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Laue rotation lines.*

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In the course of an investigation into rolling textures of titanium by X-ray diffraction, an unusual diffraction effect was observed which might be misleading if interpreted in terms of the more conventional Debye–Scherrer pattern. A similar effect, but less marked, has previously been obtained from an aluminium alloy airscrew (C. Wainwright, private communication).

A polycrystalline specimen which is rotated about an axis parallel to the X-ray beam can give rise to two diffraction patterns: the normal Debye–Scherrer pattern due to the characteristic radiation and a set of rings due to the continuous radiation, designated Laue rotation lines. Since the intensity of the continuous radiation is relatively low, the visibility of the latter pattern will be very dependent on the density of the background. In addition, the visibility depends also on the ratio of crystallite size to X-ray beam diameter. If this ratio is large, that is if only one or two crystals are irradiated, then the continuous radiation patterns will be prominent. This is, however, a trivial case, since Debye–Scherrer patterns are not obtained under these conditions. If the crystallite size is such that a stationary specimen will produce spotty Debye–Scherrer rings, there will be a corresponding increase in the number of continuous-radiation rings but a decrease in their visibility. On further reduction of crystallite size, Debye–Scherrer rings become continuous while the other rings increase in number and finally merge together to form a diffuse background.

A striking change in the appearance of the Laue rotation lines can be brought about by a change in orientation of the specimen axis of rotation relative to the beam. Fig. 1 was obtained by rotating the specimen axis of rotation through 60° about a vertical axis, the plane of the film being vertical. The prominent lines are part of the Debye–Scherrer pattern while the closed curves are formed by the continuous radiation. The interpretation of these photographs is facilitated by use of the concept of reciprocal space.

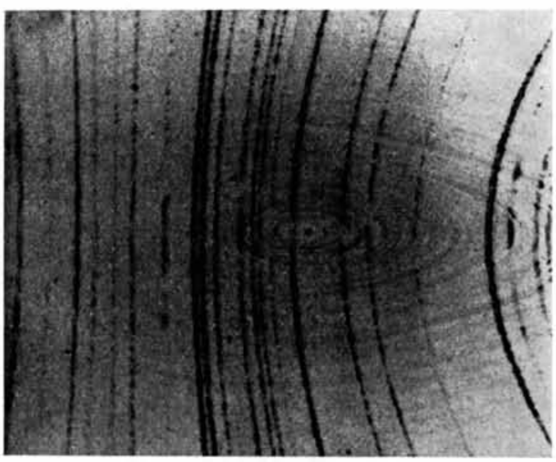

Fig. 1.

In Fig. 2, O is the origin in reciprocal space, OA is the axis of rotation, the sphere of reflexion, centre C, is assumed to be of unit radius, so that lattice planes (of spacing d) perpendicular to OB are represented by the line OB in reciprocal space. OB intersects the sphere of reflection at D and a diffracted beam will fall on the

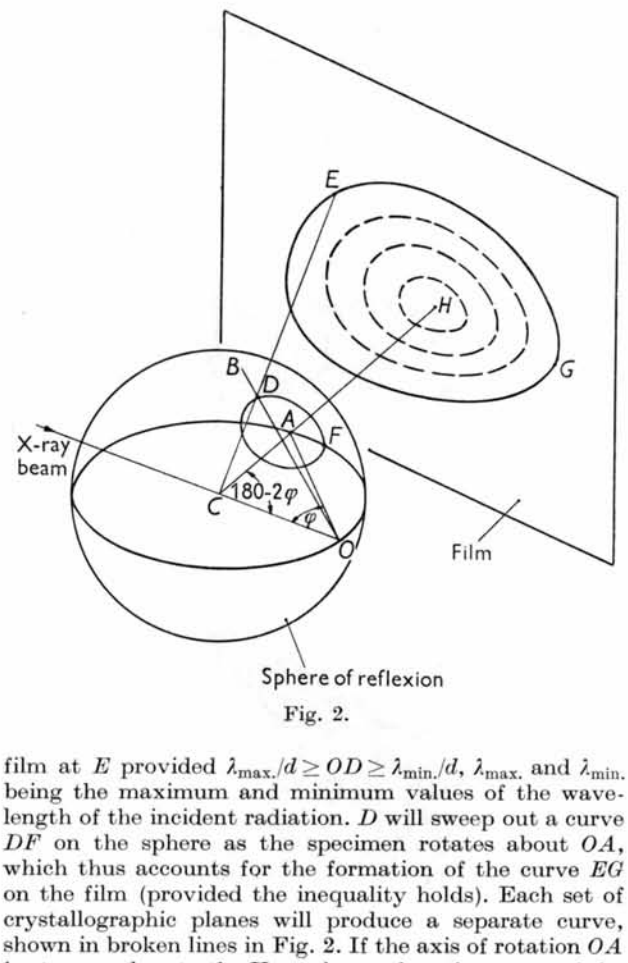

Fig. 2.

film at E provided $\lambda_{\text{max.}}/d \geq OD \geq \lambda_{\text{min.}}/d$, $\lambda_{\text{max.}}$ and $\lambda_{\text{min.}}$ being the maximum and minimum values of the wavelength of the incident radiation. D will sweep out a curve DF on the sphere as the specimen rotates about OA, which thus accounts for the formation of the curve EG on the film (provided the inequality holds). Each set of crystallographic planes will produce a separate curve, shown in broken lines in Fig. 2. If the axis of rotation OA is at an angle φ to the X-ray beam then the centre of the pattern lies on the line CH at $180–2\varphi$ to the beam.

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