

EXPERIMENTAL

As the high resolution dark field method is described in great detail elsewhere (Hirsch *et al.*, 1969), only a very brief description is included here. An electron beam striking a polycrystalline specimen with grains of different orientation (e.g., A and B in Fig. 1) is diffracted into cones, causing the typical polycrystalline ring pattern. The high-resolution dark-field method consists of tilting the incident beam so that the part of the diffracted ring passes through the optic axis of the microscope (Fig. 1b). The tilting is accomplished with the electronic beam tilt device. Then an aperture collects intensity only from those crystallites diffracting into this part of the ring, e.g., B (Fig. 1c).

Various factors involved in the interpretation of the diffraction patterns of chrysotile asbestos fiber bundles are shown in Fig. 2. The actual lattice of chrysotile is a defected, scrolled crystal with fiber axis along a (Yada, 1967). The reciprocal lattice of this crystal should be some form of a spiral, equispaced along the a^* axis. Zvyagin (1967) and Whittaker (1966) have studied diffraction effects from concentric cylinders. How deformation and shear will affect the diffraction patterns has not, to the author's knowledge, been studied and is under study here.

The simpler case of an undeformed defect-free chrysotile fiber, where the fiber is idealized as a series of concentric cylinders, as first proposed by Whittaker (1969), is shown in Fig. 2i. The reciprocal lattice then consists of a series of concentric rings, shown in Fig. 2ii (only the two rings in the $2kl$ layer are drawn). The electron diffraction pattern represents the intersection of the reflecting or Ewald sphere (ES, Fig. 2ii) with these rings (Hirsch *et al.*, 1969). This ought to result in a series of spots as shown in the $2kl$ layer line. Streaked patterns are, however, obtained from single fibers of chrysotile (Yada, 1967; Seshan and Smith, 1977).

The explanation for the streaking probably lies in refraction effects and the fiber shape (Yada, 1969); it could also result from the various faults produced during the

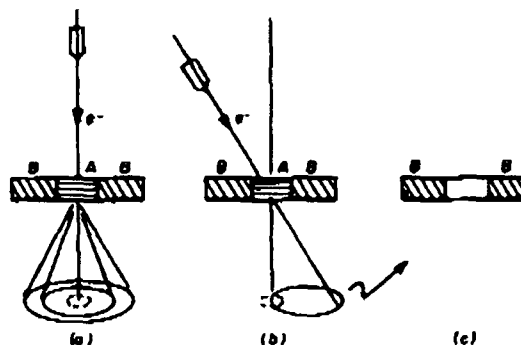


FIG. 1. Illustration of the high resolution dark-field method: (a) The bright-field image from a selected area of a polycrystal, illustrated with two grains, A and B. (b) The situation after gun tilt; only a portion of the diffracted intensity is collected by placing the objective aperture as shown. (c) The resulting high-resolution dark-field image with only favorably oriented grains, e.g., B showing diffracted intensity or "lighting up."