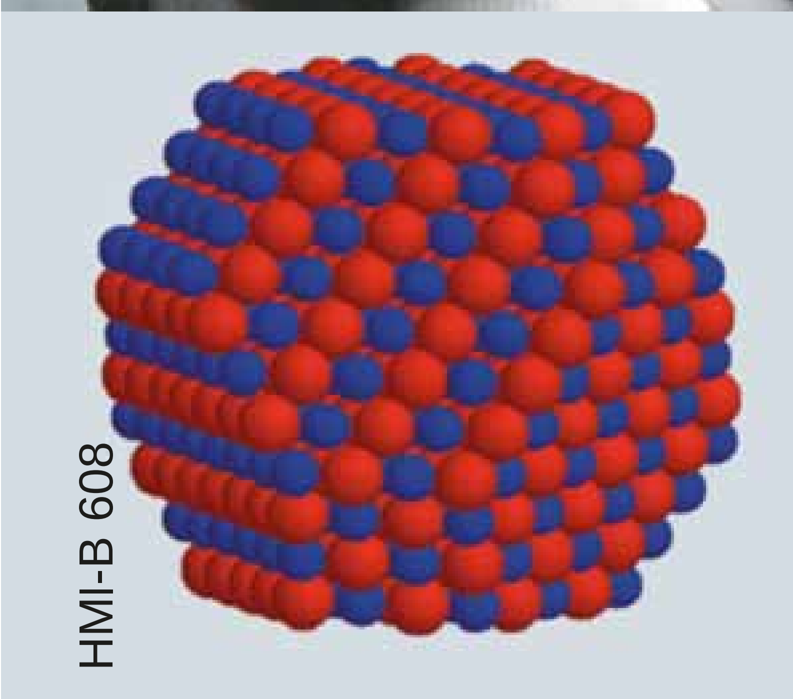
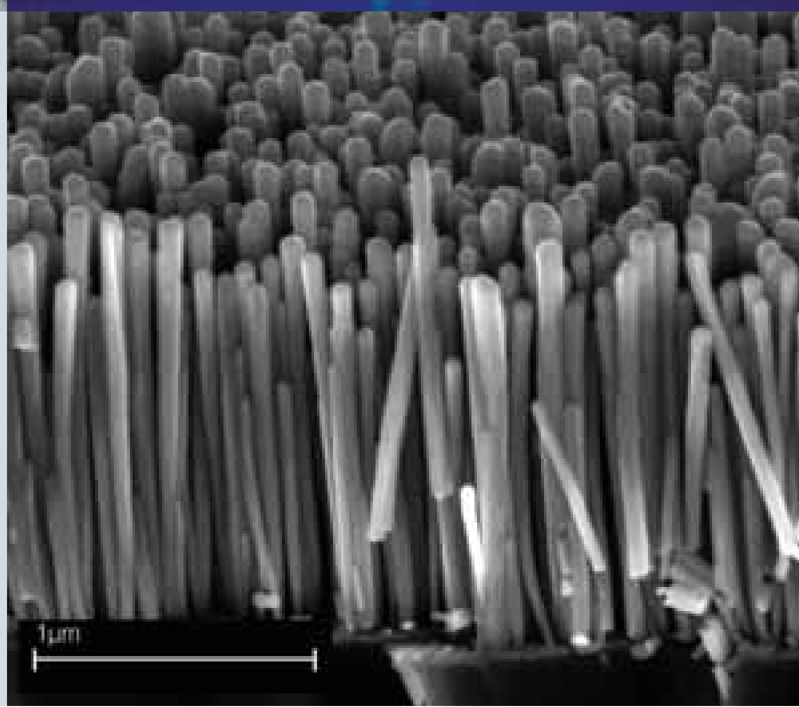
Hahn-Meitner-Institut Berlin
in der Helmholtz-Gemeinschaft

Annual Report 2005
Selected Results

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Legend to Cover Figures:

top left: Flexible solar cell developed at the Hahn-Meitner-Institut

top right: SAXS (Small Angle X-Ray Scattering) image of glass with nano-sized silver clusters induced by ion irradiation

bottom left: Snapshots of an ordered 807-atom (around 2.5 nm size) platinum/cobalt nano-particle (blue spheres stand for cobalt atoms and red spheres for platinum). These particles have been investigated at a HMI beamline at the synchrotron source BESSY.

bottom right: ZnO-Nanorods grown on Sapphire/ZnO-Substrate

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Hahn-Meitner-Institut
Berlin, 2006

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Foreword

The Annual Report 2005 of the Hahn-Meitner-Institut presents selected results of research activities obtained in that year. These highlights were selected from a large number and were not only achieved by our in-house researchers, but also by our guest researchers and external users of the large-scale facilities or in close collaborations of HMI scientists and partner institutions.

