GEMS – German Engineering Materials Science Centre

- Beam time is allocated via a proposal procedure. The introduction to the instrument, the supervision during the experiment and help during the data analysis are provided by the instrument scientists. More information about the GEMS instrumentation: **https://gems.hereon.de**

  Requests for beam time can be submitted at PETRA III beamlines: **https://door.desy.de**

  MLZ/FRM II instruments: **https://mlz-garching.de/user-office**
- Commercial service for industry - Characterisation of structural and functional materials:
  - diffraction for phase analysis, strain/stress analysis and texture analysis
  - small angle scattering (SAXS) for nanoparticle analysis
  - micro- and nanotomography

  In addition GEMS offers a world-wide unique portfolio of sample environments for engineering materials science, e.g. for *in situ* heat treatment or sample deformation.

About Helmholtz-Zentrum Hereon

Helmholtz-Zentrum Hereon conducts international cutting-edge research for a changing world: approximately 1,100 employees generate knowledge and innovation to facilitate more resilience and sustainability. Hereon's scientific spectrum encompasses high-performance materials, processes and environmentally friendly technologies for mobility and new energy systems.

Furthermore, research is conducted on biomaterials in medicine and for increasing quality of life. Through research and consulting, Hereon addresses the challenges of climate change in a solution-oriented manner and facilitates sustainable management as well as the protection of the coasts and marine environment through comprehensive scientific understanding. From fundamental understanding to practical applications – the interdisciplinary research spectrum covers a unique range.

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Cutting-edge Research for a Changing World

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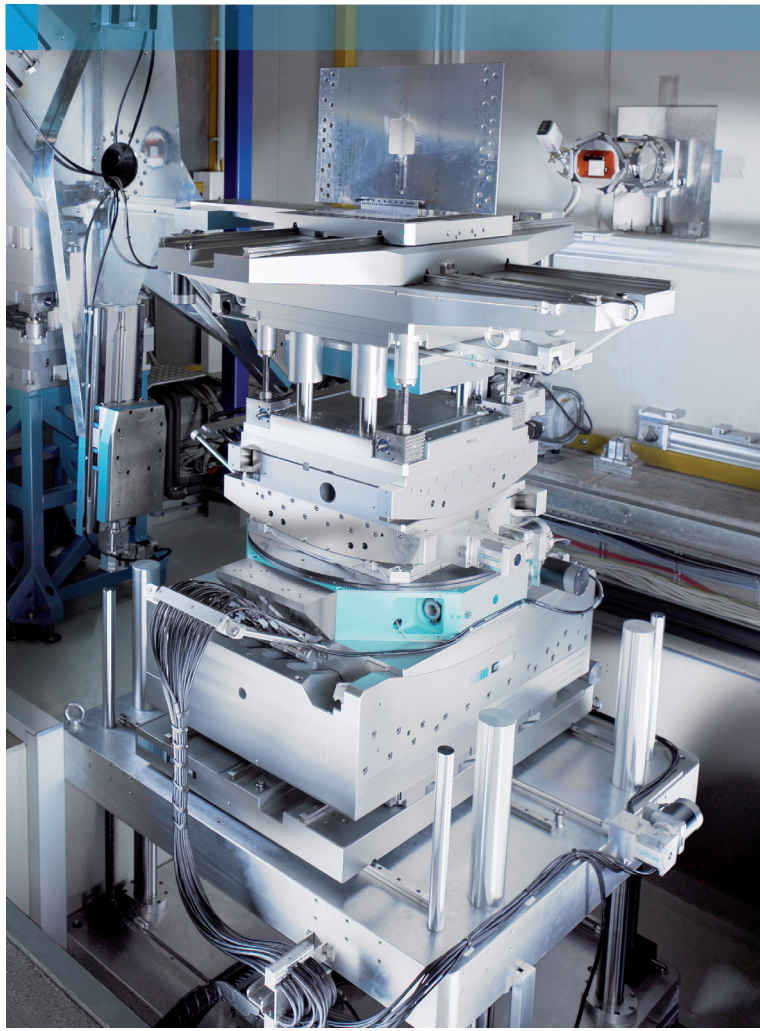
Neutrons and Photons for Science and Technology

