strong beam, a state of equilibrium is reached so that for all greater thicknesses the weak and strong beams have, on the average, the same relative intensities. This implies that the scattering from strong to weak beams is exactly matched by scattering from weak to strong beams. Thus the effect of weak beams is not that of an absorption except for very thin crystals. The main effect for thick crystals is to modify the effective structure factor for the main beams, giving changes in the average intensity and extinction distances. For rings or arcs from polycrystalline specimens, the changes may be small except in special cases such as for higher orders of strong inner reflexions (for a review, see Cowley, 1967).

The temperature dependence of diffraction rings given by polycrystalline specimens should be describable in terms of

(1) the Debye–Waller temperature factors in the structure factors for the strong reflexions,

(2) the absorption effects on the strong beams due to thermal diffuse scattering (Hall & Hirsch, 1965; Cowley & Pogany, 1968),

(3) the *n*-beam interactions between strong and weak beams, which should be strongly temperature dependent because they are affected by the Debye–Waller factors and absorption effects on all beams (Goodman, to be published),

(4) the temperature dependence, if any, of other absorption effects such as those due to plasmon or single electron excitations or scattering by crystal defects or disorder.

The fact that very good agreement has been found between the predictions of the BJR theory and experimental measurements on such a temperature dependence suggests that comparison with this type of experimental evidence may not be a very sensitive test of the rigour of an approach to dynamical theory, in that any theory taking dynamical effects into account to a sufficient degree may give much the same results.

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Interferometric study of liquid crystalline surfaces.

By S. CHANDRASEKHAR and N. V. MADHUSUDANA, *Department of Physics, University of Mysore, Mysore, India*

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The optical interferometric technique has been used to examine liquid crystalline surfaces. Topographs are given of stepped and faceted drops. Some new surface features of the smectic and cholesteric phases are also presented. The nematic phase gives fringe contours similar to those of the isotropic liquid.

We have used the optical interferometric technique to examine the topographical features of liquid crystalline surfaces. A tiny droplet of the specimen was taken on a microscope slide and a thin cover slip was placed over but not actually touching it. Two-beam interference fringes with monochromatic radiation (λ5893 Å) formed between the upper surface of the droplet and the lower surface of the cover slip were observed and photographed through a reflexion microscope provided with a hot stage (see, *e.g.* Tolansky, 1948). The substance was heated till it became liquid and then brought to the mesomorphic phase by slow cooling to any desired temperature. Under favourable conditions, an optically homogeneous drop could be formed. A few typical cases are described below.

Fig. 1(*a*) illustrates the fringe patterns obtained from a solution of potassium oleate in aqueous methyl alcohol. The solution exhibits lyotropic mesomorphism at room temperature. Microscopic examination (in transmitted light) of the textures of the mesophase showed that they are identical with those of potassium oleate in aqueous ethyl alcohol as reported by Chistyakov (1961), confirming that the phase is smectic. The fringe pattern in Fig. 1(*a*) reveals the characteristic stepped regions of the smectic phase, the origin of which can be explained from surface energy considerations (Chandrasekhar, 1966). Observations through a polarizing microscope between crossed polars showed that the specimen was optically homogeneous with the long axes of the molecules parallel to the direction of observation *i.e.* normal to the plane of the paper; in parallel light complete extinction was obtained for all settings of the microscope stage, and in convergent light the uniaxial cross was seen. Further, the interference colours produced by inserting a full-wave plate between the crossed polars established that the specimen was optically positive (see, *e.g.* Ennulat, 1968). Fig. 1(*b*) shows a stepped drop [goutte à gradins (Grandjean, 1917)] of the same substance.

Fig. 2 illustrates the striking changes in the topography of a large drop of a mixture of methyl stearate and methyl palmitate when cooled from the liquid to the liquid crystalline phase. In the latter phase the long axes of the molecules were parallel to the direction of observation. The smooth, rounded surface of the liquid drop [Fig. 2(*a*)] develops plane faces and sharp edges in the mesophase [Fig. 2(*b*)]. The faceted drop (goutte à facettes) was discovered by Bernal & Crowfoot (1933) in one of the mesophases of ethyl anisal *p*-aminocinnamate and of ethyl-phenyl benzylaminocinnamate. The presence of faces, edges and corners indicates a very high degree of molecular order resembling that in a crystalline solid, though as far as its mechanical properties are concerned this phase is more appropriately described as liquid crystalline (Bernal & Crowfoot, 1933; see also Chandrasekhar, 1966). Optical, X-ray and infrared studies (Krishnamurti, Krishnamurthy & Shashidhar, 1969) have established that a mixture of methyl stearate and methyl palmitate forms an *ordered* smectic phase over a composition range of 20–75% by weight of stearate. There is effective hexagonal packing in the smectic layers due to the rotation of the lath shaped molecules about their long axes (Bernal & Crowfoot, 1933; Herrmann, 1935).

