11.X-04 DIFFRACTION OPTICS.

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Several studies on diffraction optics recently made by our group are reviewed, most of which are concerned with dynamical diffraction effects and structure characterization of crystalline and amorphous materials using high angular resolution plane wave X-ray optical systems.

(i) Complete determination of Burgers vector from anomalies of equal-thickness fringes in plane wave X-ray topographs(Ishida et al., J. Appl. Cryst. (1976) 9, 240; Ishida, ibid. (1980) 13, 58) and electron micrographs(Ishida et al., Phil. Mag. A (1980) 42, 453).

(ii) Bragg-case diffraction in slightly distorted crystal as interpreted by wave and beam theories (Ishida, to be published).

(iii) Studies on diffuse scattering due to lattice vibration and microdefects by separate measurement of kinematical and dynamical diffraction(Iida et al., phys. stat. sol. (a) (1979) 51, 533; Iida, ibid. (1979) 54, 701).

(iv) Studies on dislocation image formation by high angular resolution analysis of plane wave X-ray topographs(Ishikawa, (1981) private communication).

(v) Studies on large scale density fluctuations in amorphous and crystalline materials by a very small angle X-ray scattering technique(Suzuki et al., Jap. J. Appl. Phys. (1980) 19, L205).

(vi) Studies on the geometry of optically polished surfaces by high angular resolution analysis of reflected X-rays(Matsushita et al., to be published).

(vii) Graphical representation of X-ray optical systems in position-angle-wavelength space(Matsushita et al., J. Appl. Cryst. 13, 465, 472).

(viii) Rotation of X-ray E-vector by 45° Bragg angle diffraction(Annaka et al., to be published).

11.1-01 DETERMINATION OF STRAIN CONCENTRATION AND STRAIN INTERACTION BY INTENSITY MEASUREMENTS OF X-RAY TOPOGRAPHS.

By S. Weissmann, Z.H. Kalman, J. Chaudhuri and G. J. Weng, College of Engineering, Rutgers University, Piscataway, NJ 08854, USA.

Long-range strains in elastically bent silicon crystals emanating from specific stress raisers such as notches, well defined cracks and inclusions were determined from intensity measurements of traverse-oscillation topographs. The diffraction method employed is based on the principle that the intensities reflected from an elastically bent, perfect crystal are directly proportional to the curvatures of the reflecting planes. Due to the action of a stress raiser the lattice curvature, induced externally by an applied moment, becomes enhanced and this enhancement is a manifestation of the strain gradient developed by the stress raiser (Kalman & Weissmann (1979) J. Appl. Cryst. 12, 209). As has been previously shown by the present authors (J. Appl. Cryst. (1980) 13, 290), the strain distribution was obtained by measuring the local densities of silver deposits using a scanning electron microscope to carry out the microfluorescent densitometry from point to point on the topograph; the resultant density range and spatial resolution of X-ray densitometry being larger by an order of magnitude than those of optical densitometry. The results of the strain analyses were directly compared to the theoretical predictions derived from continuum mechanics and good agreement was obtained. It will be shown that, difficult problems in fracture mechanics, pertaining to the interactions of strains generated by several stress raisers, can be solved directly by this X-ray method.

11.1-02 AN X-RAY TOPOGRAPHIC STUDY OF GIANT SCREW DISLOCATIONS IN SILICON CARBIDE.

By P. Krishna, S. S. Jiang and A. R. Lang. H. H. Wills Physics Laboratory, University of Bristol, Bristol. England. UK.

X-ray topography of vapour-grown 6H SiC crystal platelet, displaying three large growth spirals(Fig. 1. (0001) face), reveals that each spiral is associated with a giant screw dislocation having a hollow core that runs right through the crystal. Projection topographs taken with the $11\bar{2}6$ reflection show dislocation images parallel to the c axis, which do not appear on the $11\bar{2}0$ topographs confirming that they are pure screw dislocations parallel to [0001]. A magnified view of the relevant region of the projection topograph is shown in Fig. 2. Section topographs taken with the $22\bar{4}12$ reflection (Fig. 3) show that the hollow cores have approximately uniform circular cross-sections right through the crystal, becoming slightly larger near the surface. The diameter of the hollow cores is found to be 10 - 12μ within the crystal.

Kinematical diffraction effects produced by the rather large strain-field surrounding a giant screw dislocation have been observed (Fig. 2) and the tilt of the lattice planes around the dislocation calculated by measuring the angular displacement of the diffracted beam on $11\bar{2}6$ and $22\bar{4}12$ section topographs, taken with the incident beam intersecting the dislocation close to the (0001) surface. The Burgers vector of the single screw dislocation associated with the large hexagonal spiral on the surface is estimated to be 1200 Å. The results obtained are discussed in the light of the theory for the origin of hollow-core dislocations during crystal growth.

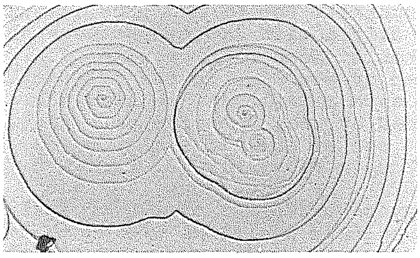

Fig. 1.

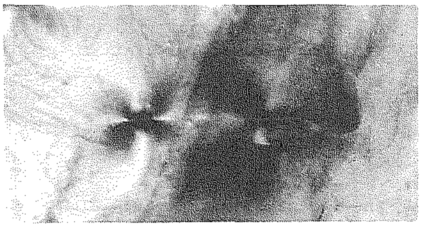

Fig. 2.

Fig. 3.