The Use of a Cavity Oscillator for a Kerr Electro-Optical Light Shutter

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Therefore, the lower opacity to electrons of the contamination would appear to be due to less physical density rather than to looseness of structure.

Again, Hillier with an electron probe of less than the usual angle has succeeded in depositing contaminant upon a very localized area of a film or specimen far from the grid. The probe was not striking the grid wires.

Hillier has observed further that with sufficient time the space inside the microscope clears and deposition ceases if the beam is not striking the grid. We have not been able to demonstrate this discontinuity ourselves but, since conditions governing the phenomenon are not all known or understood, it is not easy to duplicate them in order to demonstrate any particular circumstance. Such an occurrence would be indicative of either a cluster-ion or a free radical mechanism for the polymerization. In the original paper it was not intended to emphasize the cluster-ion hypothesis over that of the free radical, but the seeming dependence on conductivity tended to favor the former. If the dependence on conductivity is not real, either mechanism could account for polymerization and condensation from the gas phase, but the latter would be more probable.

The effect takes place under suitable circumstances to some extent with all materials but it is interesting that Cosslett is able to order substances according to the magnitude of the effect upon them. In our case the phenomenon was found to be so variable and conditions so difficult to control or analyze that such conclusions could not be drawn except to say that, in general, carbon blacks seem to be more affected than other materials. This conclusion appears to be supported by Cosslett's micrographs which demonstrate somewhat smaller changes in about the same time intervals.

Undoubtedly, as mentioned in reference 2, contamination can come from the specimen itself, but for the carbons examined the magnitude of the measured effect was not a function of the percentage of volatile matter known to be in the blacks. As for the Shawinigan black which is made by thermal decomposition at high temperature, it is known that there is but an extremely minute amount of non-carbon material in it.

Figure 1 is offered as an example of the appearance of materials which are redeposited after heating and evaporation by the bombardment of the electron beam. This shows a specimen of tetra copper calcium oxychloride which has been illuminated at high intensity and has changed considerably. In addition to the changes which have taken place over the face of the crystal itself, and which are incidental to the present discussion, it will be seen in the regions near the crystal and reaching out from it that material ejected or evaporated from the original location has been redeposited on the film. It will be noted that this "contaminant" has a structure and a granular appearance quite unlike the contaminants under discussion in this letter. If the specimen contaminations are caused by ejected or sputtered metallic particles, it might be reasonable to assume that they should have an appearance in some way similar to that in Fig. 1, but they do not.

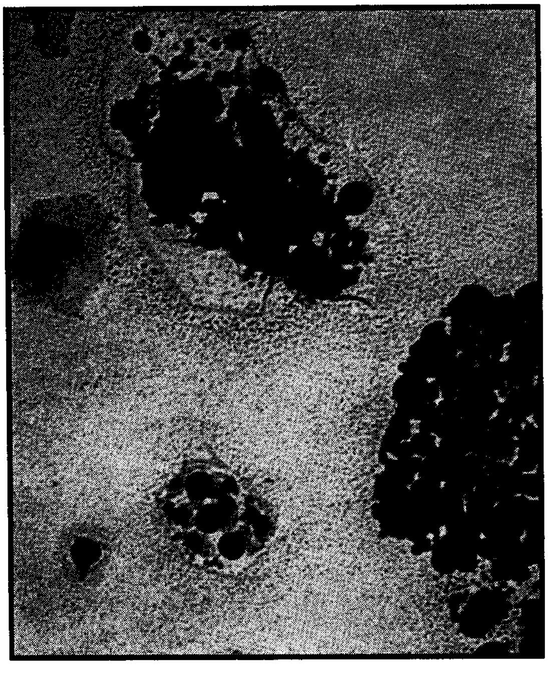

FIG. 1. Tetra copper calcium oxychloride evaporated under electron bombardment and redeposited over the supporting film (×50,000).

[1] V. E. Cosslett, J. App. Phys. 18, 844 (1947).

[2] John H. L. Watson, J. App. Phys. 18, 153 (1947).

[3] Dr. James Hillier of the Radio Corporation of America has kindly given permission to mention his unpublished work. His full observations on contamination are to appear shortly.

The Use of a Cavity Oscillator for a Kerr Electro-Optical Light Shutter*

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THE successful use of a single cavity oscillator for the acceleration of electrons to energies of over a half million volts[1,2] suggested that a modification of this method might be used for producing an ultra high speed electro-optical Kerr cell light shutter. The high frequency high potential which occurs across a small gap inside the cavity oscillator should produce a large double refraction in liquids which exhibit an appreciable Kerr effect and in which the lag in the Kerr effect is sufficiently small.

