Diamagnetic Resonance in Electronic Conductors

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RECENTLY Dresselhaus, Kip, and Kittel announced[1] the discovery of a new type of quantum resonance effect, namely the diamagnetic (or "cyclotron") resonance. The authors attribute to Dingle[2] the priority of developing the theory of this effect in solid electronic conductors.

I should like to point out that the first theoretical treatment of this new effect, as far as I know, was, in fact, advanced by me already in 1951.[3] In that article, dealing with the diamagnetic resonance in metals and semiconductors, the general features of the effect were accurately predicted and its importance was pointed out as a new means for the direct measurement of the effective mass of the carriers.

[1] Dresselhaus, Kip, and Kittel, Phys. Rev. **92**, 827 (1953).
[2] R. B. Dingle, Proc. Roy. Soc. (London) **A212**, 38 (1952).
[3] J. G. Dorfman, Doklady Akad. Nauk S.S.S.R. **81**, 765 (1951).

Ultraviolet Absorption in Barium Oxide Films

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OPTICAL absorption in BaO films evaporated on quartz tubes from BaO coatings was measured in the wavelength region between 2100A and 3500A. The structure of the experimental tubes used in these measurements is illustrated in Fig. 1. The film was evaporated on one side of the quartz wall from the coating which was activated thermally beforehand for about one hour. Particular caution was taken for the evacuation of the tubes, so the measured absorption curves were almost stable.

Sproull and Tyler[1,2] reported the presence of two distinct absorption bands in BaO; the first one exists in the energy region between 3.8 ev and 4.8 ev, and the second one, of shorter wavelength, begins at 4.8 ev. The former with accompanying photoconduction was assumed by them to be exciton absorption, while the latter was ascribed to band-to-band excitation.

The results of the present measurements were similar to theirs; that is, the threshold energy of the first absorption is 3.95 ev and the second absorption threshold is 4.95 ev. However, precise plotting of the transmittance *versus* wavelength at intervals of 2A or 5A made it possible to distinguish two peaks in the first absorption band, existing at 4.1 ev and 4.4 ev respectively.[3] It is interesting that the wavelength of the former peak shows good agreement with that of the photoconductivity peak obtained by Sproull and Tyler.[2]

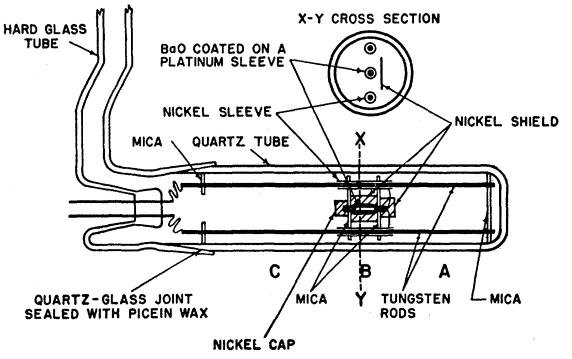

FIG. 1. The structure of the experimental tubes. The tube was evacuated to a pressure less than 1×10^{-5} mm Hg and baked by a gas flame for about one hour except for the wax joint, which was cooled by running water during the baking process; then getter was flashed in a getter chamber. The cathode mount is movable along the tungsten rods. The decomposition and activation of the cathode were carried out at position *A* and evaporation at position *B*. Position *C* was used for the blank in absorption measurements.

It is interesting to compare the absorption in the film in high vacuum, which can be considered as *n*-type BaO, with that in the *p*-type film, which can be produced in an oxygen atmosphere.[4] The absorption in the films deactivated by oxygen gas was measured. The oxygen, which was dehydrated by H_2SO_4, $CaCl_2$, and P_2O_5, was introduced to the tube through two liquid air traps by means of breakable joints. Figure 2 shows the variation of the transmittance in the films evaporated in vacuum when oxygen was introduced. The peaks of the first absorption band were gradually reduced and disappeared at room temperature as a result of the introduction of oxygen, while the threshold energy of the second absorption remained uninfluenced by oxygen.

The effect of oxygen raises a question regarding the origin of the two absorption peaks at 4.1 ev and 4.4 ev respectively. Many experiments indicate the existence of excitons in BaO. However, it is evident that the exciton is not influenced by deactivation of BaO by oxygen. Accordingly, as far as the effect of the oxygen is

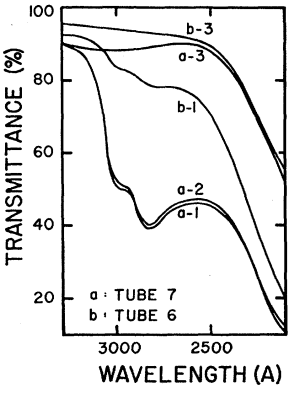

FIG. 2. Variation of the transmittance *versus* wavelength curves in two BaO films when oxygen was introduced at pressure of about 10 mm Hg: $a-1$ and $b-1$ show the curves measured in vacuum; $a-2$ shows the curve measured just after the introduction of oxygen; $a-3$ and $b-3$ show the curves measured after more than 10 hours in an oxygen atmosphere.