High Energy Materials Science at PETRA III


High Energy Experiments at PETRA III

Currently 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 planned user operation in 2009. PETRA III is a Low Emission Synchrotron Radiation Source, Technical Design Report ed. K. Siemens et al. Hamburg, DESY 2004.

- Applied research for manufacturing process optimization will benefit from high flux in combination with ultra-fast detector systems allowing complex and highly dynamic in situ studies of micro-structural transformations, e.g. during friction stir welding. The beamline infrastructure will allow easy accommodation of large and heavy user provided equipment up to 1 t.
- Experiments targeting the industrial user community will be based on well established techniques with standardised evaluation, allowing "full service" measurements. Environments for strain mapping will be provided as well as automated investigations of large sample numbers, e.g. for texture determination and tomography.

Beamline Layout and Instrumentation

Optics Hutch OH1 (13 m)
- single bounce monochromator
- water cooled bent Laue DCM (horizontal fixed exit 21 mm)
- beam diagnostics

1st Experimental Hutch / Test Facility EH1 (6.5 m)
- calibration / detector tests
- powder diffraction

2nd Experimental Hutch EH2 (7 m)
- general purpose diffractometer
- focussing optics <5 μm (CRLs & MLs)

3rd Experimental Hutch EH3 (8.5 m)
- heavy duty hexapod up to 1 t
- focussing optics <10 μm (CRLs)

4th Experimental Hutch EH4 (11 m)
- HR 3D microstructure mapper
- HR ultra fast micro-tomography
- focussing optics <1 μm (CRLs & KB mirrors)

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 9° to 15°), 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

Contacts: Prof. A. Schreyer Tel: +49 (0)4152 87 1254 E-Mail: andreas.schreyer@gkss.de
Dr. N. Schell Tel: +49 (0)4152 8906 3637 E-Mail: norbert.schell@gkss.de