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Effect of Pressure on Phosphor Decay*

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An apparatus has been developed to measure the effect of pressure to over 50 000 atmospheres on the decay rate of phosphors. Three manganese activated phosphors with exponential decay curves were studied. In two cases the rate of decay decreased, in the third case it increased. A tentative explanation is offered. An hexagonal ZnS:Cu phosphor showed little pressure effect to 40 000 atmospheres at which pressure it transformed irreversibly to the cubic form with a sharp increase in decay rate and a large decrease in intensity.

AN apparatus has been developed to measure the effect of pressure on phosphor decay. It has been operated to 52 000 atmospheres, and, under favorable conditions, is capable of considerable extension of the pressure range. The high-pressure bomb and press is the same as that used for spectroscopic studies.[1,2] The press is incorporated with a shutter system as shown in Fig. 1. The shutters are aluminum disks 13 in. in diameter cut as indicated in the figure, and rotated on a common shaft. A rubber wheel on the shaft makes a friction contact with a fly wheel turned by a 1/12 *hp* motor. The rpm can be adjusted by sliding the rubber wheel to different points on the radius of the fly wheel. The entire setup is enclosed to prevent light leak.

The light source is a BH-6 Mercury lamp which is focused on the bomb window with appropriate lenses. The phosphor output is focused on a 1*P*21 photomultiplier tube. The tube output goes to a Tektronix 122 Preamplifier, then to a Tektronix 545 Oscilloscope. The decay curves were photographed with a Polaroid type 2620 camera. The transparencies were projected on a screen to permit more accurate measurement of the decay. Six to eight pictures were taken at each pressure, and each material was run with at least 2–3 separate loadings. In order to minimize shear effects, which are particularly serious with ZnS phosphors, the samples were suspended in Canada Balsam which was inserted in a hole drilled in the NaCl pressure transmitting "fluid."

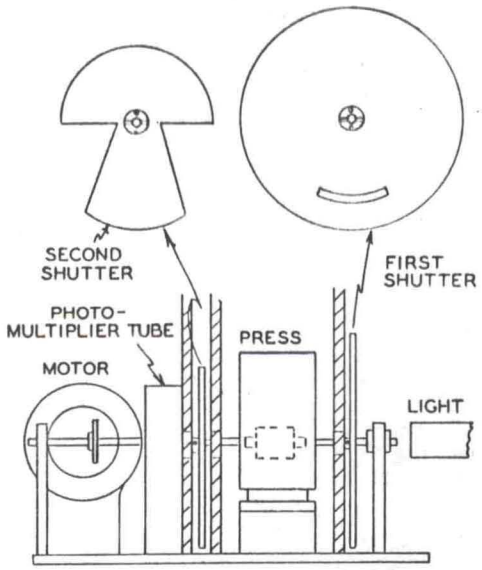

FIG. 1. Schematic diagram of high-pressure apparatus for decay studies.

RESULTS

Data were obtained on three manganese activated phosphors with substantially time independent exponential decays. These were Bureau of Standards numbers 1030, 1028, and 1025, which had compositions $(MgO)_x(As_2O_5)_y$:Mn, $ZnSiO_4$:Mn, and $Zn_3(PO_4)_2$:Mn. Plots of decay time *versus* pressure are shown in Fig. 2–4. In all cases the decays were reversible with pressure within the accuracy of the measurements. For phosphors 1030 and 1028 the decay constant increased by

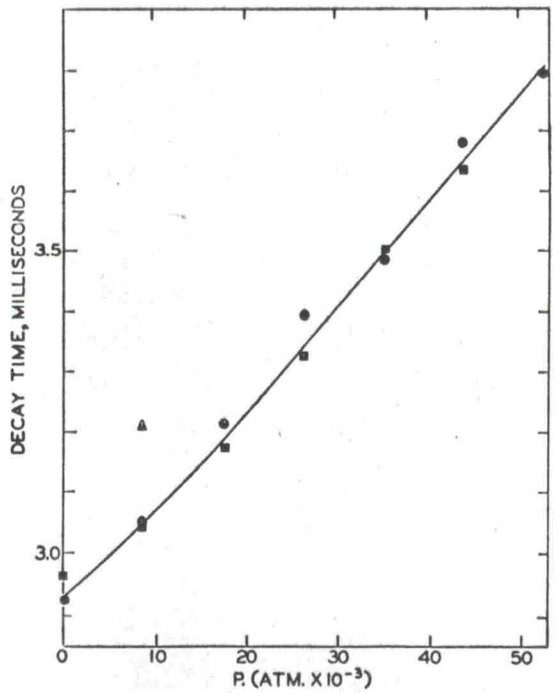

FIG. 2. Decay time *vs* pressure for $(MgO)_x(As_2O_5)_y$: Mn (1030).

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[1] Fitch, Slykhouse, and Drickamer, J. Opt. Soc. Am. 47, 1015 (1957).
[2] T. E. Slykhouse and H. G. Drickamer, J. Phys. Chem. Solids 7, 210 (1958).