13-Defects, Microstructures and Textures

All superlattice variants of the CO_3-arrangements are observed to be very susceptible to the disordering due to electron irradiation damage; first the sense of the CO_3-arrangement is lost and the superlattice variants disappear, the structure retains the symmetry of the body-centred modulated block-layer. Finally, since the displacement modulation in a block-layer is coupled to the degree of order in the CO_3 layers, it will also tend to disappear and eventually the higher symmetry of the basic perovskite structure will be achieved.

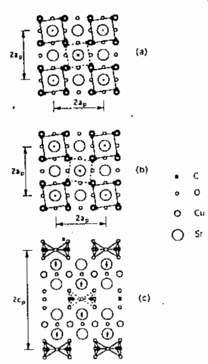

Fig.1.

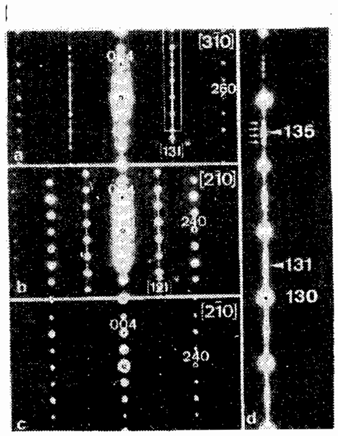

Fig.2.

Fig.1. Schematic of the two substructures in the $Sr_2CuO_2(CO_3)$ unit cells: (a) and (b) projections along [001] for the body-centred and primitive superlattice, respectively; (c) projection along [100] - the same for both cells. CO_3-layers are emphasized by C-C and C-O bonds.
Fig.2. Electron diffraction patterns of $Sr_2CuO_2(CO_3)$ along: (a) [310] zone; (b) and (c) [210] zone before and after irradiation, respectively; (d) enlargement of $[13l]^*$ row in (a).

13.02 – Characterization of Materials by Topography and High Resolution Diffractometry

MS-13.02.01 RECENT DEVELOPMENTS IN PLANE WAVE X-RAY TOPOGRAPHY By T. Ishikawa*, Department of Applied Physics, University of Tokyo, Japan.

Extremely high brilliance as well as sharp collimation in vertical direction of synchrotron radiation give a sufficient intensity of incoming beam of high resolution x-ray topography even after conditioned by perfect crystal x-ray optics for high collimation and high monochromatization. Plane wave x-ray topography, which originated in laboratory source as a version of double-crystal topography with asymmetric collimator, becomes much more easily accessible by using synchrotron radiation, because there are no vibration and heat source near the diffractometer, in addition to the high intensity of the incoming beam. At the Photon Factory, a multi-axis diffractometer for precision topography and high-resolution scattering was developed. Large area of the sample crystals, more than 50x50 mm^2, can be simultaneously exposed by expanding the narrow synchrotron beam vertically by using a single asymmetric collimator. Plane wave topography using high order reflections makes it possible to observe various inhomogeneities in state -of-art silicon crystals in as grown state. The white spectrum of synchrotron radiation makes the commercially available crystal plates such as (001) or (111) oriented as good asymmetric collimators for various reflections by a suitable selection of the wavelength. Successive use of asymmetric collimator can make the angular collimation of incident beam less than 1/200 of the intrinsic diffraction width. With this incident beam, oscillatory profiles in Laue case rocking curve were clearly observed. The small angular period of oscillation gives corresponding contrasts to minute strain fields in highly perfect silicon, which are known as equal-inclination fringes. Wavelength tunability of synchrotron radiation is useful not only for obtaining appropriate asymmetric collimator, but for realizing extremely asymmetric reflection at sample crystal. This enables us to make selective observation of crystal quality in the surface vicinity, as well as the localized strain field near the hetero-interfaces and thin epitaxial layers. Plane wave topography was expanded by adding an analyzer crystal after the sample crystal. By this, spatial mapping of dilation and inclination of lattice planes became possible.

MS-13.02.02 **TOPOGRAPHY OF THE DIFFUSE SCATTERING CLOSE TO BRAGG PEAKS.** By Paul F. Fewster, Philips Research Laboratories, Cross Oak Lane, Redhill, Surrey, U.K.

Diffuse scattering close to the Bragg condition arises from crystal imperfections. To interpret this scattering many theoretical models have been proposed to extract information on microdefects. With diffractometry alone there are uncertainties in the origin of this diffuse scattering due to instrumental artifacts and other defects of lesser interest. This paper discusses the importance of the instrumental probe and how a "δ-function type" probe (Fewster, J. Appl. Cryst. 1991, 24, 178-183) for topography gives an unanbiguous interpretation of the diffuse scattering. The scattered intensity distribution has been mapped to very high resolution in the vicinity of the Bragg peaks of good quality GaAs, device quality Si and nominally "dislocation-free" Ge substrate crystals. Topography has been used to show that the majority of the scattering emanates from surface damage or dislocations and not point defects or thermal diffuse scattering (TDS). These latter two contributors give rise to a very weak background intensity in the most highly perfect crystals.

A nominally "dislocation-free" Ge crystal was shown to have a very weak background intensity, 10^{-4} of 333 Bragg peak at 15"arc away. With this high resolution probe the relative strain and tilt associated with each image is obtained and the swamping influence of the Bragg scattering is minimised. This method has enabled the characterisation of the diffuse scattering and provided a rapid analysis of surface damage.

MS-13.02.03 **IN SITU SYNCHROTRON TOPOGRAPHY STUDIES OF FERROELASTIC DOMAIN STRUCTURE AND PHASE TRANSITION IN LANTHANUM PENTAPHOSPHATE. By Z.W.Hu*, X.R. Huang, S.S. Jiang, and D. Feng, National Laboratory of Solid State Microstructures, Nanjing University, P.R. China**

The ferroelastic domain structure and phase transition in Lanthanum Pentaphosphate(LaP_5O_{14}) have been studied. A set of normal ferroelastic domains, zigzag domains, growth bands, and growth sector boundaries are observed by white-beam synchrotron radiation X-ray topography(WBSRXT) and the domain walls are found to vanish and reappear with characteristics of a classical second-order phase transition on real time synchrotron topographs on cycling the sample between room temperature and above the transition temperature(T_c). However, a fluctuation of the number of domains or domain walls with temperature approaching T_c, is revealed and shown to be reversible by real time WBSRXT. An interpretation of this interesting phenomenon and theoretical analysis of the domain structure are presented, respectively, in terms of the classical Landau theory and group theory.

