19. A New Type of Interference Fringes Observed in Electron-micrograph of Crystalline Substance.

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The contrast observed in electron-micrograph is almost entirely determined by the thickness of the objects. With crystalline substances, however, it becomes anomalous when Bragg reflection takes place on net planes, since the aperture of objective lens is small enough to cut off the reflected beam. For example, Heidenreich¹⁾ observed extinction contours, fringes of equal inclination of net planes, for thin curved crystals. In the case of perfect crystals, he observed fringes corresponding to equal thickness. This is also due to Bragg reflection and is explained by *Pendellösung* in the dynamical theory of diffraction.

Recently, a new type of fringes, such as reproduced in Fig. 1a and b, was observed in the electron-micrograph of graphite crystals at the Hitachi Central Laboratory. They are almost straight, almost parallel and almost equally spaced. The spacing of fringes is not the same even when the micrographs are taken with the same accelerating voltage and magnification; it is several hundreds Angstroms in Fig. 1a and about 120A in Fig. 1b. A set of fringes extends on a part of a flake, the diameter of which is several thousands Angstroms. In some part, a single set of fringes appears, but in the other, two sets are intersecting with the angle of 60°. The latter fact suggests that they are correlated with diffraction of electron wave in the crystal.

A speculative interpretation of this pattern was proposed by one of the authors: Let us consider a graphite crystal cleft as shown in Fig. 2, where the angle between two flakes is very small. Such a cleavage is likely to occur since graphite has a layered structure. If the incident electron beam with the wave vector k_0 satisfies Bragg condition on a net plane $h(h_1, h_2, h_3)$, two beams, transmitted k_0 and diffracted k_h , impinges on the second flake. Furthermore, if the second flake is properly placed such that the diffracted beam k_h satisfies Bragg condition on a net plane $g(g_1, g_2, g_3)$, a new diffracted beam k_{hg} is produced. Two beams k_0 and k_{hg} may make a very small angle in certain cases; for example, this is the case when $h_1 = -g_1$ and $h_2 = -g_2$ provided $|h_3 - g_3|$ is small. The angle α between k_0 and k_{hg} is given by

1) R. D. Heidenreich: J. App. Phys. **20** (1949) 993.

$$\alpha = 2 |\theta_h - \theta_g| = \lambda \left| \frac{1}{d_h} - \frac{1}{d_g} \right|, \quad (1)$$

where θ and d denote Bragg angle and spacing respectively of the net planes indicated by the suffices. The two waves k_0 and k_{hg} should interfere each other to produce nodal lines such as those observed in Fig. 1. The spacing s of the nodal lines is given by

$$s = \frac{\lambda}{\alpha} = \frac{1}{\left| \frac{1}{d_h} - \frac{1}{d_g} \right|}. \quad (2)$$

For instance, if $h = (200)$ and $g = (201)$, the spacing turns out to be $s = 110\text{\AA}$, in agreement with that observed in Fig. 1b.

Although the above interpretation seems adequate for the present observation, its correctness must be proved by future experiments.

Fig. 1 a

b

Fig. 2