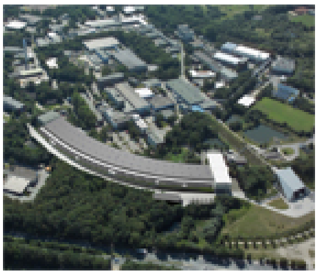

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Submicron diffraction at ALS beamline 12.3.2

Monday 18 May 2009 17:00 (45 minutes)

A new facility for submicron x-ray diffraction and fluorescence mapping has been built on beamline 12.3.2 at the Advanced Light Source (ALS) of the Lawrence Berkeley National Laboratory (LBNL). This beamline benefits from the hard x-radiation generated by a 6 Tesla superconducting bending magnet (4.37 Tesla at tangent point). The stronger magnetic field increases the available X-ray spectrum from 14 keV to 22 keV as well as the flux of a 1 μm spot from 10^7 to ~ 5 x 10^9 (at 8 keV) photons per seconds (0.1% bandwidth) when compared to the warm bending magnet source where it was originally placed on. The increase in maximum x-ray energy improves the achievable orientation and strain resolution to 0.01 deg and 5 x 10^-5, respectively. The radiation is transferred from the superbend to the experimental enclosure by a focusing toroidal mirror. Inside the lead hutch, a pair of Kirkpatrick-Baez (KB) mirrors placed in a vacuum tank re-focuses the secondary source onto the sample position. A new bending mechanism allows for more reproducible and stable mirror bending and thus mirror-focusing. Focus spots around 1 μm are routinely achieved and allow a variety of experiments which have in common the need of spatial resolution. The effective spatial resolution (~ 0.2 μm) is limited by a convolution of beam size and sample stage resolution. A four-bounce monochromator consisting of two channel-cut Si(111) crystals placed between the secondary source and KB-mirrors allows for easy changes between white-beam and monochromatic experiments while maintaining a fixed beam position. High resolution sample scans are performed while recording a fluorescence signal or an x-ray diffraction signal generated by either a monochromatic or a white focused beam. The former allows for chemical mapping and texture measurements, whereas the latter is used to produce 2-d phase-distribution-, orientation-, texture- and strain/stress-maps. Accurate sample positioning onto the x-ray focus spot is achieved with a commercial laser-triangulation unit. A Si-drift detector coupled to a multi-channel analyzer serves as a high-resolution fluorescence detector. A CCD area detector is utilized as diffraction detector. Diffraction can be performed in reflecting or transmitting geometry. Diffraction data are processed using XMAS, an in-house written software package for Laue and monochromatic microdiffraction analysis.
Future developments include the development of experimental and data-reduction tools to interpret intensities from Laue single-crystal diffraction and the expansion from 2-d mapping to depth resolved 3-d x-ray microdiffraction.

Primary author: Dr KUNZ, Martin (ALS / LBNL)

Co-authors: Mr CHEN, Kai (ALS / LBNL & UCLA); Dr TAMURA, Nobumichi (ALS / LBNL)

Presenter: Dr KUNZ, Martin (ALS / LBNL)

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