EMISSION SPECTRA OF SENSITIZED AND UNSENSITIZED LiF; TLD-100 *

by

D. Pearson and J. R. Cameron
 Department of Physics
 University of Wisconsin
 Madison, Wisconsin

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The sensitivity of TLD-100 powder can be increased about a factor of 5 by irradiating to 3×10^4 R and annealing for an hour at 280°C . This was attributed to the creation of trapping sites in the crystal⁽¹⁾. According to a new model presently under consideration, this increase may be due to the radiation production of additional recombination centers which in turn increase the probability of photon emission. If the gamma radiation creates additional recombination centers, it would be reasonable to assume that they would be different from those originally present in the crystal. One might expect to observe a change in the emission spectrum of the TL from the sensitized LiF compared to the unsensitized material.

LiF(TLD-100) powder was annealed for one hour at 400°C in a porcelain crucible and quenched by pouring onto an aluminum block at room temperature. Part of this powder was irradiated to 2×10^3 R with ^{137}Cs gamma rays. This value was chosen to give reasonable light output without appreciable sensitizing of the powder⁽¹⁾. The remaining powder was irradiated to 3×10^4 R with ^{137}Cs gamma rays, annealed 1.5 hours at 280°C and quenched on an aluminum block. The sensitivity of this powder was increased by about a factor of 5 such that a 400R exposure had about the same light output as the unsensitized powder exposed to 2×10^3 R. Thus about 80% of the TL from the sensitized powder presumably came from "new sources" not present originally. Fig. 1 shows glow curves for both sensitized and unsensitized powders.

*Purchased from Harshaw Chemical Company, Cleveland, Ohio.

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The TL from 27mg samples of powder was passed through a Bausch and Lomb grating monochromator, observed with an EMI 6256B photomultiplier and Keithley 610A electrometer, and recorded by a Moseley T-Y recorder. Figure 2 shows a schematic diagram of the apparatus. Four glow curves were recorded at each wavelength setting for both the sensitized and unsensitized LiF. The wavelength was set manually and data were taken at 10 nm intervals. The band pass of the monochromator was 5nm.

Since the glow curve shapes are the same for all monochromator settings, the height of peak 5 is a good measure of the total light emitted. The data shown in Fig. 3 represent the average of four measurements of the height of peak 5 for each wavelength setting. The standard deviations vary between 2 and 6%. The emission spectra have been normalized to coincide at their maxima. Since we were looking for differences in spectra, the data were not corrected for PMT response or monochromator grating blaze. The longer wavelength data include a small amount of stray light.

The fact that the glow curve shape appears independent of wavelength is consistent with a two center model in which the traps and recombination centers are different species. According to such a model, the glow curve shape depends primarily upon the relative proportions of different traps, and the emission spectrum depends upon the nature of the recombination centers. The data in Fig. 3 would seem to indicate that any recombination centers created by radiation could not have an optical transition significantly different from that of the recombination centers originally present in the crystal.

REFERENCE

1. J. R. Cameron and D. W. Zimmerman, Tl vs R in LiF: A Proposed Mathematical Model, AEC Report C00-1105-102 (1965)

FIGURE CAPTIONS

Fig. 1 Glow Curves for Sensitized and Unsensitized LiF(TLD-100)

Fig. 2 Schematic Diagram of Apparatus

Fig. 3 Emission Spectra

LIF TLD-100

Fig. 1

Fig. 2

EMISSION SPECTRA
TL FROM LIF TLD-100

Fig. 3