11.1-13 OPTICAL PROCESSING OF X-RAY TOPOGRAPHS.

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The paper describes the results of the processing of X-ray topographs in the scheme of optical coherent filtering. For the images of Si perfect crystals obtained in the symmetrical Laue-case the resolution was improved by an order of magnitude and the sensitivity to the structure defects of the crystals was enhanced. Computer simulation of the process of filtering made it possible to relate the permissible sensitivity of the method to the size of the structure defect.

11.1-14 ON THE CHANNEL ORIGIN IN THE CRYSTALS.

By E. Scandale, Istituto di Mineralogia e Petrografia, Università di Bari, Italy and A. Zarka, Laboratoire de Mineralogie-Cristallographie, Université P. et M. Curie, Paris VI, France.

Although channels are often observed in crystals, their formation mechanism is not well understood. In the present work, several natural and synthetic crystals were studied by X-ray topography and in the optical microscope using polarized light. The results suggest no single explanation for the origin of channels, but some of these defects appear to have, in different crystals, dislocation-like features (i.e. configuration, topographic contrast). A good correlation was established between the optical contrast and the topographic contrast of the heavily strained region around these defects. Computer simulations of the diffraction contrast of dislocation bundles are actually in progress to match the optical and topographic observations.

11.1-15 SYNCHROTRON RADIATION TOPOGRAPHY OF CUBIC (100)Co-(8wt%)Fe BINARY ALLOY.

By J.D. Stephenson, Freie Un.Berlin and Fritz-Haber Inst. der Max Planck Gesellschaft,Dahlem, Berlin.

Polychromatic synchrotron radiation (DORIS,Hamburg) is used in Bragg reflection topography to observe magnetic stripe domain structure in the binary ferromagnetic alloy Co-(8wt%)Fe when subjected to [100]-compression and a variable [100] -magnetic field. Different domain structure is observed in simultaneous $5\bar{1}1$ - and 822 - reflections and possibly can be explained by primary extinction contrast.

Previous assumptions presumed that the optimum domain contrast was produced by interbranch scattering from Y-junctions formed between 90° and 180° Bloch walls, situated at depths corresponding to i) the first pendellösung minimum in the Laue transmission case and ii) the first pendellösung maximum for the Bragg back reflection case. Primary extinction contrast theory is shown to be capable of explaining the light grey- dark grey contrast sometimes observed between alternate stripe domains in X-ray topographs (Stephenson,phys. stat. sol. (a) 64 , XXX,(1981) and to give an approximate depth of the Y-junctions below the surface of the crystal.

Calculations indicate that the depths of Y-junctions in the case of Co-(8wt%)Fe are within 0-6 µm for those producing dark grey contrast and within 10 to 12 µm for those producing light grey contrast.

Similar experiments on Fe-(3wt%)Si crystals indicated that the Y-junction depths were approximately 9 to 12 µm below the surface (Stephenson,Tuomi and Kelhä, phys. stat. sol.(a),57,191 (1980) which were of the same order of magnitude (5 µm) directly observed in iron single crystal whiskers by Chikaura et al,J. Phys. Soc. Japan,35,404 (1973).

11.1-16 STUDY OF PERFECTION OF FLUX GROWN α-Al$_2$O$_3$ SINGLE CRYSTALS BY TRANSMISSION X-RAY DIFFRACTION TOPOGRAPHY.

By Krishan Lal and Vijay Kumar, National Physical Laboratory, Hillside Road, New Delhi -110012, INDIA.

α-Al$_2$O$_3$ crystals have been grown by a number of techniques like Vernueil method, Czochralski method, chemical vapour deposition (CVD) method and flux method. We had undertaken a comparative study of perfection of α-Al$_2$O$_3$ single crystals grown by different methods (Lal and Kumar, J. Electrochem. Soc. 125, 2079 (1978); Lal, Kumar and Verma, Indian J. Phys. 53A, 78 (1979)). In the present paper results of study of perfection of flux grown crystals are described. The specimen used in this investigation have their larger faces parallel to the basal plane (0001). Almost all the crystals investigated were free of grain boundaries and low angle boundaries. However, these gave fairly broad diffraction curves even though the peaks due to $K\alpha_1$ and $K\alpha_2$ characteristic radiation were resolved. It shows that the general degree of perfection of these crystals is good. As reported earlier, the Czochralski grown material has low angle boundaries. CVD grown crystals on the other hand showed much higher degree of perfection than the present specimen. Growth features produced contrasts in the topographs of all the flux grown crystals. Some of these crystals had a fairly low dislocation density and dislocations could be resolved conveniently. Fig.1 shows a typical projection topograph of one such crystal. Dislocation lines observed parallel to $\langle\bar{2}110\rangle$ were found to be edge type dislocations by performing the usual topographic contrast analysis.

