

implies a highly localized photoeffect, i.e., a drift length for the photocarriers in the field direction small compared to the image width (0.1 cm).

In the case of cell No. 2, the time constant for the decay of the photoresponse is stated by the manufacturer to be 2×10^{-4} second. If it is assumed that this time constant represents the lifetime τ of the free photocarriers, then the expected drift length w for the higher-field case (taking the mobility μ to be of the order of $1 \text{ cm}^2/\text{volt sec}$)³ would be

$$w = \mu E \tau = 0.15 \text{ cm},$$

a distance large compared to the drift length implied by Table I. The most likely explanation of this discrepancy is that the time constant is very much longer than the free lifetime owing to the phenomenon of trapping⁴ in these layers. The importance of trapping has heretofore not received recognition in theoretical treatments of this subject (summarized in reference 3) and complicates greatly the task of deriving an adequate theory.

We are indebted to H. Müser and to J. R. Haynes for helpful exchanges of correspondence relative to this experiment.

¹ H. Müser, *Z. physik. Chem.* **198**, 52 (1951).

² In private correspondence Dr. Müser has expressed his agreement with this explanation.

³ R. A. Smith, *Advances in Physics* **2**, 321 (1953).

⁴ A. Rose, *RCA Rev.* **12**, 362 (1951); J. R. Haynes and J. A. Hornbeck, *Phys. Rev.* **90**, 152 (1953); H. Y. Fan, *Phys. Rev.* **92**, 1424 (1953); **93**, 1434 (1954).

New Class of Ferroelectrics

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WE find that guanidine aluminum sulfate hexahydrate,¹ $(\text{CN}_3\text{H}_6)\text{Al}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$, is ferroelectric from as high a temperature as it will stand for a short time (about 200°C) down to the temperature of liquid N_2 , the lowest we have employed. The material is trigonal, with perfect cleavage in the basal plane; the direction of spontaneous polarization is along the trigonal axis. Ferroelectricity is not usually observed when electrodes are applied to naturally grown faces; the effect can be seen when new faces are generated by abrasion or better by cleavage.

At room temperature the saturation polarization is about 0.35 microcoulombs per sq cm, and the coercive force is between 1200 and 1500 volts per cm measured at 60 cps. These quantities increase with decreasing temperature. The small-signal dielectric constant is about 15 along the axis and about 5 perpendicular to the axis. Of isomorphous substances, we have so far

examined those in which D_2O replaces H_2O , in which Ga^{3+} and Cr^{3+} replace Al^{3+} , and in which $(\text{SeO}_4)^{2-}$ replaces $(\text{SO}_4)^{2-}$. These substances show essentially the same properties. Dr. S. Geller and Dr. E. A. Wood have in progress a determination of the crystal structure of the material; they inform us that the space group is $C_{3v}(2) - P31m$, and the unit cell contains three molecules. The material bears no obvious structural relation to previously known ferroelectrics.

¹ F. Ferraboschi, *Proc. Cambridge Phil. Soc.* **14**, V, 473 (1908).

Radiation-Controlled Electroluminescence and Light Amplification in Phosphor Films

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THIS is a preliminary report of a new phenomenon observed when voltage is applied to a layer of ZnS:Mn,Cl phosphor during excitation by uv or x-rays. The luminescent layer (about 10 microns thick) is deposited by vapor reaction.^{1,2} As contrasted with the granular phosphor commonly used for electrolumines-

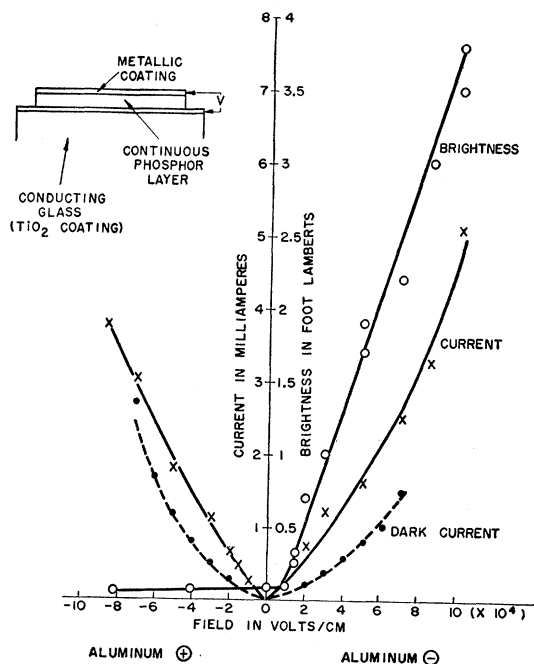


Fig. 1. Dependence of cell brightness and current on the average dc field (for constant 3650 A excitation intensity).

cent sources, this phosphor consists of a solid structureless sheet which makes unbroken contact with the electrodes. (See Fig. 1, upper left.) Such a cell exhibits negligible emission when a dc or ac potential is applied