

The results of further observations and fuller descriptions will be given elsewhere.

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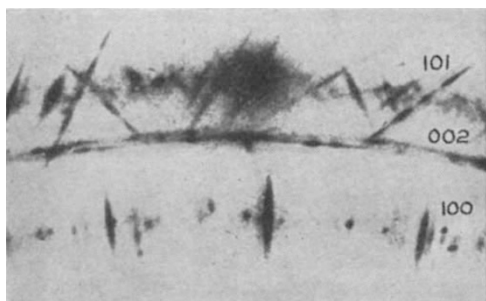
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Sept. 15.

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³ Cowley, J. M., and Rees, A. L. G., *Nature*, **158**, 550 (1946); *Proc. Phys. Soc.*, **59**, 287 (1947).
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Line-Breadth in Electron Diffraction

ONE of the major factors determining line-breadth in electron diffraction powder patterns has been shown¹⁻³ to be the refraction of the electron beam resulting from the finite inner potential of the crystals. Striking differences in line-breadth occur in patterns from crystals of regular habit, such as the cubes of magnesium oxide and cadmium oxide smokes and the elongated hexagonal prisms of zinc oxide smoke. Certain reflexions, for example, $h00$ in magnesium and cadmium oxides, and $00l$ in zinc oxide, are sharply defined, and it has been shown by Cowley and Rees³ that the refraction components lie along these rings and do not contribute to the line-breadths. Moreover, any elongation of reflexions arising from the non-spherical symmetry of the scattering function about the reciprocal lattice points for zinc oxide of this habit will lie along these rings also. Nevertheless, these breadths are still greater than can be accounted for by limitation of crystal dimensions and the finite breadth of the beam.

Patterns of zinc oxide smoke recorded with a high-resolution diffraction camera designed and constructed in this laboratory⁴ have shown that variation of lattice parameters, at least in small crystals of this type, makes a considerably larger contribution than hitherto suspected. In the accompanying photograph, a greatly enlarged portion of a zinc oxide pattern is reproduced to demonstrate a spread of the 002 reflexion amounting to 1.1 per cent. At a number of places on this ring, the individual crystals contributing have sufficiently different cell dimensions to produce an apparent doubling of the ring. The fine structure apparent in the two other rings in the photograph, 100 and 101 , is ascribed to both refraction and the shape of the scattering function in



Portion of an electron diffraction pattern from zinc oxide showing the 100 , 002 and 101 rings. The variation in cell dimensions from crystal to crystal is evident in the 002 ring. Enlargement, $12\times$

reciprocal space (determined by the crystal habit); this will be the subject of a forthcoming publication by us. The 200 rings of magnesium and cadmium oxides show a similar spread of the lattice parameter (see ref. 2, Fig. 4).

Possible explanations are: (1) that lattice strains exist as a result of bending of the long zinc oxide spines; (2) that the smaller crystals contributing to the pattern have smaller cell dimensions in accordance with the theory of Lennard-Jones⁵; and (3) that there are slight differences of composition or structure from crystal to crystal resulting from the conditions of preparation. Lattice strains would result in the occurrence of a range of parameters in each crystal, whereas the individual single-crystal reflexions are sharply resolved in the direction of the radius vector (see photograph). It appears more likely that either crystal dimensions or non-stoichiometric composition may account for these variations in cell dimensions from crystal to crystal; the latter is a distinct possibility for such small crystals of these oxides prepared by burning the pure metal in oxygen. For zinc oxide particles of length $\sim 3 \times 10^3$ Å. (estimated from electron micrographs), the half-width of the 002 reflexion, calculated from Brill's formula, is 2×10^{-5} radian. The half-width of the whole line measured by microphotometry is 8.4×10^{-5} radian, and that of the single reflexion, 2.8×10^{-5} radian.

It would appear that the breadths of electron diffraction rings, obtained under high-resolution conditions, may be accounted for completely by contributions from (1) broadening governed by the size and shape of the crystals, (2) refraction, and (3) spread of lattice parameters.

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Dec. 8.

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² Cowley, J. M., and Rees, A. L. G., *Nature*, **158**, 550 (1946); *Proc. Phys. Soc.*, **59**, 287 (1947).
³ Honjo, G., *J. Phys. Soc. Japan*, **2**, 133 (1947).
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⁵ Lennard-Jones, J. E., *Z. Krist.*, **75**, 215 (1930).

Electrical Properties of Gold-Chromium Alloys

IT is known from earlier researches^{1,2} that the gold-chromium alloys are characterized by a decrease of electrical resistivity when deformed plastically by cold-working. In an investigation on alloys with fairly high concentration of chromium, I have found, in addition to the effects already known, certain new resistance properties.

Fig. 1 gives the results of measurements of the change of resistance with time when ageing cold-worked specimens (degree of reduction of area 0.987) at $+20^\circ$, 100° or 200° C., the alloy containing 21.6 atomic per cent chromium and 0.2 atomic per cent iron (as impurity). R_0 denotes the resistance value obtained immediately after cold-working the specimen, all measurements being made at room temperature. After 650 hr. at 20° C., R/R_0 had reached the value 1.058 (not plotted in the graph). The final resistance of a given sample when completely re-