Wavelength Dependence of Photostimulated TL in LiF

MASTER

by

D. Pearson and J. R. Cameron

Photostimulated TL has been used by several research groups as a sensitive method for detecting photoionization of various color centers^{1,2,3,4} and under certain conditions, for distinguishing between electron and hole centers. We previously reported⁵ observing photostimulated TL in LiF and wish to report some preliminary results of studies of the wavelength dependence of this effect. Two LiF phosphors* have been studied: TLD-100 and a high purity optical grade LiF we call H64UV.

Figure 1 shows the photostimulation process in schematic form. The phosphors in powder form were exposed to 10^5 R of ^{137}Cs gamma rays at room temperature. This exposure produces the order of 10^{17} F centers per cm^3 . A 30 mg sample of phosphor was then heated to empty the TL traps of interest leaving the deeper traps unaffected. For TLD-100 this was accomplished by heating to 300°C for two minutes, for H64UV two minutes at 200°C was sufficient. The sample was then exposed at room temperature for two minutes to monochromatic light having a band width of 2.5 nm and an intensity of approximately 3 uwatt/cm^2 .

Photoionization of the remaining deep traps provides free charge carriers to partially refill the empty TL traps. The TL glow curve of the sample recorded in a conventional manner is then a measure of the amount of refilling. For the particular

* Obtained from Harshaw Chemical Co., Cleveland, Ohio.

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission, makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information disclosed in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe upon privately owned rights; or

B. Assumes any liability with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As stated in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor, prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

feg

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

light exposure and initial gamma ray exposure used the photostimulated TL was the same as the TL from a gamma ray exposure of a few hundred mR. A sample could be stimulated and measured many times without loss of sensitivity. Two to four glow curves were recorded for each wavelength setting. (It might be pointed out that photostimulation is the method used by M.B.L.E. to obtain multiple readings from one dosimeter).⁶

Averaged peak heights of the photostimulated TL glow curves, corrected for the variation in output of the light source as a function of wavelength, are shown in Figures 2 and 3. It is not obvious to which centers one should ascribe the photostimulation effect. One is tempted to suggest that the F center has a low photoionization yield at room temperature and that the peaks shown correspond to K and L bands. The low temperature stimulation curve for NaCl shown by Fieschi and Scaramelli² is suggestive of such an interpretation. Further experiments on the temperature dependence and gamma dose dependence of photostimulation should help clear up the problems of interpretation.

REFERENCES

1. B. Bosacchi, R. Fieschi and P. Scaramelli, Phys. Rev. 138, A1706 (1965).
2. R. Fieschi and P. Scaramelli, Phys. Rev. 145, 622 (1966).
3. A.A. Braner and M. Israeli, Phys. Rev. 132, 2501 (1963).
4. P.D. Townsend, C.D. Clark and P.W. Levy, Phys. Rev. 138, 908 (1967).
5. D. Pearson and J.R. Cameron, AEC Progress Report COO-1105-140, (1968).
6. R. Schayes et al. Luminescence Dosimetry, USAEC Conf.-650637

1 γ -RAY PREDOSE

CONDUCTION BAND

FILLED TRAPS

EMPTY RECOMBINATION
CENTERS

VALENCE BAND

2 FIRST HEATING

CONDUCTION BAND

SHALLOW TRAPS
EMPTY

DEEP TRAPS
FILLED

SOME RECOMBINATION
CENTERS FILLED

VALENCE BAND

Figure 1.1 and 1.2 - Schematic Representation of Photo-stimulation Process

3 UV EXPOSURE

CONDUCTION BAND

VALENCE BAND

4 TL MEASUREMENT

CONDUCTION BAND

VALENCE BAND

Figure 1.3 and 1.4 - Schematic Representation of Photostimulation Process.

Figure 2 - Photostimulation spectrum of TLD-100.

Figure 3 - Photostimulation spectrum of H64UV.