The High Energy Materials Science Beamline (HEMS) at PETRA III

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High Energy Experiments at PETRA III

Refurbished for operation with 6 GeV @ 100 mA, the storage ring PETRA III on the DESY site in Hamburg will be one of the most brilliant 3rd generation x-ray sources with first users already in autumn 2009.

The High Energy Materials Science Beamline HEMS is fully tunable in the range 30-250 keV and optimized for sub-μm focusing with Compound Reflective Lenses and Kirkpatrick-Baez ML mirrors. Design, construction, operation and main funding is the responsibility of GKSS. 2/3 of the beamtime will be dedicated to materials research, 1/3 to "general physics" experiments covered by DESY.

- Fundamental research encompassing metallurgy, physics, chemistry, biology with investigations of the relation between macroscopic and micro-structural properties of polycrystalline materials, grain-grain interactions, re-crystallisation processes, and the development of new & smart materials or processes.
- Applied research for manufacturing process optimisation, complex and highly dynamic in-situ studies of micro-structural transformations, e.g. during friction stir welding, easy accommodation of large and heavy user provided equipment up to 1 t.
- Targeting of the industrial user community based on well established techniques with standardised evaluation and "full service" measurements for strain mapping, texture determination and tomography.

Key Properties of High Energy X-Rays

- High penetration depth → non-destructively bulk properties measurable → deeply buried structures accessible
- Large Ewald Sphere → lines and planes in reciprocal space can be imaged → small Bragg angles (typically 5° to 10°), monitoring of complete diffraction rings with area detectors possible
- Extinction and multiple Bragg scattering negligible
- Focussing to spot sizes in nm range possible → combination of high penetration depth and high flux → very short data acquisition times possible (<1 s) → non-destructive observation of highly dynamic processes → high spatial resolution narrowing the gap to electron microscopy
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Beamline Layout and Instrumentation

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