11.X-01 RECENT DEVELOPMENTS IN X-RAY TOPOGRAPHY.

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Following an examination of the type of information obtainable using X-ray topography, the possible reasons behind the surprisingly slow expansion of X-ray topographic usage through the 1970s will be discussed. Developments in four areas which may significantly effect the future potential of the technique will be reviewed. These are;
(a) improvements in high resolution position sensitive electronic detectors giving the possibility of dynamic experiments,
(b) increases in computing power making image simulation a viable analytic facility,
(c) advances in microprocessor technology making automation of X-ray cameras very inexpensive,
(d) the continuing increase in brilliance of X-ray sources. In the last context recent work on the use of synchrotron radiation for X-ray topography will be highlighted.

Bibliography
Tanner, B.K. (1976): X-ray Diffraction Topography, Pergamon Press
Tanner, B.K. and Bowen, D.K. (1980) Eds: Characterization of Crystal Growth Defects by X-ray Methods, Plenum Press.

11.X-02 NEUTRON DIFFRACTION TOPOGRAPHY.

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The extension of X-ray topographic techniques to neutrons only started ten years ago (Doi et al, J.Appl. Cryst. 4, 528 (1971)), probably because there are rather few neutron beams in the world.A substantial step forward was achieved when it was shown that, although the instrumental resolution is poor, images of individual defects, like dislocations, can be obtained (Schlenker et al, Appl.Phys.Lett. 25, 382 (1974)) ; Malgrange et al. Phil. Mag. 33, 743 (1976)). The resolution cannot be easily improved to better than $\sim 4.10^{-2}$ mm because it is related to the indirect photographic neutron detection process on the one hand, and mainly to the flux of available neutron beams on the other : exposure times cannot be increased far above one day, and therefore rather large beam divergences ($\sim 0.2°$) and wavelength ranges ($\Delta\lambda/\lambda \sim 10^{-2}$) have to be tolerated. In spite of this drawback, neutron diffraction topography (NDT) has developed along two main lines where other techniques are not applicable: 1) investigation of inhomogeneities, in highly X-ray absorbing crystals, and 2) direct visualization of magnetic domains of all kinds.
1) In most materials neutron absorption is weak. It is thus possible to investigate in transmission either thin crystals containing heavy elements, like $PbCO_3$ (Baruchel et al, J. Cryst.Growth 44, 356 (1978)) or, by using the principle of section topography, virtual slices of thick crystals (∿cm) (Tomimitsu and Doi, J.Appl.Cryst. 7, 59 (1974) ; Davidson, J.Appl.Cryst. 7,356 (1974) ; Schlenker et al, J.Appl.Phys. 46, 2845 (1975) ; Tomimitsu et al Phil.Mag.A 38,483 (1978) ; Bouillot et al, this conference).
2) Neutrons have a magnetic moment, and can therefore directly sense the arrangement and/or the direction of ordered magnetic moments within the crystal. Ferromagnetic domains can be visualized using polarized neutrons (Schlenker and Shull, J.Appl.Phys. 44, 4181 (1973)) ; images of the walls also occur when unpolarized neutrons are used (Schlenker et al, Phil.Mag. B, 37, 1 (1978)). This makes it, in principle, possible to observe the domain structure within a non transparent sample. But the area where NDT has supplied most original information is the study of the various antiferromagnetic domains. Since the pioneering work on spin-density wave domains in chromium (Ando and Hosoya, Phys.Rev.Lett. 29, 281 (1972)), which has shown that theoretical predictions about domain size were at variance, by several orders of magnitude, with experimental facts, many other investigations have been carried out. Propagation vector (k-domains) and spin direction (S-domains) related domains have been observed in NiO : it was possible, from the obtained images, to rule out < 110 >,one of the suggested possibilities as antiferromagnetic direction, and to unambiguously identify each domain type (Baruchel et al, J.Appl.Phys. 48, 5 (1977), and this conference). On the other hand polarized NDT is the only available technique to visualize two other kinds of antiferromagnetic domains : we have performed the first observation of 180° (or time-reversed) domains in MnF_2, and qualitatively explained their behaviour when a magnetic field is applied during the paramagnetic-antiferromagnetic transition by taking into account the piezomagnetic properties of this material (J.Magn.Magn. Mat. 15-18,1510 (1980)) ; and we have recently observed chirality domains (right- and left-handed helices) in helimagnetic terbium (Baruchel, Palmer and Schlenker, this conference).

NDT has opened new fields of investigation. Its usefulness and applications will probably increase in the next years, not only for the investigation of magnetic domains and of defects in crystals too absorbing for other probes, but also, as soon as perfect enough magnetic crystals are available, in experimental tests of the dynamical theory of magnetic neutron scattering.

11.X-03 DIFFRACTION THEORY AND EXPERIMENT RELATED TO STUDIES OF DEFECTS, OTHER THAN TOPOGRAPHY.

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The various diffraction techniques for the study of statistically distributed defects are characterized in reciprocal space. The emphasis is on recent progress in diffuse scattering experiments and on the present understanding of Bragg diffraction in imperfect single crystals. Professor Kato's extinction theory provides a new perspective for the discussion of the diffraction mechanism in real crystals. Experiments are needed which relate this theory to the actual defect structure of the single crystal sample. Here the use of Synchrotron radiation which is linearly polarized and tuneable in wavelength should be of great help. A diffractometer adapted to the properties of Synchrotron radiation will be presented. As an example of the use of short wavelength photons in diffraction experiments some results from γ-ray diffractometry will be discussed.