GEMS - German Engineering Materials Science Centre



picture: Hereon/C.Schmid

gems German Engineering Materials Science Centre Helmholtz-Zentrum hereon

Helmholtz-Zentrum hereon

Hereon bundles the activities in the field of synchrotron radiation and neutrons at the „German Engineering Materials Science Centre" GEMS.

GEMS as part of the Institute of Materials Physics is the user platform providing external users with unique research instruments for their materials research with a strong focus on challenging *in situ* experiments.

The instruments at GEMS are available for the use of research scientists and engineers from universities, research institutes and industry.

The synchrotron radiation instruments are operated at the Hereon outstation at the synchrotron radiation source PETRA III at DESY in Hamburg.

The instruments using neutrons are located at the Hereon outstation at the research reactor FRM II in Garching near Munich.

TU München/W. Schürmann

Instrumentation at the X-ray source PETRA III

P07/HEMS

The High Energy Materials Science Beamline (HEMS) uses highenergy X-rays to penetrate deeply into materials, enabling the study of engineering materials, components and processes. *In situ* experiments can be performed, e.g. using a quenching and deformation dilatometer for *in situ* characterisation of processes in materials, with high time resolution due to the high intensity available. The techniques offered at HEMS are diffraction, used for phase, residual stress and texture analysis, as well as microtomography.

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P61A/WINE

The White Beam Engineering Materials Science Beamline (WINE) offers unique experimental possibilities using energy-dispersive diffraction. The intense beam up to high photon energy enables e.g. residual stress analysis in 2 cm thick steel in transmission or up to several 100 micrometres below the surface in reflection geometry. This can be used for controlling compressive stresses induced in a material by surface treatments like, e.g., laser shock peening for increasing the lifetime of a component under service conditions. Moreover, the high intensity of the white beam also enables high-speed radiography for imaging fast processes.

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P05/IBL

The Imaging Beamline (IBL) delivers highresolution 2D and 3D images of materials by using imaging techniques with attenuation and phase contrast, leading to datasets very rich in detail. The microtomography station provides micrometer resolution while the nanotomography station delivers data with a resolution in the nanometer range. By using a lower energy range than HEMS even materials with very low density contrast can be investigated with very high optical contrast. Due to their flexible geometries, both instruments allow experiments under *in situ* conditions. Thanks to high beam intensities data can be recorded with a high temporal resolution, i.e. to obtain time-resolved 3D (so-called 4D) datasets.

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Nanofocus Endstation

The Nanofocus Endstation of the DESY beamline P03 (MINAXS) provides conditions for scanning X-ray nano-diffraction (SXND) for materials science, even in extended *in situ* sample environments, with a beam size of 250 nm and an energy in the range 8 - 23 keV. In addition, control for pressure, E/B fields, temperature, fluid shear, tension or indentation force are available.

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Instrumentation at the neutron source MLZ/FRM II

REFSANS

The horizontal reflectometer REFSANS is designed to enable specular reflectometry as well as grazing incidence neutron scattering studies of the interfaces of solids and liquids. Specific sample environments include an electrochemical cell, and controlled atmosphere setups.

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SANS-1

SANS-1 is dedicated to the small-angle scattering technique. The very high neutron flux allows for the characterisation of nanostructures (1-100nm) in a variety of materials, from soft-matter to engineering alloys.

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STRESS-SPEC

The STRESS-SPEC diffractometer measures the mechanical tensions and texture properties of materials - in particular in large steel components, which cannot be penetrated by X-rays.

SANS-1 and STRESS-SPEC can accommodate a wide variety of dedicated sample environments such as a quenching and deformation dilatometer for *in situ* characterisation of modern engineering materials.

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