Cholesteryl oleate is smectic at room temperature (Friedel, 1922). Fig. 3 shows the patterns from a homogeneous drop in which the long axes of the molecules are parallel to the direction of observation. A new feature seen here is the waviness of the fringes, which is due to the presence of hills and craters on the surface. Similar patterns were obtained with cholesteryl palmitate, which is also smectic.

Cholesteryl 2-propyn-1-yl carbonate is optically uniaxial negative at 75 °C and displays bright colours characteristic of the cholesteric mesophase. An open droplet of the liquid crystal invariably consisted of randomly oriented birefringent regions that could be seen in transmitted light between crossed polars. The surface of such a droplet gave smooth fringe contours resembling those from a liquid drop except that the fringes had a grainy appearance probably due to the slight variations of the reflecting power of the birefringent regions. When the droplet was squeezed and made to spread by pressing the cover slip, interesting surface features developed. These are illustrated in Fig. 4 for a region of the droplet that has flowed from the bottom to the top of the photograph. The area of contact between the cover slip and the liquid crystal is not shown. The broad fringes on the right hand top corner are from the glass surface of the microscope slide. The wavy pattern corresponds to the topography of the region of liquid crystal that has flowed upwards without coming into contact with the cover slip. The unevenness of the surface caused by flow was also visible in transmitted light. The wavy pattern disappeared when the substance was heated to the liquid phase.

Nematic liquid crystals gave fringe contours similar to those of the isotropic liquid.

We have carried out some preliminary experiments using multiple-beam interferometry. The upper surface of the microscope slide and the lower surface of the cover slip were semi-silvered. Fig. 5 gives the patterns with oriented droplets of cholesteric oleate in the smectic phase. Comparison with Fig. 3 shows the marked improvement in the sharpness of the fringe system. A number of hills are present on these droplets, but hardly any craters.

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The dependence of X-ray beam homogeneity on absorption by the target.

By W. A. Denne, *Division of Chemical Physics, CSIRO Chemical Research Laboratories, P.O. Box 160, Clayton, Victoria 3168, Australia*

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It is found that absorption of X-rays by the target material can result in beam inhomogeneities of more than 30% at low take-off angles.

It has often been implied or specifically stated (*e.g.* Furnas, 1957; Alexander & Smith, 1962; Burbank, 1964; Young, 1969) that if all parts of the crystal can 'see' all parts of the focal spot in an X-ray diffraction experiment, then the crystal is effectively bathed in a uniform flux of radiation. Although this may be generally true, the absorption of X-rays at low take-off angles by the target is rather high, and as the measurements of Cole, Chambers & Wood (1962) for example show, the rate of change of flux with take-off angle is considerable.

Assessment of the consequent change of flux across the X-ray beam in the region of the crystal was made with a 4-circle diffractometer which has a facility for easy change of tube orientation without disturbing the alignment of the system. A pinhole of diameter 0·0005 inch in lead sheet was mounted on a goniometer head at the centre of all four circles and the counter was set to monitor the resulting direct beam. Movement of the arcs adjustments had little effect on the counting rate, confirming that the aperture size was relatively insensitive to orientation, and a stepwise scan of the counter verified that the scintillation counter had constant sensitivity over the active area. For each of a range of take-off angles the pinhole was used to produce a photograph of the focal spot, and in each case it showed that from the crystal position there was an unimpeded view of all parts of the focus. The pinhole was then made to traverse the beam in the plane of the take-off angle by using the traverse adjustment slide and then in the plane perpendicular to it by rotating the χ-circle through 90·0°. The resulting profiles are shown in Fig. 1.

It is evident that appreciable inhomogeneity exists in the take-off plane for angles less than about 5°, whereas there is none in the plane perpendicular to this, as expected. Such flux variations can result in quite significant systematic errors in accurate intensity measurements especially if the crystal is irregularly shaped or inadequately centred.