theoretical results lying in the incorrectness as to phase locations of the old theory. (2) The present photoelectric experiments agree approximately in amplitude of the deviations with the Guth-Mullin theory with, as has been pointed out, the experimental amplitudes coming out somewhat smaller usually. The experimental amplitudes therefore are smaller than predicted by the old theory and larger than by the Juenker theory. (3) The present photoelectric experiments agree quite closely with the Juenker theory in the magnitude of the difference between positions of successive zero deviation points; 0.9π comes out of the experiments as the average value of the half-period of the appropriate parameter as against π in the theory.

PHYSICAL REVIEW VOLUME 91, NUMBER 3 AUGUST 1, 1953

The Storage of Energy in Silver Activated Potassium Chloride*

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(Received February 2, 1953; revised copy received April 20, 1953)

Crystals of KCl-Ag and NaCl-Ag have been excited by x-ray irradiation. The photostimulated light yield of the ultraviolet emission band has been observed simultaneously with application of the stimulating near-ultraviolet light. The decay with time of the stored energy in the two phosphors is compared.

THE energy storage properties of some silver activated alkali halides have been discussed in several recent publications.[1,2] The procedure outlined in references 1 and 2 has been to irradiate an excited phosphor with long wave light and observe in a phototube (RCA-1P28) what may be described as a "post-stimulation phosphorescence" of the ultraviolet emission band after the stimulating long wave light has been extinguished. In using the 1P28 as a detector, difficulties are encountered if attempts are made to measure the stimulated emission while the stimulating light is on, because the phototube's spectral response is such as to respond to the stimulating light as well. The stimulated light emitted while the stimulating light is on might be called "co-stimulation phosphorescence." To avoid this problem, the writers have employed photosensitive Geiger counters to detect the stimulated emission. It has long been known[3] that photosensitive Geiger counters can be produced which have an excellent sensitivity at 2500A but no response to near-ultraviolet or visible radiations. Accordingly, in the present investigation, photosensitive Geiger counters have been employed to detect the photostimulated emission of the ultraviolet bands of KCl-Ag and NaCl-Ag, the ultraviolet band of KCl-Ag being centered at 2800A and that of NaCl-Ag at 2500A. Irradiation, storage, and measurements relating to all phosphor samples were carried out at toom temperature (25°C).

To study the photostimulated emission from NaCl-Ag and KCl-Ag, a polycrystalline mass of KCl-Ag (AgCl concentration 0.10 ± 0.02 percent by weight) and a single crystal of NaCl-Ag prepared by The Harshaw Chemical Company (AgCl concentration 0.37 ± 0.06 percent by weight) were irradiated by x-rays of maximum energy 25 kev for ten minutes to receive a dosage of three roentgens. The irradiations were carried out in total darkness, and the materials were stored for twenty-four hours in light-tight containers. At the end of that time, the crystals were each stimulated by a one-watt tungsten lamp at a distance of seven centimeters for a period of one minute. The counting rates of NaCl-Ag and KCl-Ag before, during, and after the one-minute period of photostimulation are shown in Fig. 1. A time of one minute before the stimulating light was turned on was taken arbitrarily as time zero. Prior to stimulation, the slow normal unphotostimulated phosphorescence of NaCl-Ag was $\sim$35 counts per minute, rising immediately to $\sim$50 000 counts per minute in the form of co-stimulation phosphorescence. After one minute of photostimulation, the stimulating tungsten lamp was extinguished, and the luminescence from NaCl-Ag dropped immediately to a post-stimulation phosphorescence count of about 9000 per minute. Thus, photostimulation with the one-watt bulb of NaCl-Ag twenty-four hours after receipt of a dosage of three roentgens gave rise to a co-stimulation phosphorescence 1400 times greater than the residual unphotostimulated phosphorescence (35 counts per minute) existing prior to stimulation, and to a post-stimulation phosphorescence greater than the same quantity by a factor of 257. The similarly exposed KCl-Ag gave no evidence of slow unphotostimulated phosphorescence at 25°C, twenty-four hours after excitation. The counting rate in the photosensitive Geiger counter was only the natural background count. However, upon photostimulation, the

* Assisted by the joint program of the U. S. Office of Naval Research and the U. S. Atomic Energy Commission.
[1] M. Furst and H. G. Kallmann, Phys. Rev. **82**, 964 (1951); **83**, 674 (1951); Kallmann, Furst, and Sidran, Nucleonics **10**, No. 9, 15 (1952).
[2] Bittman, Furst, and Kallmann, Phys. Rev. **87**, 83 (1952).
[3] P. B. Weisz, Electronics **19**, No. 7, 106 (1946); H. Friedman and C. P. Glover, Nucleonics **10**, No. 6, 24 (1952); C. E. Mandeville and H. O. Albrecht, Phys. Rev. **79**, 1010 (1950).

