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An Analysis of the Fringe Contrast seen on X-ray Topographs of the $-X$, Z Growth Sector Boundary in Synthetic Quartz

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Parallel stacking-fault type fringes on Lang topographs of synthetic quartz have been observed in the region of the growth sector boundary when the boundary is inclined at a shallow angle to the X-ray entrance and exit faces of the specimen. Fringes have been previously reported at the growth sector boundary on Lang topographs of a number of different materials under similar diffraction conditions [Klapper, H. (1971). *J. Cryst. Growth.* **10**, 13–25; Ikeno, S., Maruyama, H. & Kato, N. (1968). *J. Cryst. Growth.* **3, 4**, 683–693]. However, the only previous attempt at accounting for these fringes quantitively (by Ikeno *et al.*) is conceded by its authors to yield unsatisfactory results. The X-ray energy flow pattern in the crystal in the vicinity of the growth sector boundary has been determined by X-ray section topography and the pattern closely resembles the energy flow observed in a crystal of calcite containing a thin twinned lamella and analysed theoretically by Authier, A. & Sauvage, M. [*J. Physique*, **27**, C3-137–C3-150] to be due to a change in X-ray incidence conditions close to the boundaries between the two halves of the crystal separated by the thin twinned region. An analysis of a number of section topographs for different orders of reflexion from the same set of lattice planes using Cu $K\alpha_1$ and Mo $K\alpha_1$ radiation employing the Authier & Sauvage theory shows that there is a pure tilt of $2 \cdot 8 \times 10^{-6}$ radians between the two growth regions. The origin of this tilt is discussed in terms of the lattice deformation in the vicinity of the growth sector boundary proposed by Parpia [*J. Appl. Cryst.* (1975). **8**, 203].

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An Investigation of the Nature of the $-X$, Z Growth Sector Boundary in Synthetic Quartz

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Growth sector boundaries exist in all crystals where adjacent regions which have grown on crystallographically different faces meet one another. There is however disagreement in the literature [Fishman, Yu. M. & Lutsau, V. G. (1970). *Phys. Stat. Sol.* (*a*), **3**, 828–837; Beswick, D. M. & Lang, A. R. (1972). *Phil. Mag.* **26**, 1057–1070] about the nature of this boundary, and the diffraction contrast seen at the interface between the two regions of growth on Lang X-ray topographs is not satisfactorily explained. The boundary between the $-X$ and Z growth regions in synthetic quartz has been studied using X-ray topography and other techniques and it has been found that the crystal lattice remains coherent at the boundary. A comparison of the X-ray powder diffraction photographs obtained from the material from the two sectors shows that the $-X$ region is expanded in the direction of the c axis relative to the Z region with $\Delta c/c \simeq 7 \cdot 2 \times 10^{-5}$ and contracted with respect to the Z region in the a direction with $\Delta a/a \simeq 7 \cdot 4 \times 10^{-5}$. The result that there is a contraction of the material in the $-X$ region of growth in the a direction, which also colours preferentially on X-irradiation, is in agreement with Bonse's finding [Bonse, U. (1965). *Z. Phys.* **184**, 71–84] that the growth bands in natural quartz which colour preferentially on X-irradiation are also contracted in the a direction relative to the ones which do not colour. It is therefore possible to account for the direct image contrast of the grwoth sector boundary seen on X-ray topographs in terms of the proposed model of the lattice deformation in the region of a coherent boundary between adjacent regions having relative differences in lattice spacings.