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E. BRANNEN
W. WEHLAU

University College,
University of Western Ontario,
London, Canada
May 26.

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Experiments on the Acousto-Electric Effect

PARMENTER¹, and later Gurevich², predicted that a single longitudinal acoustic wave passing along a metal or semiconductor should produce a steady potential difference in the material. Weinreich and White³ and Sasaki and Yoshida⁴ observed the effect in germanium.

We have attempted to observe the acousto-electric effect in copper and aluminium. In our most conclusive experiment, vibrations of high energy, at 25 kc./s., produced by an ultrasonic drill were passed along a copper wire, and were absorbed at the other end by a mass of 'Plasticine' to prevent reflection. The particle amplitude of the specimen was observed under the microscope. The vibrations were continuous over the whole length of the wire from the transducer to the absorber, showing that no standing waves were formed.

The acoustic energy in the wire was calculated to be about 9 watts, and its diameter was 0.07 cm., giving an intensity of 2000 watts/cm². According to Parmenter's theory this should produce an acousto-electric e.m.f. of 400 μ V./cm. (For a good conductor, Gurevich calculated an even higher e.m.f. of 0.3 μ V./cm. for each 0.1 watt/cm² acoustic intensity.) In actual fact, we observed at most only 1.4 μ V. on a specimen of 25 cm. length, and also on another of 150 cm. length. (The smallest detectable signal was about 0.3 μ V.) As this potential difference required an appreciable time to appear and to disappear, it was probably due to heating effects. Thus the observed effect would be at most only a very small fraction (about 1/7000) of that predicted by the theory.

In an earlier experiment high-energy pulse trains, of 300 kc./s., were produced in a nickel magnetostriction tube and passed along an aluminium specimen. No effect was observed.

The tests were carried out at room temperature.

PIROSKA SMITH (nee VERMES)

D. O. SPROULE

Department of Physics,
Birbeck College,
University of London.

May 29.

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Intensity of the (111) Reflexion for Diamond

RECENTLY¹ the intensity of the (111) reflection of diamond was measured. A value was found which deviated from that given formerly² but which agreed with the value based on McWeeny's³ calculations of the atomic scattering factor for carbon.

F-values given in the recent publication¹ were calculated from the experimental data using the absorption coefficient for CuK α -radiation $\mu/\rho = 4.52$ as given in Compton and Allison, p. 802, Table 1 (1942) and also in D'Ans-Lax, "Taschenbuch für Chemiker und Physiker", p. 83 (1949). But, since also the higher value of 5.50 is cited (for example, "Internationale Tabellen zur Bestimmung von Kristallstrukturen", 1935), and because the absorption coefficient also was found to vary from crystal to crystal² a determination of μ/ρ was carried out on the sample used for the above-mentioned measurements. It was found that $\mu/\rho = 5.56 \pm 0.14$.

With this absorption coefficient the mean value of $\frac{1}{3}F_{111}$ determined by the reflection-method becomes 2.39₅ and the weighted mean of all experimental values, that is, including the data obtained by the transmission method (which are independent of μ), is 2.35 in agreement with the former determination². It must be concluded, therefore, that while for higher $\sin \theta/\lambda$ values the agreement of measurements and McWeeny's calculations is generally good, an appreciable discrepancy is present at $\sin \theta/\lambda = 0.141$, that is, for f_{111} at diamond.*

It can be shown that this is due to the fact that the accumulation of binding electrons between two carbon atoms in diamond which gives rise to the appearance of 222, also strengthens the intensity of 111. It does not influence 220, however, and the experimental value of f_{220} agrees, indeed, accurately with McWeeny's calculation. On the other hand, f_{311} is expected to be weaker and this is also in agreement with the experimental observation². At higher orders these effects fade out. The details and an extended discussion will be given elsewhere.

R. BRILL
H. BARTH

Fritz-Haber-Institut der Max-Planck-Gesellschaft,
Berlin-Dahlem.

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* This is also confirmed by measurements of E. Wölfel (private communication.)

Fibre Surface Replication by Rolling

A TECHNIQUE for replicating fibres by rolling has been developed in these laboratories. It is only applicable to fibres which approximate to a cylindrical shape, such as nylon, 'Terylene' and wool, but with these it can give replicas with sufficient resolution for the full magnification available in light microscopy. It is not known yet to what extent the replicas are suitable, either directly or in second stage form for electron microscopy.

A glass microscope slide is dipped in 'Necol' cement (diluted with acetone to more than three times its volume) and allowed to dry, protected from dust. When it is sufficiently dry to be non-tacky, three lengths of fibre, each about 3 mm. long, are placed on