Letters to the Editor

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Luminescence of Beryllium Oxide*

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IN the course of a survey of the luminescence of metallic oxides, some interesting properties of beryllium oxide have been noted. When irradiated by alpha particles, an intense ultraviolet fluorescence was observed. From the spectral sensitivity of the detector, it was estimated that a considerable emission occurs at wavelengths of 2500A or less.

Although earlier investigators have reported a visible blue luminescence from BeO under action of a vacuum discharge, apparently no mention has been made of the fact that the spectrum extends far into the ultraviolet. Under alpha irradiation, white powdered BeO yielded an emission band extending from above 4000A into the ultraviolet to ~2000A. The spectrogram was obtained in a small Hilger quartz spectrograph. Bombardment of a combustion tube of sintered BeO gave the same result. BeO has been reacted with other materials, such as SiO_2, to produce numerous phosphors but does not itself appear to have been studied in detail. A comparison of the intensity of the ultraviolet fluorescence of powdered BeO and of NaCl—Ag under alpha-particle excitation is shown in Table I.

Nine different samples of BeO were obtained from eight different suppliers, and all exhibited a detectable long-period phosphorescence as well as energy storage at room temperature (20°C) when excited by cathode rays, x-rays, or ultraviolet light. Irradiation by alpha particles resulted principally in fluorescence. One sample of BeO, excited by cathode rays, decayed over a period of 400 minutes on a $\log I - \log t$ plot with a slope of -0.83. The decay of both visible and ultraviolet portions of the spectrum followed the same law. Spectrographic analyses showed that B, Mg, Al, Si, and Fe could be present as impurities. The afterglow which immediately followed excitation could be considerably enhanced in the case of the less pure samples by ignition at 1400°C. Under cathode-ray excitation, this afterglow equaled in intensity that of the best samples of NaCl—Ag. The purest material was obtained from Johnson, Matthey, and Company, Ltd., and although it had good fluorescent response for alpha and beta particles, phosphoresced only faintly under irradiation by excitants of all types. Ignition of this particular material had small effect upon the phosphorescence and energy storage. The alpha-particle-excited fluorescence of all samples seemed to remain unchanged by ignition.

TABLE I. Ultraviolet fluorescence.

Phosphor[a]	Yield
NaCl+0.0008 percent AgCl	31
NaCl+0.004 percent AgCl	71
NaCl+0.02 percent AgCl	370
NaCl+0.10 percent AgCl	1160
NaCl+0.22 percent AgCl	3150
NaCl+0.50 percent AgCl	4630
NaCl+1.00 percent AgCl	3730
BeO	1060
BeO (ignited)	990

[a] AgCl concentrations in weight percent.

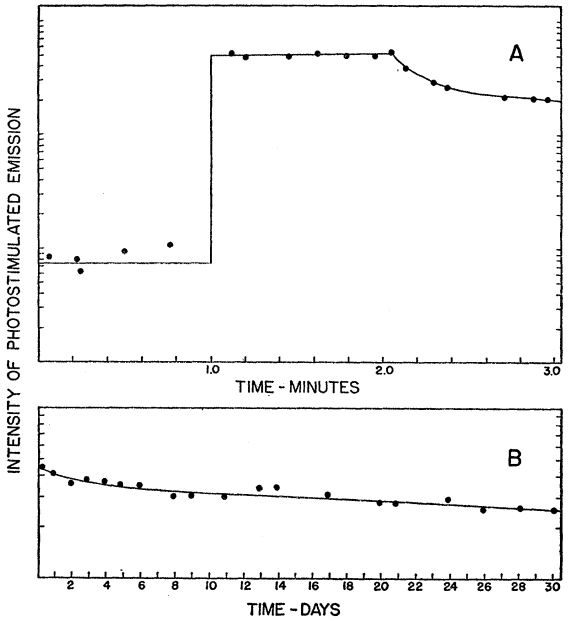

FIG. 1. Photostimulated emission of x-rayed beryllium oxide. In Fig. 1(A), photostimulated emission occurs during one minute of stimulation and is followed by a post-stimulation afterglow. Figure 1(B) is a plot of the decay of the energy stored in x-rayed BeO. Excitation and all measurements carried out at room temperature (20°C).

A sample of BeO obtained from Fisher Scientific Company, Inc., was ignited at 1400°C and irradiated by 20-kev x-rays and stored in darkness. After twenty-two hours, the excited phosphor was photostimulated by light from a tungsten lamp for one minute. The emission during stimulation and the post-stimulation afterglow are shown in Fig. 1(A). A similar specimen was x-rayed, and bursts of ultraviolet of duration six seconds were drawn from it by photostimulation at intervals of 24 to 48 hours over a period of thirty days. This photostimulated emission is approximately proportional to the amount of energy remaining stored in the beryllium oxide. These data are plotted in Fig. 1(B), where it is clear that a large fraction of the stored energy remained after thirty days—more than in any other phosphor studied in this laboratory. Under identical conditions of photostimulation, the emission from BeO was less than one percent of that from transparent samples of NaCl—Ag of the same area. However, the transmission of the powdered BeO is low, and only light released near the surface could be measured.

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Restoration of F and V_1 Centers Following Low-Temperature Bleaching

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THE following observations were made in the course of experiments with single crystals of KCl colored at 113°K by 180-kv x-rays.

The freshly colored crystals contain a large fraction (up to 50 percent) of unstable F centers which require a thermal activation of only 0.02 ev in order to decay, presumably by tunneling of electrons to neighboring positive hole centers. This is revealed by