The apparatus used in these experiments is similar to that used by Hereford[2] except that the cavity was filled with carbon disulphide. The cylindrical re-entrant type cavity was made of brass and was designed to resonate in the 400-megacycle range when filled with carbon disulphide. Essentially, the cavity may be considered as two quarter-wave concentric line resonators placed back to back with a small spacing between the inner conductors of the two lines. When properly matched to a generator a high frequency field occurs across the gap between these inner conductors. The dimensions of the cavity were as follows: Outer conductor diameter, 15.5 cm; length of cavity, 20.3 cm; inner conductor diameter, 2.54 cm; spacing between inner conductors adjustable from 1.3 to 5.1 cm. The generator was a Western Electric 7C22 twin triode oscillator which delivers a peak power of 500 kilowatts with pulse operation and can be tuned from 390 to 425 megacycles. The tube was pulsed for 6×10^{-6} sec. 60 times per sec. by a conventional pulsing circuit with an output voltage of 18 kv. Power was transmitted from the tube through a $1\frac{1}{4}''\times 3''$ coaxial 50-ohm transmission line to a properly oriented coupling loop inside of the cavity. Cavity resonance was observed by the usual crystal detector arrangement.

Light from a magnesium spark in series with the high voltage line to the tube was plane polarized by a Nicol prism so oriented that the electric vector of the light made an angle of 45° with the electric field in the cavity gap. The light passed through small strain free windows on opposite sides of the cavity gap and then into a second Nicol prism crossed with respect to the first. When the cavity was not in resonance, no observable light passed the second Nicol but, as soon as resonance occurred, light was observed to pass the second Nicol, showing that the cavity was operating as a Kerr cell light shutter. Carbon disulphide was used in the cavity because it has a medium-sized Kerr constant, is a good insulator without large dielectric loss at 400 megacycles and is known[3] to have a lag in the Kerr effect of less than 10^{-8} sec. It is planned to test other liquids with the hope of finding a better one, as well as to study the Kerr effect itself at high frequencies.

* This work was supported by the Bureau of Ordnance, U. S. Navy, under Contract NOrd-7873.

[1] Bowen, Pulley and Gooden, Nature **157**, 840 (1946).

[2] Hereford, Dissertation, University of Virginia (1947), J. App. Phys. (in press).

[3] Beams and Lawrence, J. Frank. Inst. **206**, 169 (1928).

New Books

Los Rayos X y La Estructura Fina de los Cristales. Fundamentos Teoricos y Metodos Practicos. (X-Rays and the Fine Structure of Crystals. Theoretical Fundamentals and Practical Methods.)

By Julio Garrido (del Instituto National de Física y Quimica de Madrid) y Joaquin Orland, S.J. (Professor de Metalografia en el Instituto Católico de Artes e Industrias). Pp. 260, 21×27 cm. Editorial Dossat, S. A., Plaza de Santa Ana 9, Madrid, 1946.

This is one of a half-dozen post-war foreign books which have appeared on the general subject of the application of x-ray diffraction to the study of crystals and crystalline aggregates. This particular book is unique in confining its coverage to the application of x-ray diffraction to the determination of crystal structures. It is an authoritative treatment of the subject written by authors who are known for their contributions in the field. It is not only well written, but it is profusely illustrated by well chosen line-cuts and photographs. Together with Bunn's excellent book, it emphasizes the crystallographer's rather than the pure physicist's approach, and it is, therefore, a most welcome contribution to crystallographic literature.

The book, which contains ten chapters, is subdivided into three parts: Part one is a discussion of general principles; part two contains a discussion of the determination of crystal structures, while part three is entitled, "Some results of the study of the fine structure of matter by means of x-rays."

Part one contains a two-chapter development of the origin and physics of x-rays. This is followed by a chapter on the fundamentals of crystallography. The rest of part one consists of a very long chapter on the diffraction of x-rays by crystals. The whole section is very well done, and the chapter on crystallography is particularly well treated.

Part two contains chapters on the various x-ray diffraction methods, on the sequence of experiment and argument in the determination of a crystal structure, and examples of structure determination. This part constitutes the heart of the book, and should prove extremely useful to the student who wishes to know specifically how to go about a crystal structure determination. The several methods of recording x-ray diffraction are discussed in good perspective, although there is considerable emphasis on Garrido's own method of interpreting Weissenberg photographs. The completeness of the chapter on the "Course of a structure determination" is indicated by the list of the topics covered: selection and preparation of material; determination of the symmetry; determination of the symmetry with the aid of the physical properties; determination of the symmetry with the aid of Laue diagrams; observations on the determination of the symmetry; determination of the crystallographic constants; selection of method; determination of the dimensions of the elementary cell; determination of the number of atoms contained in the elementary cell; the determination of the net type and the rules of extinction; determination of the axes of the definitive unit cell; determination of the Bravais group; elements of symmetry and extinctions; extinction tables [following Donnay and Harker]; observations on the determination of the space group; determination of the space group without utilizing x-rays [morphological determination of space group, following Donnay and Harker]; geometrical analysis of the space group; determination of the coordinates of the atoms; the Fourier method; the Fourier-Patterson method; proof of the structure.

To illustrate the determination of crystal structure by specific examples, the arguments are given for the determination of the structures of the following crystals: copper brucite, rutile, and manganite. These examples proceed