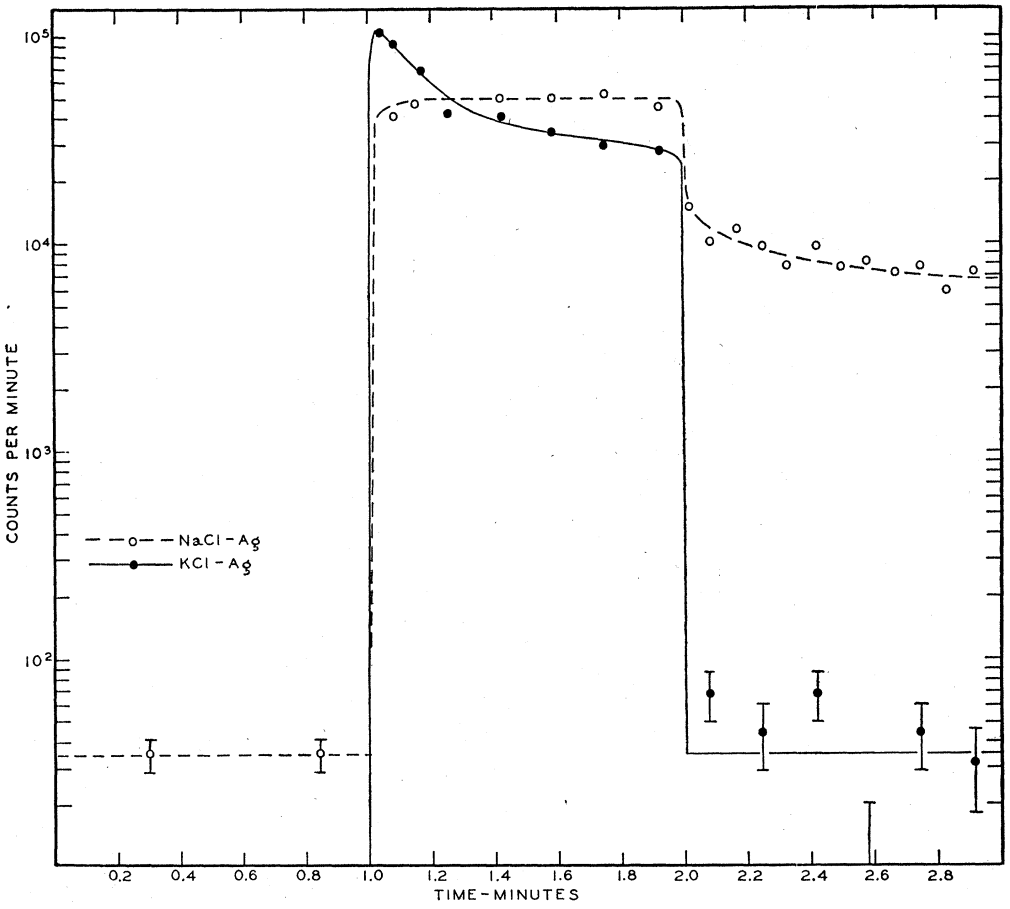

FIG. 1. Photostimulation for one minute of NaCl-Ag and KCl-Ag twenty-four hours after irradiation by three roentgens of x-rays.

counting rate rose to $\sim 10^5$ counts per minute, decreased to 2.5×10^4 counts per minute during one minute of photostimulation, and dropped very nearly to zero when the stimulating light was turned off.

Thirty seconds after the one-minute period of photostimulation, the counting rate arising from NaCl-Ag was 7600 counts per minute, whereas that of KCl-Ag was ~ 35 counts per minute. The large difference in the two curves at $t = 2.5$ min explains why Bittman, Furst, and Kallmann[4] reported the post-stimulation photophorescence of KCl-Ag to be essentially zero which led to the conclusion that only NaCl-Ag exhibits good storage properties. The fact is that KCl-Ag exhibits light storage which can be measured by co-stimulation phosphorescence, but not by poststimulation phosphorescence.

In Fig. 2 is shown a comparison of the co-stimulation phosphorescence of NaCl-Ag and KCl-Ag, the AgCl concentrations being the same as previously given. To obtain the data of Fig. 2, equal volumes of the two materials were irradiated in an x-ray field of intensity twenty roentgens per hour for a period of ten minutes. The irradiated materials were immediately stored in darkness and subsequently stimulated by the one-watt tungsten lamp for a period of six seconds every twenty-four hours. The counting rate during the six-second period of photostimulation is recorded.

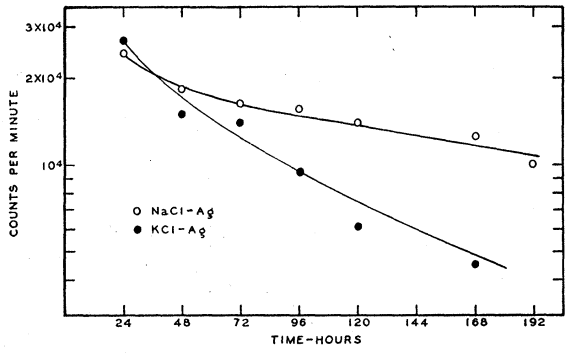

FIG. 2. Decay of co-stimulation phosphorescence of KCl-Ag and NaCl-Ag. The sample of NaCl-Ag was a single crystal (Harshaw).

Note added in proof:—Particular attention should be called to the papers of Mikao Kato, Sci. Papers Inst. Phys. and Chem. Research (Tokyo) **41**, 113 (1944); **41**, 135 (1944); **42**, 35 (1944); **42**, 95 (1944). In the fourth publication of the series, he describes many of the storage properties of KCl-Ag and comments on the spectral response of the Geiger counter and its importance in photostimulation studies. Kato's measurements differ from those of the writers in that his means of primary excitation were limited to ultraviolet light. Copies of Kato's papers have been difficult to obtain in the United States and were not available to the writers until after this manuscript had been submitted for publication.

[4] Bittman, Furst, and Kallmann, Phys. Rev. **87**, 83 (1952).