The HMI as a member of the Helmholtz Association acts in the framework of the so-called programme-oriented funding, and since 2005, the entire research activities of the HMI are funded according to this new scheme. One has to emphasise that the HMI researchers have succeeded in adjusting to this new frame and also to continuing their research under these new conditions. The stronger networking has turned out to be very positive and the enhanced competition within the Helmholtz Association stimulates our scientists.

The research programme of the department Trace Elements (SF6), participating in the Helmholtz Programme *Environmental Health* and the HMI eye tumour therapy activities (so-called Precision Proton Therapy) of the department SF4, participating in the Helmholtz Programme *Cancer* of the Helmholtz Research Area *Health* had their midterm evaluations in 2005. In these surveys carried out by members of HMI's Scientific Council supported by external experts, both activities received excellent evaluations and comments. The official reports will be given in 2006.

Concerning our ambitious future project at the Berlin Neutron Scattering Center BENSC, the High Field Magnet (the former N25T-Project) which should reach magnetic fields for neutron scattering experiments of 25 Tesla and above, a feasibility study has demonstrated that pure superconducting technology is not yet ready to provide higher fields than about 22 T even when high-T_c superconductors are used. Therefore at the end of 2005, we have decided to redesign our project and plan a hybrid system consisting of a superconducting part as an outer coil and a resistive part as an inner coil and in addition, to apply for additional money at the Helmholtz Association due to higher costs of this most promising but more complicated system.*

At HMI and in particular at BENSC, the research and the development programme associated with the scientific user service for the international community at our large-scale facilities is very important. We are pleased that in 2005 the number of proposals applying for beam time at our BENSC instruments increased again after the shut-down of the research reactor BER II in 2004 due to the implementation of the neutron guides in our new Neutron Guide Hall II. The installation of the neutron guides and choppers, the moving of the instruments and the new instrumentation in the Neutron Guide Hall II proceeded in 2005 as planned. In addition, we are proud that the HMI beam line behind the 7T-Wiggler at BESSY and

*By the time of printing (July 2006), the funding of the High Field Magnet has been assured.

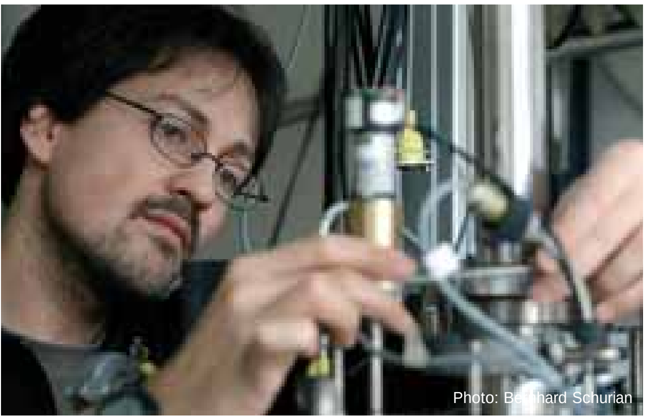
Photo: Bernhard Schurian


Photo: Bernhard Schurian


Photo: Peter Witt

the corresponding instruments are now available for external users. Since the 1st of May, 2005 after a half year commissioning phase, both the white beam instrument EDDI for energy dispersive diffraction and residual stress analysis and the monochromatic instrument MAGS for resonant magnetic scattering and high resolution diffraction offer excellent opportunities for synchrotron experiments in many cases complementary to those at neutron facilities. The number and wide spectrum of the received proposals in the first round confirmed the demand and the special concept of the chosen instrumentation. First experiments were already carried out successfully and provided evidence that also investigations with hard x-rays up to the 100 keV regime are possible. Herewith, through the HMI, Berlin is one of the few places worldwide where neutron and synchrotron radiation are in parallel available whereby the access is easy and well organised at BENSC in the framework of a common portal.

We are happy to announce that Dr. Bella Lake has joined the HMI. She will lead a so-called 'Helmholtz Young Investigators Group' and will become a Junior Professor at the Technical University Berlin (TU). The proposed projects address the understanding of high-T_c superconductors, the investigation of exotic magnetism and non-equilibrium spin dynamics with its practical implications for functional devices. With her expertise we strengthen the area of magnetism and quantum phenomena at HMI and these research activities should play a significant role in fostering the cooperation with the TU Berlin.

HMI's scientific director Prof. Michael Steiner (left) and administrative director Dr. Ulrich Breuer

With this report we would like to commemorate and to impart a huge amount of successful activities and to thank the staff of the Hahn-Meitner-Institut, their collaboration partners and scientists from outside who have contributed to the results as a whole in 2005. Their motivation is most gratefully appreciated.

