11.X-6 X-RAY STANDING WAVE APPLICATIONS IN CRYSTALLOGRAPHY. By G. Materlik, Hamburger Synchrotronstrahlungslabor HASYLAB at DESY, Hamburg, F.R. Germany

Over the past decade x-ray standing waves, which are generated by dynamically diffracting an X-ray beam from a perfect single crystal have become of increasing use in structure investigations of surface structures such as adsorbate geometries and substrate relaxation. By using the fluorescence yield as a marker signal, complex adsorbate geometries and temperature dependent studies were performed, the later to study phase transitions at elevated temperatures.
For epitaxial layers ($NiSi_2$/Si(111) and $CoSi_2$/Si(111)) it was shown that the interface binding geometry can be determined together with the lattice mismatch between layer and substrate.
Bulk studies have proven, that the phase of the structure factor can be determined as phase difference relative to known sublattices. This effect will be discussed in terms of the anomalous dispersion corrections f', f" as a function of the photon energy. This energy is chosen to be close to absorption edges of atoms constituing the crystal lattice. As examples, the noncentrosymmetric structures of GaAs and $LiNbO_3$ are chosen.

11.X-7 PERFECT CRYSTAL OPTICS FOR CONDITIONING ANGLE, ENERGY, POSITION AND POLARIZATION OF X-RAYS. By T.Ishikawa, Photon Factory, National Laboratory for High Energy Physics, Japan.

The extremely high photon flux produced by synchrotron radiation sources opened a number of new possibilities of X-ray diffraction, scattering and spectroscopy studies. In all of these, perfect crystal X-ray optics are effectively utilized not only as high-performance 'in-beam conditioner' but as 'out-beam analyzer' with respect to angle (momentum), energy (wavelength), position (space) and/or polarization.
As novel applications of perfect crystal X-ray optics combined with synchrotron radiation, the following topics will be discussed:
(1) Plane and Ultra Plane-Wave X-Ray Topography
(2) Angle-Resolved Plane Wave X-Ray Topography and Equi-d Mapping Topography
(3) Detection of Magnetic Scattering by Polarization Analysis
(4) Mili-eV X-Ray Spectroscopy using Bragg Back Reflection.

11.X-8 RECENT DEVELOPMENTS AND APPLICATIONS IN PERFECT CRYSTAL OPTICS
W. Graeff, Hamburger Synchrotronstrahlungslabor HASYLAB at DESY, Notkestr. 85, D-2000 Hamburg 52, FRG

The advantages of a Laue-Bragg case combination as a double crystal monochromator (e.g. for synchrotron radiation) have been known for quite a while. They include good harmonic rejection and inherent focussing of beams without bending of the crystals. Up to now the Laue crystals could only be produced by mechanical cutting and were rather thick (0.2-0.3 mm) whereas the optimal thickness is 0.4 $\Delta_e$, $\Delta_e$ being the Pendellösungs length, hence 10-30 µm. Such thin crystals with several $cm^2$ of entrance surface have been made by epitaxial growth of silicon on specially prepared subtrates. After preparation of the thin crystal layer a window is etched into the substrate leaving a rigid frame around the thin Laue crystal.
Details of the preparation, topographs of the crystals and first tests of various cooling designs will be reported.
Another application of modern semiconductor technology is the Bragg reflection zone plate which was recently proposed and tested by Aristov et al. (Conf. on Short Wavelength Coherent Radition: Generation and Applications, Monterey 1986, AIP Conf. Proc. 147, 1986, p. 253-59). By means of microlithography a relief of several micron depth is etched into the surface of a perfect crystal. Each atomic layer can be considered to form a two-dimensional zone plate. Close to the Bragg condition the scattering of all layers adds up coherently. Possible geometries and applications will be discussed.
A third topic to be reported is the use of special perfect crystals which show certain strong nuclear Bragg reflections with forbidden electronic contribution, like $^{57}$Fe-enriched YIG and $FeBO_3$ crystals, for the isolation of Mößbauer quanta from the white spectrum of synchrotron radiation. This is caused by different nuclear scattering amplitudes of the $^{57}$Fe-nuclei in non-equivalent sites of the electronic unit cell, where the crystal field influences the nucleus but not the electrons. Very recently the observation of quantum beats due to magnetic and electric hyperfine splitting have been reported by Gerdau et al. (Phys. Rev. Lett. 57, 1141 (1986)). The exact interpretation of the beat spectra is only possible by the Dynamical Theory of resonant nuclear scattering as the collective nuclear excitation decays much faster than the individual nucleus. Such time spectra increase the accuracy of hyperfine parameter determination by one to two orders of magnitude.