MS34 P03

The status of GKSS' High Energy Materials Science beamline at Petra III
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Keywords: synchrotron X-ray diffraction, materials structure and characterization, X-ray microtomography

The high energy materials science beamline will be among the first fourteen beamlines planned to be operational in 2009 at the new third generation synchrotron light source Petra III at DESY, Germany. The operation and funding of this beamline is assured by GKSS. 70% of the beamline will be dedicated to materials science. The remaining 30% are reserved for physics and are covered by DESY. The funding for this beamline was approved in 2005, the project was started in 2006. The materials science activities will be concentrating on three intersecting topics which are fundamental, applied, and industrial research. The beamline will combine three main features: Firstly, the high flux, fast data acquisition systems, and the beamline infrastructure will allow to carry out complex and highly dynamic in-situ experiments. Secondly, a high flexibility in beam shaping will be available, fully exploiting the high brilliance of the source. Thirdly, the beamline will provide the possibility to merge in one experiment different analytical techniques such as diffraction and tomography.

For the insertion device a five meter long in-vacuum undulator is in the design phase. It will be placed in a high-β section. The device will be fully tunable in the range from 50 to 300 keV with a main energy of 120 keV, and it will be optimized for sub-micrometer focussing. Filters for the suppression of energies below 50 keV are foreseen to allow the operation of subsequent optical elements in air or inert atmosphere.

The optics hutch will house the primary slits, a water cooled fixed exit bent Laue double crystal monochromator, and collimating Compound Refractive Lenses (CRLs).

Two experimental hutches will be available. In the first one a high resolution microstructure and strain mapper is in the design phase. The aim for this instrument is to be highly flexible in beam shaping and focussing down to spot sizes far below 1 μm. The implementation of a Kirkpatrick-Baez microfocussing X-ray mirror system and CRLs is planned. Furthermore the hutch will accomodate a diffractometer for physics experiments.

The second hutch will be equipped with a heavy duty diffractometer for sample environments up to 1 t. One of the in-situ applications will be a friction stir welding device which is in the design phase and which will be tested beforehand at GKSS' HARWI II beamline at HASYLAB/DESY. Furthermore space for user provided experiments and optics will be available. At the end of the second hutch, about 90 m from the source, will be placed a tomography setup.

In addition to the two experimental hutches a side station with a hutch for the test of optical components and detectors will be installed on the beamline. This test hutch will be available for internal users.

MS34 P04

The ESRF Upgrade Programme
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Keywords: nano, synchrotron, high brilliance

After more than ten years of supplying synchrotron light of outstanding quality to the many thousands of ESRF users, the time has come to envisage a “step function” in the improvement of the accelerator and source, the beamlines and the infrastructure. The ESRF is now writing a detailed scientific and technical report describing plans for a significant enhancement of its facilities and the new science that would become possible.

The Upgrade will allow the current ESRF beamlines to be enhanced and rebuilt for new science. The experimental hall will be extended for beamlines up to 140 metres in length to allow nano-sized beams with sufficient space around the sample. Crystallography will benefit from an improved suite of beamlines using nanofocus beams and the high coherence of the source (for example a dedicated nano-diffraction beamline with 50 nm beam for single crystal diffraction and scanning SAXS/WAXS techniques). All beamlines will benefit from an increased intensity: through a higher stored current (300 mA) and via longer straight sections allowing longer undulators. For example, the increased X-ray beam intensity combined with improved detectors will accelerate powder diffraction measurements by an order of magnitude allowing an efficient parametric study of a system (e.g. varying T, P or systematic variations in chemical synthesis of the samples). To meet the demands of structural biology, the macromolecular portfolio of beamlines will be redeveloped with a spectrum of specialised stations (such as automated screening; ultra-low, ultra-high resolution data; routine collection of diffraction data at long wavelengths; data from micro-crystals and from crystals with very long unit cell axes). These improvements aim to give the possibility of screening of many hundreds (or even thousands) of samples followed by transfer of the best to the most appropriate beamline for final data collection.

