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# The Creation of a Defect Giving Rise to a Thermoluminescence Glow Peak in Urea by X-Irradiation

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# The Creation of a Defect Giving Rise to a Thermoluminescence Glow Peak in Urea by X-Irradiation

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**Abstract**—Repeated brief X-irradiation of a sample of urea caused an initially absent thermoluminescence peak to grow in intensity, while the brightness of a second peak decreased in such a manner that the total integrated emission intensity remained constant. It is postulated that this is a consequence of a new trapping site being formed at a previously existing defect, and that this is competing for charge with another trap.

Observations of the thermoluminescence of urea in both powder and crystal forms indicate that a defect giving rise to a new glow peak can be created by X-irradiation, causing a diminution of the intensity of a subsequent feature. To the author's knowledge no other examples of this phenomenon have been reported, and during an examination of the X-ray stimulated thermoluminescence of over 40 organic solids this phenomenon was observed in only one material.

It was found that repeated 10-minute irradiations of urea samples at liquid air temperature using a Mo target X-ray tube giving a dose of 0.12 megarad/hour, followed by warming to 270 °K gave, within the limits of experimental error, the same total integrated light intensity (as measured by the area under the experimental curve). Since the efficiency of emission as a function of temperature, as measured by the X-ray stimulated fluorescence intensity, is constant

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in the region of interest, the unchanging total emission implies that a fixed number of charges are trapped in centres capable of giving rise to thermoluminescence. (If the time of irradiation prior to the next warming was varied the intensity was found to change in the manner described by Brocklehurst *et al.*[1])

Although the total thermoluminescence intensity remained constant during repeated brief irradiations, the peak occurring at the lowest temperature which was initially not very bright when a fresh sample was used, showed a considerable increase in intensity as the number of 10-minute irradiations which it had received became greater (Fig. 1). Simultaneously the total emission intensity of the second peak decreased. No systematic variation could be observed in the intensity of the third peak (i.e. that occurring at the highest temperature), possibly because it was of such low intensity that any slight change would be obscured by photomultiplier noise. A simple experiment showed that the defect responsible for the first peak was formed by the irradiation. When a fresh sample which had not been

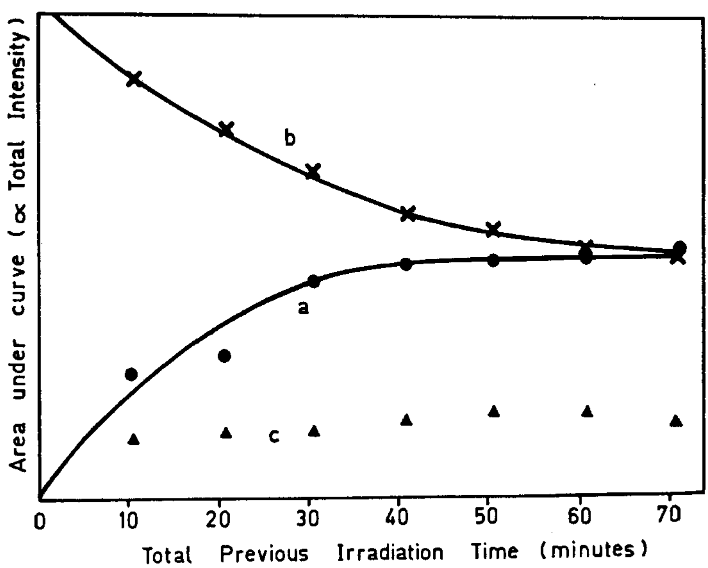


Figure 1. The total integrated intensity of the three glow peaks (as measured by the areas under the experimental curve) as a function of the total radiation dose received by the sample during a number of 10-minute irradiations. (a) First peak, (b) second peak, (c) third peak.

previously exposed to X-rays was irradiated for 1 minute at liquid air temperature and then warmed, the very faint glow curve observed using a liquid air cooled photomultiplier showed no sign of the first peak, but when the same sample had been exposed to X-rays for 30 minutes the glow curve resulting from a 1-minute irradiation showed this feature distinctly, together with the second peak which then had reduced intensity (Fig. 2).



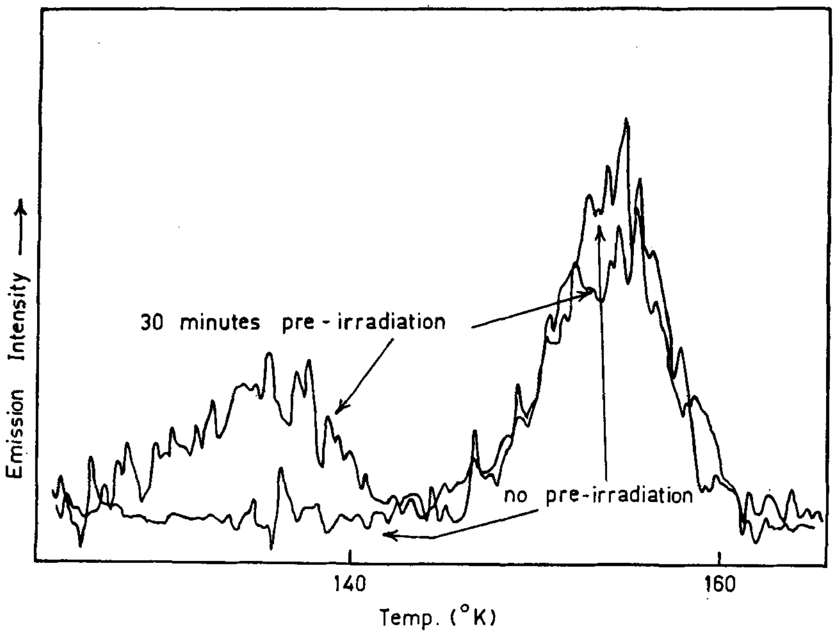


Figure 2. Superimposed tracings of the experimental plots of the glow curves obtained after one-minute irradiations of a fresh urea sample, and of the same sample after it had received a total of 30-minutes irradiation.

Thus it appears that a given radiation dose produces a fixed number of charged defects capable of giving rise to thermoluminescence, as seen by the constant total integrated light intensity, and that after the sample had a history of previous irradiation a new defect was formed and competed with the intrinsic defect in the trapping of charges. It is also apparent that this new defect is located at an impurity site or pre-existing lattice irregularity since, as shown by Fig. 1, the intensity of the first peak does not continue to increase with the total cumulative radiation dose received until it dominates the curve, but rises to a certain level and then saturates when the number of available sites is exhausted.


### REFERENCE

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