Thanks are also given to the funding authorities, the Federal Government, in particular to the Federal Ministry of Education and Research, the Senate of Berlin, the European Commission and all the other third party funding agencies for their continuing support.

Photo: Bernhard Schurian

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HMI in brief

The Hahn-Meitner-Institut (HMI) in Berlin is one of Germany's leading centres for research on solar energy conversion, condensed matter and materials science. It has approximately 800 employees, including almost 300 scientists – most of them physicists and chemists. Most of the institute's annual budget of roughly 70 Million € is provided by the German Federal Government and the City of Berlin in a ratio of 9 to 1.

The Hahn-Meitner-Institut is member of the Helmholtz Association of National Research Centres, an organisation representing fifteen of Germany's largest scientific institutions. The common mission of the Helmholtz centres is to develop, set-up and operate large-scale facilities, to solve complex – often multidisciplinary – scientific and technological problems in long-term proactive research programmes and to develop high technologies for the future. The Helmholtz Association concentrates its work in six research fields: *Energy, Earth and Environment, Health, Structure of Matter, Transport and Space* and *Key Technologies*. For each of these fields, scientists develop several research programmes for 5-year periods. These programmes are then evaluated by a group of international experts. This evaluation forms the basis for the programme-oriented funding, which distributes the financial resources to the scientific programmes of the Helmholtz research fields rather than to the institutes.

Scientific work at the Hahn-Meitner-Institut is organised in two divisions reflecting the two main fields of activity: Solar Energy Research and Structural Research. The Solar Energy Research is part of the programme *Renewable Energies* within the research field *Energy*. Most of the activities of the Structural Research Division are part of the programme *Large-Scale Facilities for Research with Photons, Neutrons and Ions* in the research field *Structure of Matter*. The eye tumour therapy and the research on trace elements are conducted in the Helmholtz programmes *Cancer and Environmental Health* within the research field *Health*.

Solar energy research at the Hahn-Meitner-Institut is the largest effort in the field of sustainable energy within the Helmholtz Association and comprises approximately 25 % of HMI's research and development efforts. As an interdisciplinary activity between solid state physics, material chemistry, optics and interfacial chemistry, it aims at creating scientific and technological preconditions for significantly increasing the contribution of sustainable energy to our energy supply over the next decades. This activity is taking advantage of an already well balanced research infrastructure and increasingly uses the unique measurement opportunities provided by the large scale facilities operated at the Hahn-Meitner-Institut.


Photo: Sebastian Frenkel


Photo: Peter Witt


Photo: Peter Witt

At the centre of the solar energy research at HMI are materials and concepts for thin-film solar cells – activities covering the entire spectrum from basic research to the design of actual devices. The focus is on the currently most promising technologies, namely thin-film poly-crystalline silicon and compound semiconductors of the I-III-VI_2 and III-V type. Research projects aim at the development of efficient photo-voltaic solar cells which allow substantial reductions in the costs of solar power generation. The strategy is to develop existing thin-film technologies to a state of maturity and, in parallel, to explore new materials and concepts for solar cells of the future, e. g. nanocomposite crystalline materials.

Structural research at the Hahn-Meitner-Institut is focused on experimental investigations of structures and materials using neutrons and fast ions as probes. These two probes are provided by two in-house large-scale facilities sited on the institute's grounds in Berlin-Wannsee: The 10 MW research reactor BER II with the Berlin Neutron Scattering Center BENSC and the accelerator complex of the Ion Beam Laboratory ISL. In addition to that, the Hahn-Meitner-Institut makes use of a third complementary probe – synchrotron radiation – by operating instruments at the 3rd generation electron storage ring BESSY, an independent research institution in Berlin-Adlershof.

All facilities are primarily operated for a national and international user community. About 70 % of the beam time at the instruments is used by scientists from other research institutes, universities and industry from Germany and from abroad. It is HMI's policy to provide these users with full scale technical and scientific support, this way enabling them to make best possible use of the facilities. An outstanding highlight among the HMI activities are neutron scattering studies of samples in extreme sample environments such as very high magnetic fields and extremely low temperatures made possible by the institute's unique expertise on sample environment equipment. Fields in the focus of in-house structural research are magnetic phenomena, properties and design of engineering components and materials, soft matter and biological systems as well as theoretical physics.

At ISL, roughly a quarter of the beam time is used for the therapy of tumours in the human eye using 70 MeV protons. The costs of the therapy are covered by the national health insurance companies.


Photo: Peter Witt


Photo: Reiner Hausleitner


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