

Fig. 1. Unit-cell dimensions of form *C* of normal fatty acids.

and *b* axes are found to decrease, having asymptotic values of 9.21 Å and 4.95 Å respectively. The monoclinic angle  $\beta$  decreases towards  $127^{\circ} 17'$ . The *c* axes and long spacings,  $d(001)$ , are linear functions of the carbon content within experimental error:

$$\begin{aligned} c &= pn+q, & d(001) &= Pn+Q, \\ p &= 2.5378 \pm 0.0042 \text{ \AA}, & P &= 2.0850 \pm 0.0024 \text{ \AA}, \\ q &= 5.124 \pm 0.080 \text{ \AA}, & Q &= 2.383 \pm 0.044 \text{ \AA}. \end{aligned}$$

The constants are determined by the method of least squares.

Vand, Aitken & Campbell (1949) pointed out that long-chain compounds are only 'approximately homologous', and this is obviously the case with this form and likely also with the other crystal forms of normal fatty acids.

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### Short Communications

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**Electron diffraction by electropolished surfaces and mean inner potentials of silver and copper.** By SUSUMU YOSHIDA, *The Government Mechanical Laboratory, Suginami-ku, Tokyo, Japan*

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Electropolished surfaces of metal single crystals are almost flat, and only slightly undulating. An undulating surface is composed of minute facets which form small angles with the macroscopic surface. From electron-

diffraction data, Kranert, Leise & Raether (1944) estimated the angle to be  $1-2^{\circ}$  for an electropolished copper single crystal. However, they had to assume a certain value for the mean inner potential of the copper crystal.

In the present work we have tried to determine the mean inner potential and the mean angle without assuming either of these quantities.

Let us consider the case as shown in Fig. 1, where

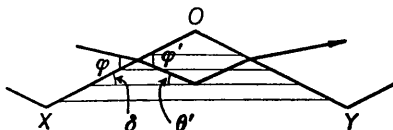


Fig. 1. Refraction of electrons by submicroscopic facets of a crystal.

minute facets form a small angle  $\delta$  with a net plane. We assume that the macroscopic surface is exactly parallel to the net plane. If an incident electron beam falls upon the facet  $OX$ , it is refracted on the facet and then reflected by the net plane when the Bragg condition is fulfilled. Since the Bragg angle  $\theta'$  for the refracted beam is approximately equal to  $\theta$  for the unrefracted beam, the deviation of the beam due to the effect of refraction is calculated by Snell's law (Thomson & Cochrane, 1939) to be

$$\varphi' - \varphi = \frac{\mu^2 - 1}{\varphi' + \varphi} \approx \frac{\mu^2 - 1}{2\varphi'} \approx \frac{\mu^2 - 1}{2(\delta + \theta)}, \quad (1)$$

where  $\mu$  is the refractive index for electrons and  $\varphi$  and  $\varphi'$  are the angles indicated in Fig. 1. If we assume, as Kranert and others have done, that the reflected beam departs from the crystal through another facet  $OY$ , the total deviation due to the effect of refraction is  $2(\varphi' - \varphi)$ . Using the familiar relation  $\mu^2 - 1 = V/E$ , where  $V$  is the mean inner potential and  $E$  the accelerating voltage, we get the following equation:

$$A_n \equiv 2(\varphi'_n - \varphi_n) = \frac{V}{E} \frac{1}{\delta + \theta_n}, \quad (2)$$

where the suffix  $n$  indicates the order of reflexion. This formula can be rewritten as

$$B_n = -\delta A_n + V, \quad (3)$$

where  $A_n = \Delta_n E$  and  $B_n = \Delta_n \theta_n E$ . Equation (3) is a linear relation between  $A_n$  and  $B_n$ , both of which can be obtained by measuring  $\Delta_n$  and  $\theta_n$  on a rotation photograph. Plotting  $A_n$  and  $B_n$  on a diagram for a series of reflexions, we can determine  $V$  and  $\delta$ .

Measurements were made for (100) surfaces of silver single crystals and (100) and (110) surfaces of copper single crystals. Specimens were prepared by cutting crystals parallel to the surfaces as accurately as possible. They were mechanically polished and then electrolytically polished. The electrolytic solution used for polishing copper was 50 cm.<sup>3</sup> of orthophosphoric acid (90%) diluted in 90 cm.<sup>3</sup> of water. Electropolishing was carried out at 15–20° C., the applied d.c. voltage being 1.6 V. An electron-diffraction rotation photograph was taken of each specimen in an azimuth where the effect of simultaneous reflexion was as far as possible avoided (Uyeda, 1936; Tull, 1951a). The specimens thus prepared always show diffraction spots elongated towards the incident spot. This

indicates that the angle  $\delta$  is not unique but is distributed in a certain range. We measured the point of maximum intensity and applied our theory. Thus we obtained the average value of  $\delta$ . An example of the application of the theory is given in Fig. 2. It must be noted that in general

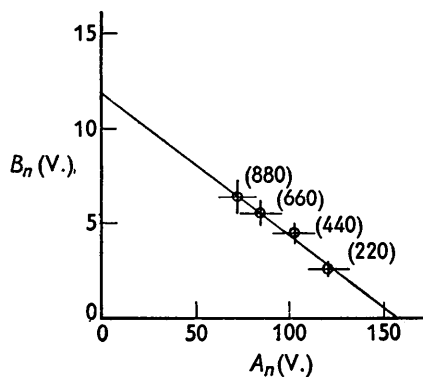


Fig. 2. A diagram for calculating  $V$  and  $\delta$ ; Cu (110).

the plots do not lie on an exact straight line as in this figure. This may be due in part to the fact that the effective angle  $\delta$  depends upon  $\theta_n$  and in part to the variation of apparent mean inner potential in low-order reflexions. The results of the present work are given in

Table 1. *The mean inner potential  $V$  and facet angle  $\delta$  of silver and copper*

Crystal face	Specimen No.	$V$ (V.)	$\delta$ (°)	$V^*$ (V.)
Silver (100)	—	22±6	17±6	23.2 (exp.)
Copper (100)	—	11±4	10±4	—
Copper (110)	1	12±3	4.5±3	—
Copper (110)	2	13±3	5±3	—
Copper (110)	3	9±3	3.5±3	13.7 (calc.)
Copper (110)	4	8±4	3±3	—
Copper (110)	5	14±3	4.5±3	—

\* Tull, 1951a, b.

Table 1 with Tull's data (Tull, 1951a, b) for comparison. Our data agree with his in order of magnitude.

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