

ARRANGEMENT OF A TLD SYSTEM TO MEASURE THE DOSE TO PATIENTS UNDERGOING IRRADIATION

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SUMMARY

A dosimetric system has been developed to measure the doses to patients undergoing irradiation for medical purposes. This system is based on $\text{Li}_2\text{B}_4\text{O}_7\text{:Mn}$, TLD-800, in ribbon form, only recently manufactured by Harshaw Chem. Co.. The main advantages of TLD-800 are its equivalence tissue, its single glow-curve, its very easy annealing procedure. The problems investigated are: annealing procedure, linearity, energy response and fading characteristics.

SAMPLES AND READER-SYSTEM

The samples of $\text{Li}_2\text{B}_4\text{O}_7\text{:Mn}$ studied are ribbons, measuring $3.2 \times 3.2 \times 0.9 \text{ mm}^3$, and a density of 2.4 gm/cc . The effective Z of borate, for photoelectric absorption, is 7.4. After exposure, the samples were readout in a Harshaw thermoluminescent reader-system, model 2000 B+C, with a constant flux of nitrogen (about 5 l/min).

ANNEALING

The first problem investigated was the annealing procedure to be used on $\text{Li}_2\text{B}_4\text{O}_7\text{:Mn}$ ribbon, in order to eliminate the effects of previous exposure.

The TLDs, six chips, were annealed for 10 minutes at various fixed temperatures between 200°C and 300°C, with 25°C steps. After cooled to room temperature in air, three chips were irradiated at 20 rads and readout. The other three chips were readout for background check. The results are shown in fig.1. Each point of the graph is based upon nine measurements (3 readouts on each of 3 TLDs). It can be seen that the best reproducibility (lowest S.D.) is achieved at 275°C, whereas the absolute value of TL output is maximum at 275°C. The whole experiment was repeated at higher dose levels, with practically the same results. Previously irradiated chips were annealed at 275°C for times varying between 10 min and 30 min, with 10 min steps. The results are shown in fig.2. The lowest S.D. is at 10 min. The optimum annealing to produce high sensitivity TLD-800 is 10 min at 275°C.

DOSE RESPONSE

Fig.3 shows the shape of the glow-curve at various dose levels. Fig.4 shows the response of borate, peak area, exposed to ^{60}Co . The linearity index, starting around 10 R, is about 0.85 (1).

ENERGY RESPONSE

The energy dependence of the response of TLD-800 is shown in fig.5. The energy response is lightly different from J.J.Thompson et al. data (2), which used borate in powder form.

FADING

No evidence of thermal fading was found during a short time of storage (10 days). Experiments are being run to test the fading effect over longer times.

CONCLUSION

The range of sensitivity of lithium borate is such that its most use is in clinical-therapy dosimetry rather

than in health physics. The results of this preliminary investigation have demonstrated that manganese-activated lithium borate ribbon is satisfactory for measuring high doses in some clinical applications like in therapeutic linear accelerator.

REFERENCES

1. Schulman,J.H., Kirk,R.D. and West,E.J.(1967): In: Luminescence Dosymetry, CONF - 650637, p.113.
2. Thompson,J.J. and Ziemer,P.L.(1972):Health Phys., 22, 399.

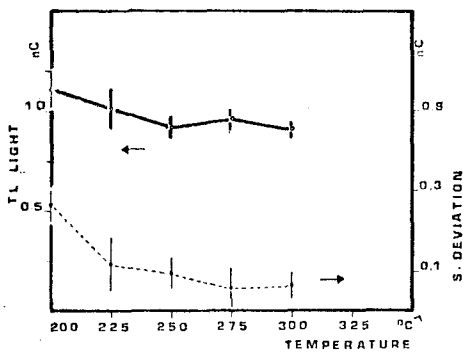


FIG. 1. ANNEALING: DETERMINATION OF OPTIMUM TEMPERATURE AT 10 MINUTES

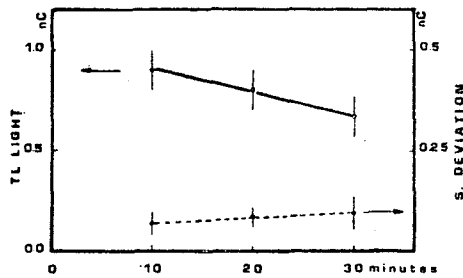


FIG. 2. ANNEALING: DETERMINATION OF OPTIMUM DURATION AT 275 °C

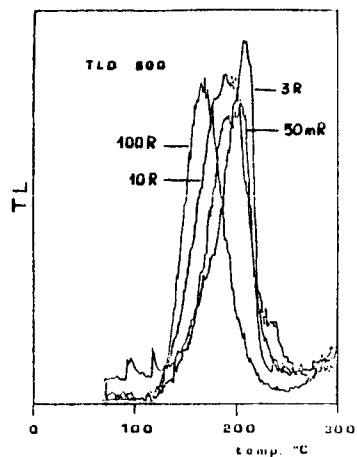


FIG. 3. TYPICAL GLOW CURVES
AT DIFFERENT DOSE LEVELS

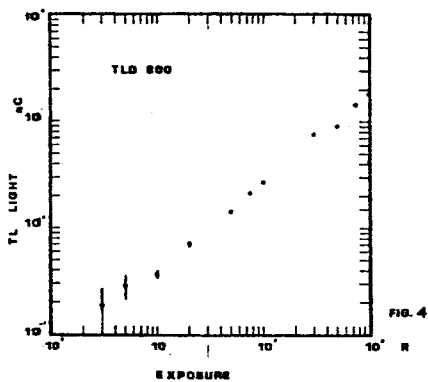


FIG. 4

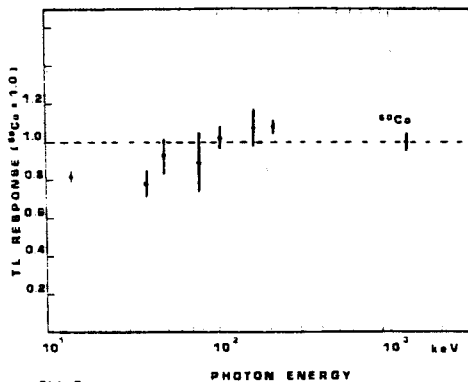


FIG. 5