Tetragonal metals

The composition plane of twinning in β-tin has recently been redetermined by Clark, Craig & Chalmers (1950) as the (301) plane. The (010) plane is normal to this, and, since it is a plane of symmetry, it must represent the plane of shear. The intersection of these two planes gives $\eta_1 = [\bar{1}03]$ and a construction of atomic positions in the twinned and untwinned state shows $K_2 = (\bar{1}01)$, $\eta_2 = [101]$.

Chalmers (1935) has studied the atom movements involved in the twinning operation, but he took the lattice as face-centred tetragonal (Clark & Craig, 1952). The unit cell is, in fact, tetragonal with four atoms in the special positions 0, 0, 0; 0, $\frac{1}{2}$, $\frac{1}{4}$; $\frac{1}{2}$, 0, $\frac{3}{4}$ and $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$. An analysis of the atom movements shows that very few of the atoms move into their new positions by simple homogeneous shear. However, the atoms at $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$ do obey the homogeneous shear rule, and their movement probably stabilizes the deformation twin and allows it to develop.

The composition plane for twinning in indium has also been recently determined (Becker, Chalmers & Garrow, 1952) as of the type (101). By considering the planes of symmetry, as in the case of β-tin, the remaining twin components and the shear can be determined.

Rhombohedral metals

The accepted components for twinning in these metals are $K_1 = (110)$, $\eta_1 = [001]$, $K_2 = (001)$, $\eta_2 = [110]$.

The value for s can then be obtained as

$$s = \frac{4 \cos \alpha \sin \frac{1}{2}\alpha}{\{1 - 3 \cos^2 \alpha + 2 \cos^3 \alpha\}^{\frac{1}{2}}}$$

or

$$s = \frac{2 \cos \alpha}{\{\frac{1}{2}(1 + \cos \alpha) - \cos^2 \alpha\}^{\frac{1}{2}}},$$

where α is the rhombohedral angle. This corrects the expression given in Schmid & Boas (1950, p. 94). The redetermined values of the shear are listed.

α-Uranium

Cahn (1953) has studied the twinning modes of α-uranium. This metal is orthorhombic, and some components of the twins have irrational indices. Examples of these are more common in minerals, for, in metals of high symmetry, compound twins, with all elements rational, are usually observed. Frank (1953) has shown how these irrational modes are to be expected from a consideration of the allied structure of zinc.

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Surface layer on crystalline quartz.

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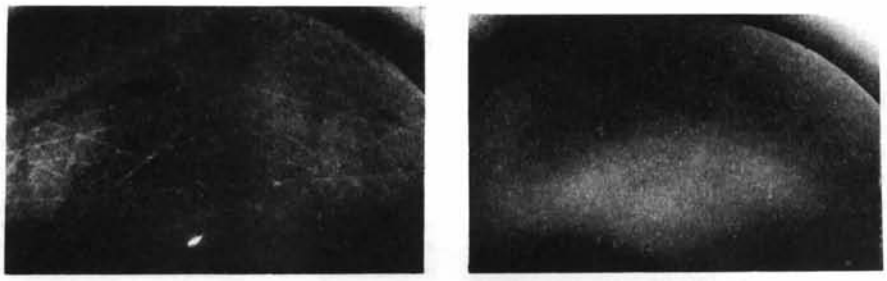
In an X-ray examination of particles of crystalline quartz, Nagelschmidt, Gordon & Griffin (1952) have deduced the presence of an amorphous layer on the surface of the particles. The presence of such a layer is assumed by Clelland, Cumming & Ritchie (1952), who state that such a layer may be produced by the action of hydrochloric acid on the crystal surface. The thickness of the layer, deduced from the X-ray evidence, is of the order of 300 Å. Such a layer on a crystalline material would be readily detected by electron diffraction. In the absence of an amorphous surface layer, a rock-quartz crystal surface yields a sharp Kikuchi pattern. Fig. 1(*a*) shows the pattern obtained after treating such a crystal surface with boiling concentrated hydrochloric acid for 1 hr. The pattern is found to be very slightly *clearer* than that obtained before treatment. This may be due to the removal by etching of a strained (but still crystalline) surface layer.

It is of importance to know the minimum thickness of amorphous layer which could be detected by obscuration of the Kikuchi pattern. This will depend on the surface microtopography. If the local surface nowhere makes an appreciable angle with the mean surface, then (neglecting refraction) the depth of penetration of the beam is given by $d \sim \frac{1}{2}L\theta$, where θ is the glancing angle and L the mean free path. Putting $\theta = 0{\cdot}01$ radian and $L \sim 1000$ Å, we obtain $d \sim 5$ Å. The presence of an amorphous layer of this thickness would thus completely obliterate the Kikuchi pattern. If the local surface makes large angles with the mean surface the situation is less favourable. For the worst case, in which the beam enters and leaves a projection normally, the depth of amorphous layer



(*a*) (*b*)

Fig. 1. (*a*) Kikuchi pattern from rock-quartz crystal surface after treatment with boiling hydrochloric acid for 1 hr. (*b*) Pattern from crystal with aluminium layer of mean thickness 0·9 Å covering surface.

which may escape detection may be estimated as $\leqslant$ 40 Å.

A simple experiment served to determine the minimum detectable amorphous layer on the quartz crystals being examined. A thin (invisible) film of aluminium was evaporated on to the quartz, simultaneously with layers on glass plates placed nearer to the source. The thickness of the latter deposits were determined from their optical transmission using the results given by Walkenhorst (1941). The thicknesses observed on the nearer plates indicated that the thickness variation was approximately given by the inverse square law. The diffraction pattern shown in Fig. 1(*b*) was obtained with an aluminium layer of mean thickness 0·9 Å covering the surface; the Kikuchi lines are almost completely obliterated. The quantity of aluminium deposited corresponds to less than one atomic layer; from the known tendency to aggregation of such deposits, it is likely that under these conditions the quartz surface is covered with small nuclei, one or two atoms thick. The scattering power of aluminium is approximately the same as that of the atoms in quartz. Since so small an amount of aluminium suffices to obscure the Kikuchi lines, it is clear from the sharpness of the patterns obtained from the rock-crystal that any non-crystalline surface disorder cannot extend beyond the first one or two molecular layers.

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Notes and News

Announcements and other items of crystallographic interest will be published under this heading at the discretion of the Editorial Board. Copy should be sent direct to the British Co-editor (R. C. Evans, Crystallographic Laboratory, Cavendish Laboratory, Cambridge, England).

Exhibition of X-ray Crystallographic Equipment

The X-ray Analysis Group of The Institute of Physics announces that its autumn conference will be held in London on 20 and 21 November 1953, and an exhibition of X-ray diffraction equipment will be an important feature of it. Offers of exhibits are invited under two headings: (*a*) apparatus commercially available in the U.K.; (*b*) examples of recent developments in X-ray crystallographic equipment that have been made in universities and other research centres in the U.K. Examples of the kind of exhibit envisaged are: X-ray tubes, diffraction cameras of all types, micro-beam techniques, counters and counter-spectrometers for diffraction work, any aids to interpretation, monochromators, microdensitometers, travelling microscopes, X-ray films and photographic accessories, and spectrometers for fluorescent analysis. Owing to the limited space available a selection will no doubt have to be made from the offers submitted.

Offers of exhibits giving details of approximate bench and floor space required and of any services needed should be submitted before 1 September 1953 to the Conference Secretary, Mr H. J. Goldschmidt, c/o The Institute of Physics, 47 Belgrave Square, London S.W.1, England.