

concerned, it is more reasonable to attribute these peaks to the electronic transition occurring at the donor energy levels than to the excitons. On the other hand, there are some reasons which make it difficult to consider that these peaks are a structure-sensitive property as was indicated by Sproull and Tyler; that is, large absorption constant and small temperature shift.

The author intends to continue this work. He wishes to express his gratitude to Dr. Y. Ishikawa, Research Laboratory of Nippon Electric Company, under whom this work was undertaken.

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¹ W. W. Tyler and R. L. Sproull, *Phys. Rev.* **83**, 548 (1951); W. W. Tyler, *Phys. Rev.* **76**, 1887 (1949).

² R. L. Sproull and W. W. Tyler, in *Semiconducting Materials* (Butterworths Scientific Publications, London, 1951), p. 122.

³ After this work was performed, the author received a communication from Dr. Sproull that R. J. Zollweg of Cornell University has found similar peaks in this region.

⁴ Ishikawa, Sato, Okumura, and Sasaki, *Phys. Rev.* **84**, 371 (1951).

Mechanism for Photovoltaic and Photoconductivity Effects in Activated CdS Crystals

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IN previous papers,^{1,2} experimental results with activated CdS crystals were reported that could be explained by the Brosser-Kallmann-Warminsky theory of conduction.

Brosser, Kallmann, and Warminsky³ suggest two possible mechanisms which can explain conduction in activated crystals: (a) They propose that the holes formed by excitation are localized in the filled band and cannot migrate to the electrodes; as long as this is the case, electrons in the conduction band can be in thermal potential equilibrium with the electrodes. This permits a re-supply of electrons from the cathode. The conductivity then depends on the number of bound holes and on the length of time the holes are localized. (b) They apply the Riehl-Schön model. Here it is assumed that part of the excited electrons pass into a band which is somewhere between the conduction band and the filled band and in which the electrons can move freely. The electron density in this band is in thermal potential equilibrium with the electrodes and electrons remain in this band for a relatively long time. As long as there are sufficient electrons in this band, additional electrons can pass from the electrodes. During this period, metallic conduction is possible.

Recent investigation of the spectral response of the photovoltaic effect in activated CdS single crystals² shows a response in the red portion of the spectrum. Photoconductivity measurements as a function of wavelength show two peaks: one at the absorption cutoff and the other in the longer-wavelength region. When the photoconductivity is measured from short wavelengths toward long wavelengths and *vice versa*,¹ a shift in the position of the peaks is observed. When the photoconductivity is measured from short to long wavelengths, the peaks are shifted toward long wavelengths because of long-lived electrons in the impurity band; this also causes a tailing out in the long-wavelength region. When the experiment is reversed, photocurrent is not observed until sufficient energy is available to excite electrons to the impurity band; this diminishes the long-wavelength tail.

The energy separation of the bands in CdS would not give rise to the photovoltaic response in the red region mentioned above. The excitation of electrons in impurity levels below the conduction band by light of wavelengths in the red and near infrared could explain the spectral response by allowing a two-step process to the conduction band; however, this would not explain the photoconductivity.

These long lifetimes cannot be explained by the above-mentioned two-step excitation process unless we assume that the holes are fixed. If this were the case, the photovoltaic effect would not be observed. Therefore, to be consistent with both photovoltaic and photoconductivity effects, it appears that the intermediate energy level must be a band. This conforms to the Riehl-Schön model.

¹ Reynolds, Czyzak, Allen, and Reynolds (to be published).

² Reynolds, Leies, Antes, and Marburger, *Phys. Rev.* **96**, 533 (1954).

³ Brosser, Kallmann, and Warminsky, *Z. Naturforsch.* **4A**, 631 (1949).

Electronic Susceptibility in Certain Alloys*

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IN recent measurements of magnetic susceptibility *vs* composition in the MgCu₂-MgZn₂ system (Fig. 1), Klee and Witte¹ have discovered some interesting features in the dependence of susceptibility on electron concentration, and have analyzed the experimental results using the model of nearly free electrons moving in a weak cosine potential. In particular they attribute the two peaks on the left part of the experimental curve of Fig. 1 to anomalies in the orbital magnetism of the valence electrons associated with the successive touching of the Fermi surface to the two kinds of faces of the