In some crystals inclusion like features were observed in the topographs. These are apparently inclusions of the flux materials.

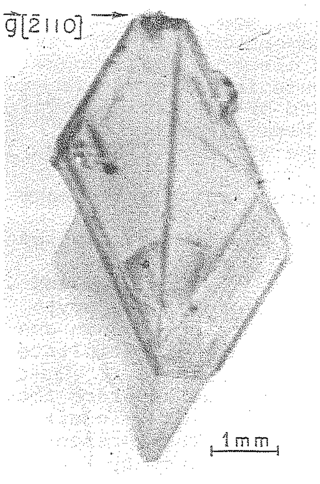

Fig.1: A typical projection topograph of a flux grown α-Al_2O_3 single crystal recorded with MoKα radiation and $[\bar{2}110]$ diffraction vector.

The authors are grateful to Dr. B.M. Wanklyn for supplying the specimen used in this investigation.

11.2-01 DEFECT STRUCTURE ANALYSIS OF POLYCRYSTALLINE MATERIALS BY COMPUTER CONTROLLED DOUBLE CRYSTAL DIFFRACTOMETER AND POSITION SENSITIVE DETECTOR.

By W. Mayo, R. Yazici, T. Takemoto, and S. Weissmann, College of Engineering, Rutgers University, Piscataway, NJ, USA.

Lattice defects of grains in stainless steel, aluminum and titanium alloys induced by fatigue, stress corrosion and corrosion fatigue were analyzed by rocking curve measurements. The work represents an extension of the X-ray double crystal diffractometer method using a photographic film to record the grain reflections (Weissmann, S., J. Appl. Phys. (1956) 27, 389). By utilizing a position-sensitive detector with interactive computer controls, the tedious and limiting task of data acquisition and analysis was greatly simplified. The specimen is irradiated with crystal-monochromated radiation and the numerous microscopic spots emanating from the reflecting grains are recorded separately by the position sensitive detector and its associated multichannel analyzer at each increment of specimen rotation. An on-line mini-computer simultaneously collects these data and applies the necessary corrections. This process is then automatically repeated through the full rocking curve range. The computer carries out the rocking curve analysis of the individual grain reflections as well as that of the entire reflecting grain population. The X-ray studies showed that the surface layer work-hardened much more rapidly than the bulk of the specimens. By analyzing the build-up of the excess dislocation density both in the surface layer and in the bulk, employing X-radiation of different penetration capability, the accrued prefracture damage could be determined and the onset of catastrophic failure predicted.

11.2-02 THE DEFECTS IN SYNTHETIC QUARTZ.

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The grown-in defects in synthetic quartz crystals grown from Z-cut seed plates were surveyed by X-ray topography and ion probe method. Besides usual dislocations and growth striations it has also been found some rare fault surfaces which have not been reported before. They appeared at the later stage of the growth and were situated in the grain boundaries along $11\bar{2}0$ or $01\bar{1}0$. The results of the ion probe experiments revealed that the concentration of impurities was much higher in the regions of fault surfaces than that in the matrix material. The configuration, the fault vector and the formation was suggested. A model of their formation was suggested theoretically and agreed well with the experiments.

11.2-03 X-RAY STUDY OF NEAR-SURFACE STRAIN IN IMPLANTED SILICON.

By B. C. Larson, J. F. Barhorst, and S. S. Goldenberg,[+] Solid State Division, Oak Ridge National Laboratory,* Oak Ridge, TN 37830.

The magnitude and depth dependence of near surface strain in boron implanted (2×10^{15} and 1×10^{16} B cm^{-2}; 35 keV) silicon have been studied using 400 Bragg reflection profiles and CuKα x-rays. Bragg profile measurements were made on as-implanted silicon, implanted and laser annealed silicon, and implanted silicon after 650-900°C thermal annealing. The measurements were analyzed in terms of lattice strain using the dynamical theory of diffraction for one-dimensionally strained crystals where an iterative procedure was used to obtain strain profiles that would simulate the Bragg scattering data. Debye-Waller factor effects were included in the analysis and thermal diffuse scattering corrections were made on the measured data. Positive strain distributions were found for the as-implanted crystals and either negative strains or combinations of positive and negative strains were found for the laser and thermally annealed cases. These results will be discussed in connection with transmission electron microscopy observations of defects and defect microstructure associated with silicon under these conditions.

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