11.5-07 HIGH RESOLUTION X-RAY STUDIES OF MICROSTRUCTURAL CHANGES ASSOCIATED WITH CONDUCTION AT HIGH ELECTRIC FIELDS IN SEMICONDUCTORS AND INSULATORS. By Krishan Lal, National Physical Laboratory, Hillside Road, New Delhi-110012, India and P. Thoma, Physikalisch-Technische Bundesanstalt, 3300 Braunschweig, F.R. Germany.

At high electric fields, the electric current through the insulators and semiconductors is not uniformly distributed in the volume. In the present work a new high resolution X-ray technique has been developed and used to directly observe the microstructural changes that occur in insulators and semiconductors subject to high electric fields. A highly collimated $K\alpha_1$ beam obtained by combining a fine focus X-ray source, a special collimator and a grooved silicon monochromator is used as the exploring beam. The specimen is in the form of a disc with thin aluminium electrodes (few micron thickness) evaporated on its larger faces. It is oriented for diffraction of X-rays from a predetermined set of atomic planes. Before the application of electric field, a high resolution projection topograph, a diffraction curve at the middle position of the electrodes is recorded. Projection topographs, diffraction curves and diffracted beam intensity are recorded at various values of electric fields. Also the diffracted beam intensity and the electric current through the specimen are recorded simultaneously as a function of time. The field strength varies from material to material. A comparison of the topograph before, during and after the application of the electric field gives a direct picture of microstructural changes taking place in the specimen as a result of electric fields (Fig. 1). At high power densities the electric current and the diffracted beam intensity are changing. An excellent correlation has been observed between the diffracted beam intensity and the electric current (Fig. 2). Remarkable changes in the positions and shapes of diffraction maxima have also been observed.

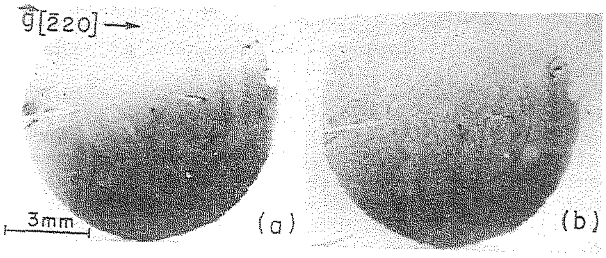

Fig. 1 Traverse topographs of a Si single crystal (a) at zero electric field (b) under electric field (E=135V/mm; I = 10mA), Mo $K\alpha_1$ radiation was used.

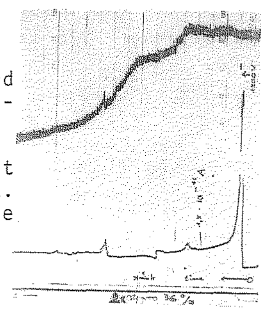

Fig. 2 Simultaneous record of diffracted X-ray intensity from (200) of LiF crystal and the electric current through it when it is subject to E=8000 V/mm. The two recording pens are shifted by 5 mm.

11.5-08 DIPOLE ORIENTATION EFFECT ON LATTICE DISTORTION OF KCL:Eu^{2+} CRYSTAL. By J.Stępień-Damm, K.Łukaszewicz. Institute for Low Temperature and Structure Research, Polish Academy of Sciences, Wrocław, Poland.

In Eu^{2+} doped KCl crystals the impurity dipoles are composed of Eu^{2+} ions and cation vacancies in the nearest neighbour positions. It has been recently found that Eu^{2+} dipoles bring about extremaly strong compression of KCl matrix (Stępień-Damm, Dubiel, phys.stat. sol.(a),(1980) 59,743), by far larger than that induced by other Me^{2+} ions (Stępień-Damm, Łukaszewicz, Krist. und Techn.(1980),15,1173). Under the action of d.c. electric field the Eu^{2+} dipoles undergo preferential orientation (Unger, Perlman, Phys.Rev.B(1972) 6, 3973). We have used KCl:Eu^{2+} (~130 ppm Eu) samples cut parallel to (110). After polarization (~9 KV/cm) in |110| direction at 233 K, the sample was cooled down to ~173K, electric field (E) was switched off and interplanar distances were measured for |110| and |1$\bar{1}$0| directions by the Bond method. It has been found that, in agreement with our expectation, electric field induced dipole orientation brings about an asymmetric distortion of the matrix. This asymmetry is preserved up to about 208 K (Fig.) at which temperature frozen-in dipoles start to rotate in agreement with thermally stimulated depolarization current measurements. At higher temperatures both interplanar distances are the same. The above measurements show that the lattice undergoes contraction along the axis of the dipole and an expansion in perpendicular direction.