11.1-4 X-RAY TOPOGRAPHIC STUDY OF DISLOCATION FORMATION AT ARTIFICIALLY INTRODUCED INCLUSIONS. By M. Goebbels, R. A. Becker and H. Klapper, Institut fuer Kristallographie der RWTH, D-5100 Aachen, Federal Republic of Germany.

During crystal growth dislocations originate mainly from inclusions of solvent, of solute precipitates (*e.g.* gas bubbles), or of foreign particles. The dislocations result from lattice closure errors which occur when the inclusion is being covered and 'closed' by the growth layers spreading out over the growth face. Thus, the generation of growth dislocations is strongly correlated with inclusions.

Recent X-ray topographic studies of organic molecular crystals grown from undercooled melts indicate that the generation of dislocations 'behind' inclusions (viewed along the growth direction) depends on the growth face, *i.e.* inclusions formed on one growth face may lead more frequently to dislocations than inclusions on other (non-equivalent) faces. In order to study this occasional observation in more detail, the following experiments were carried out.

Rings of NiCr wire (0.1 mm Ø) were placed into slightly undercooled melts of benzophenone and salol. A seed crystal was suspended in the centre of the ring. During growth the ring was completely incorporated into the crystal. By choosing suitable orientations of the seed with respect to the ring, the wire was incorporated on different (non-equivalent) growth faces. Plates containing the rings were examined by X-ray topography using $CuK\alpha_1$-radiation. The essential observations are summarized as follows.

- In general, many dislocations appear 'behind' the grown-in wire. Wire segments (approximately) parallel to the growth face generate more dislocations than segments inclined to the face, *i.e.* lattice closure errors occur more frequently at inclusion surface segments parallel to the growth face. This can be understood by geometrical reasons.
- For salol (Fig. 1) increased occurrence of dislocations in certain growth sectors could not be confirmed. In benzophenone, however, only a few dislocations are formed in {110} and {010} sectors (Fig. 2), but many occur in {111} sectors.
- A predominant occurrence of certain Burgers vectors in a given growth sector could not be established.
- Frequently glide dislocation (half-loops) are generated by the stress surrounding the wire.

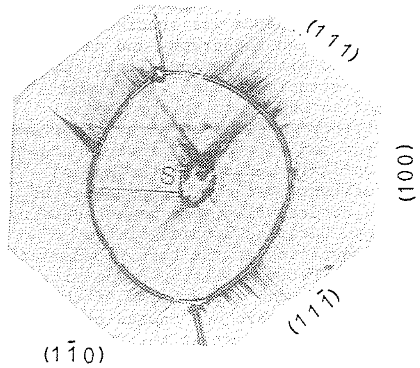

Fig. 1. (010) plate of salol, 1.5 mm thick. S: seed crystal. Many dislocations (mostly inclined towards the plate surface) originate from the ring (about 25 mm diameter).

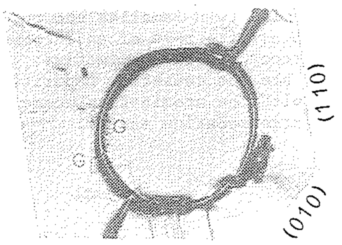

Fig. 2: (001) plate of benzophenone, 1.5 mm thick. Only few dislocations originate from the ring (16 mm diameter). G: Glide dislocations (half-loops).

11.1-5 CRYSTAL DEFECTS INDUCED BY DEVICE MANUFACTURE OF QUARTZ OSCILLATORS. By M. Fehlmann, Institut für Kristallographie, ETH-Zürich, Switzerland.

U-shaped bars of quartz single crystals are frequently used as tuning forks for the control of electric timing in watches. We have examined such quartz oscillators by X-ray topography in order to determine the cause of the anisochronal behaviour (i.e. the frequency change as a function of operating time) of some of these oscillators.

Lang topographs (Fig. 1) show various dislocations, originating from different sources, for both isochronal and anisochronal oscillators. The heavily distorted regions (A) at the ends of the prongs and at the stem occur after the tuning of the oscillators by means of sandblasting, but these defects are also seen in isochronal tuning forks. Crystal defects located at the bifurcation (B) seem to be responsible for the anisochronal behaviour. We then examined whole crystal plates (Fig. 2) during the manufacturing process (sawing, etching, deposition of a Cr/Au film, etc.) to identify the cause of these defects. The defects at the bifurcation turned out to be produced during the sawing of the slits. The creation of the straight edge dislocations along the edges of the electrodes (C) is due to the photolithographical removal of part of the Cr/Au film and this enables the strain introduced by the deposition process to be relieved.

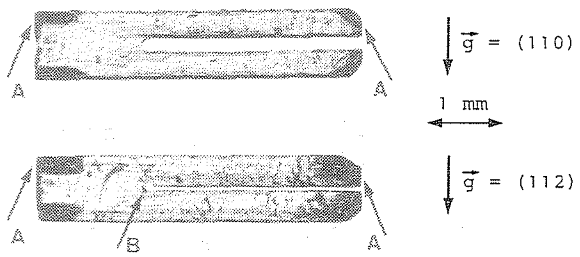

Fig. 1. X-ray topographs of isochronal (top) and anisochronal (bottom) tuning forks

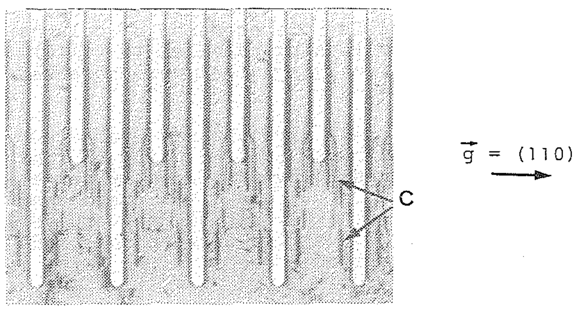

Fig. 2. X-ray topograph showing part of a quartz plate before the final cut to produce the single tuning forks