A key component of the Upgrade will be the routine availability of complementary techniques, both integrated on the beamlines and in support laboratories, allowing a fuller characterisation of samples. Even more extreme environmental conditions (important for example for planetary science) will be developed: pressure, temperature and pulsed and static magnetic fields together with higher time resolution. Some of these developments will be catalysed through science-driven partnerships.

The enhanced beamlines will require enabling technologies such as nano-compatible engineering, novel sample support and manipulation technology, improved optical components, and state-of-the-art detectors. Computing developments will target on-line data analysis and data curation so users can collect large quantities of data more efficiently, and then analyse or transfer the data to their home laboratories

The ESRF’s continuing long term goal is to provide the best possible service to European science, including industrial applications. The ESRF can make an important contribution to the development of the European Research Area (ERA), not only directly through its own synchrotron radiation science, but also by working with the EU national synchrotrons.

MS34 P05

Reduction of strain in a internally cooled monochromator for synchrotron radiation

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Keywords: monochromator, thermal deformations, internal cooling

More and more leading synchrotron facilities are aiming for heigher flux. Higher flux is connected with higher thermal distortions in monochromators used in these facilities. The goal of our x-ray optics group is to minimalize the deformations caused by the manufacturing of the monochromator and the head load due to absorbed radiation. These deformations are partly due to the strain caused by the cooling process of the solder. We have made some efforts to lower these deformations and the thermal bump and to bring the slope error around or less than 1 μrad. To achieve this result we studied several approaches like: proper etching of the microchannels (see Fig. 1), proper thickness of the Si layer above the microchannels, choosing the optimal solder, different geometry of the microchannels causing turbulent flow instead of laminar, the use of incline geometry in totally new designs of monochromators! All these steps should result in the reduction of the lattice deformation.

Fig. 1

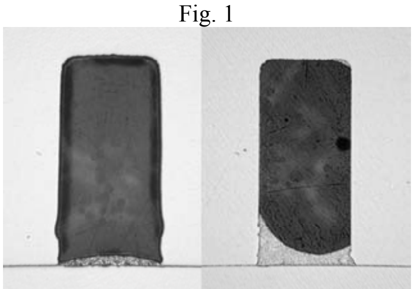
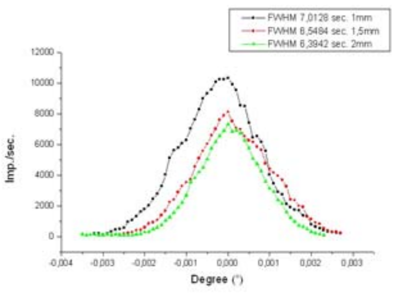


Fig. 2



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MS34 P06

Diamond Light Source MX Beamlines: An Update

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Keywords: Diamond, Synchrotron, Beamlines

The Diamond Light Source, a third generation synchrotron in the UK, is now operational and has had its first users collecting data. We report here a progress update.
Diamond is well set up to cater for the macromolecular crystallography (MX) community. There are three beamlines specifically for MX out of seven phase-one beamlines with several other MX beamlines planned for later phases of construction. The three beamlines are essentially designed to be the same although one beamline is set up such that pathogenic samples can be analysed safely. Automation played a strong role in the design criteria so all beamlines are equipped with Rigaku Actor sample-handling robots. Each beamline uses an ADSC Quantum 315R CCD detector, mounted on an A-frame assembly. An on-line viewing system allows users to see their samples as the X-rays will hit them. Each of the three beamlines will be tunable in the range 0.5 to 2.5Å, radiation being provided by in-vacuum undulators allowing MAD and SAD experiments to be carried out with ease. Each experimental beamline has its own 20 TB data storage to cope with the huge amount of data we expect to be produced. Control software has been developed to facilitate data collection and gives users a simple interface with which to carry out their experiments. Work is about to begin on the construction of the first side-station which will be a fixed-wavelength experimental station aimed at the high-throughput users who do not require tunable X-rays. The micro-focus beamline hutches have now been built and installation of services will begin shortly. 2007 will be an exciting time for MX work at Diamond with commissioning coming to an end and users beginning to use the facility routinely.