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Phase transformations in molecular crystals

In recent studies of polymorphic transformations in molecular solids Mnyukh *et al*[1, 2] have shown that, in general, no definite orientational relationship can exist between the crystal lattices of two polymorphs. Their morphological and X-ray evidence covers a wide range of molecular solids including aromatic and non-aromatic structures, structures involving hydrogen bonds and the "rotator phase" solids and shows that a pleurality of indefinite orientations is invariably observed.

In this communication attention is drawn to certain observations made during our studies of the photochemistry of aromatic solids [3] which is strongly at variance with the above generaliz-

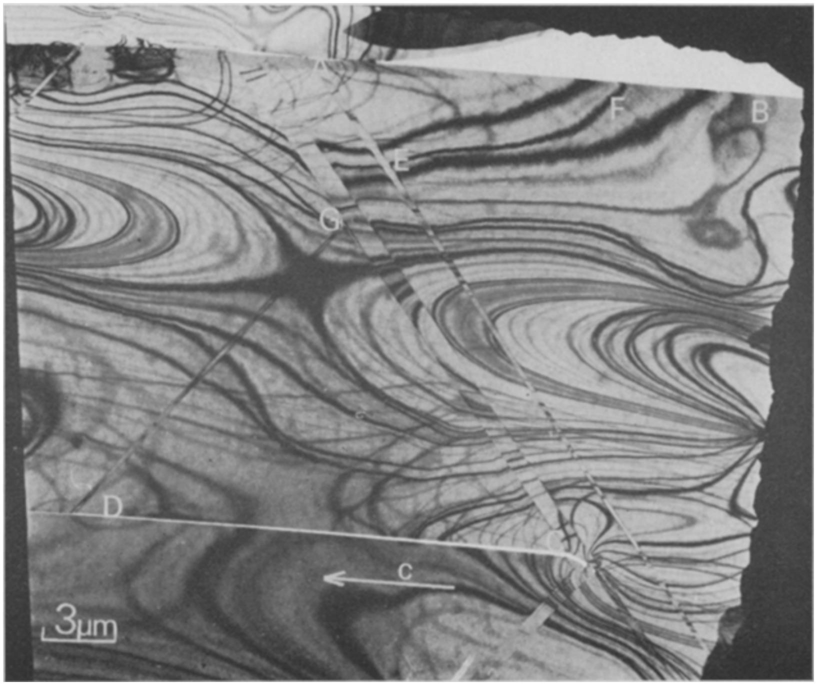

Figure 1 An electron micrograph of a crystallite of 1:8 dichloro-10-methyl anthracene showing plates of a new structure within the parent matrix. The habit planes are approximately parallel to crystallographically equivalent {301} planes.

ation. The results have been obtained on 1,8 dichloro-10-methyl anthracene employing electron and optical microscopy, X-ray studies and differential enthalpic analysis and will be reported in detail elsewhere [4]. The essential information relating to the present discussion is contained in Fig. 1 which shows an electron micrograph of a solution-grown crystal taken with the electron beam normal to *ac* planes. The *c*-direction is indicated and often coincides with crystallite edges (AB) or cracks (CD). Diffraction contrast arises mainly from bend extinction contours, e.g. EF, which are characteristic of the electron micrographs of thin specimens. Certain faulted areas are apparent, e.g. CG, DG, which consist of bands almost parallel to ⟨103⟩ and across which the bend extinction contours are displaced. Analysis of selected-area electron diffraction patterns reveals that the structure inside and outside the faulted regions is different and that well defined orientational relationships exist between the two structures. Furthermore, the available evidence is consistent with the occurrence of a diffusionless (martensitic) transformation [5] in this material and in many respects its behaviour is similar to that exhibited by single-crystalline and bulk polyethylene [6-8]. The procedure adopted by Bevis and Crellin [9] for investigating the crystallography of shear-like processes in polyethylene is applicable to the case of 1:8 dichloro-10-methyl anthracene, but the latter material has distinct advantages over polyethylene for the study of diffusionless transformations in molecular solids since direct observation of the interface between the two phases is possible.

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The influence of flaw density and flaw size distribution on the static and dynamic fatigue behaviour of graphite

Graphite is brittle and fractures by the propagation of the most suitably orientated Griffith-type flaw [1]. The material contains a range of flaw sizes and this leads to a large variability in both fracture and fatigue strengths. Fracture strength depends on the distribution of flaws and applied stress and, hence, must also depend on material volume, shape and mode of stressing. Therefore, the design of structural graphite components has to be statistical in nature and must account for flaw distributions etc., to arrive at acceptable probabilities of failure for practical application.

In two recent publications [2, 3] experimental data concerning the fatigue behaviour of graphite have been statistically examined in an effort to develop a practical method of estimating the cumulative fatigue failure probability of brittle materials. This work has prompted us to further consider the effects of flaw density and flaw size distribution on fatigue behaviour. This has been done by comparing the experimental data with the results expected in the case of an imaginary material containing a single flaw. We present here a preliminary and qualitative discussion of our ideas, which we hope will stimulate further discussion and experimental work in this area.

The results presented for RC4 graphite* showed that dynamic fatigue life of this material increases with applied fatigue stress, σ_A, at a

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*RC4, extruded graphite from Speer Carbon Co of Canada Ltd, Montreal, Canada.