Interferometry

PS15.04.01 PHASE-CONTRAST IMAGING WITH HARD X-RAYS. S.W. Wilkins, T.J.Davis, D. Gao, T.Gureyev, A. Pogany, and A.W. Stevenson, CSIRO, Division of Materials Science and Technology PB 33 Clayton South MDC Vic 3169 Australia

Entirely new methods of X-ray imaging have recently been developed involving phase-contrast rather than conventional absorption contrast. These methods are sensitive to the real part of the X-ray refractive index and more particularly to the quantity itself or to derivatives of this quantity. In the case of conventional X-ray interferometry [1,2], it is the phase (modulo 2) which is detected while for other methods involving crystal analyzer systems [3-6], the quantity detected is a phase gradient. In the present paper, emphasis will be given to outlining different approaches to differential phase-contrast imaging and to understanding the physical nature of image formation in different regimes.

Examples of phase-contrast images for different cases will also be presented to help illustrate the key features of some of these approaches.

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Polarization Generation & Exploitation

PS15.05.01 DIAMOND PHASE PLATES FOR X-RAY CIRCULAR AND LINEAR POLARIMETRY AT THE ESRF. C. Giles[1,2], C. Malgrange[3], J. Goulon[1], F. de Bergevin[4], C. Vettier[1], A. Fontaine[5], E. Dartyge[6], S. Pizzini[5], F. Baudelet[6], G. Grubel[1], L. Varga[3], A. Freund[1]. [1]European Synchrotron Radiation Facility, B.P.220, F-38043, Grenoble, France; [2]Laboratorio Nacional de Luz Sincrotron, Cx.P. 6192, 13081-970, Campinas, Brazil; [3]Laboratoire de MineralogieCristallographie, Universites de, Paris 6 et 7, Tour 16 case 115, 4 Place Jussieu, 75252 Paris, Cedex 05, France; [4]Laboratoire de Cristallographie, CNRS, BP 166X, F38042, Grenoble, France; [5]Laboratoire de Magnetisme Louis Neel, CNRS, F-38042 Grenoble, France; [6]LURE, Universite Paris Sud, Batiment 209D, 91405 Orsay Cedex, France.

Low emittance third-generation storage rings, like the ESRF, provide an optimum condition for the use of perfect crystal phase plates combined with ondulator sources. Their low angular and spatial distributions in both the horizontal and vertical directions are suitable to an excellent performance of diamond crystals as quarter-wave plates (QWP) and half-wave plates (HWP). Recent experiments performed at the ESRF (Troika Beamline) confirm 99% and 97% efficiencies of diamond phase plates in the transformation of horizontal linear polarization into circular polarization and linear polarization in the vertical plane respectively. A diamond QWP has been used to investigate the magnetic domains in a spiral antiferromagnet like holmium via magnetic x-ray scattering. Furthermore, the successive use of two QWP allowed the production of linear polarization in any desired direction and the complete characterization of the polarization state of the circularly polarized beam within 1%. The diamond phase plate set in an asymetric Laue transmission geometry at 9 keV, allowed a transmission efficiency of 40%. Diamond phase plates have also been tested in the energy dispersive absorption spectrometer at DCI ring (LURE, Orsay) in order to record X-ray Magnetic Circular Dichroism (XMCD) spectra at different rare-earths absorption edges from Pr L2 (6440 eV) to Tm L3 (8648 eV). The efficiency of the phase plate has been measured comparing such XMCD spectra with those obtained in the standard technique (using the elliptically polarized beam below the orbit plane). The polarization rate and the intensity on the sample where higher with the QWP technique. Finally, good XMCD spectra have also been obtained using beryllium phase plates with a mosaicity of the order of 80 arcsec. The good efficiency of mosaic crystals as phase plates far from the Bragg peak can be interpreted.

Extinction & Absorption

PS15.06.01 SEPARATION OF OBSERVED INTEGRATED INTENSITIES INTO COHERENT AND INCOHERENT COMPONENTS. T. Takama, T. Nishide and *A. Onodera, Department of Applied Physics, Faculty of Engineering, Hokkaido University, Kita-ku, Sapporo 060, Japan and *Department of Physics, Faculty of Science, Hokkaido University, Kita-ku, Sapporo 060, Japan.

The statistical dynamical theory of diffraction by Kato (Acta Cryst. A36, 1980, 763-778) has great potential to predict diffraction from perfect to imperfect crystals. The theory has been improved theoretically and tested experimentally. It is, however, far from satisfactory for practical applications to extinction correction and still in the development stage. The integrated intensity in the theory consists of the coherent and the incoherent terms (including the mixed term). The terms are related to crystal perfection, wavelength, crystal thickness and reflection plane. Therefore, one of the ways to advance the theory is to clarify the relations experimentally.

In the present study, the integrated intensities from Si single crystals with different perfection were measured and separated into the two terms. Dislocation-free Cz-Si single crystals with a thickness of about 0.5 mm were used for the experiment. Micro defects of SiO_2 with random distribution were introduced into the specimens by annealing at 1073 K for 4 h then at 1273 K for 1 to 32 hr in dry oxygen gas. The oxidized surface layers were removed by chemical etching. The integrated intensities on the symmetrical Laue case were measured by two separate methods using white X-rays as an incident beam. In one method, the intensities were measured as a function of wavelength and in the other for fixed wavelength as a function of crystal thickness. It was observed that both the intensities and the Pendellösung beats spacing increase and the amplitude of beats decreases depending on the annealing time and the reflection index. The coherent parts were separated from the intensities using the amplitude of the beats as a clue. The incoherent parts were obtained by subtracting the intensities due to the Borrmann absorption from the remainders. The two parts were compared with the model in which the correlation length of amplitude in the theory is assumed to be a free parameter (Takama and Harima, Acta Cryst. A50, 1994, 239-246). The result showed a fairy good agreement between the model and the present experiment.