DETERMINATION OF THE THERMOLUMINESCENCE KINETIC PARAMETERS IN $Li_2B_4O_7$:Ag SINGLE CRYSTALS

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Applying a computerized glow curve deconvolution technique in the routine thermoluminescence (TL) dosimetry allows to lower the minimum dose that can be measured, improves the accuracy and overall reliability of the measurements [1]. Implementation of such technique requires a kinetic model, which describes the dynamics of charge detrapping and recombination during heating and able to reproduce the experimental glow curve of the given TL phosphor. Determination of the model parameters becomes quite difficult and ambiguous in case of complicated glow curve consisting of several strongly overlapping peaks [2]. A doped $Li_2B_4O_7$ is an example of such type of material. Therefore, we used a fractional glow technique (FGT) for preliminary estimation of the activation energy of traps [3]. Further determination was done using computerised least square fitting of the experimental glow curves recorded in the wide range of linear heating rates. Applying combination of these two techniques for the single crystal samples of $Li_2B_4O_7$:Ag showed potential of such approach.

The order of TL kinetics of $Li_2B_4O_7$:Ag single crystal was determined in a usual way by analyzing the temperature position of the glow curve peaks after X-ray irradiation of the samples in the dose range 1–300 Gy. Glow curves were recorded in the temperature range 20–300°C at linear heating rate of 3 °C/s. Obtained experimental data showed that TL of $Li_2B_4O_7$:Ag single crystal belongs to the first order of kinetics. Therefore, the classic Randall-Wilkins function was used as a base for the model.

The results of the FGT showed that in $Li_2B_4O_7$:Ag single crystal exist groups of traps with continuous distribution of the activation energy. Further determination of activation energy values and corresponding frequency factors was done using simultaneous least square fitting of the four experimental glow curves recorded at linear heating rates 3, 0,5, 0,05 and 0,005 °C/s. Thus it was found that TL of the $Li_2B_4O_7$:Ag single crystal in the 20–300°C temperature range satisfactory described by model consisting of three groups of traps with continuous distribution of the activation energy and corresponding kinetic parameters were determined.

References

[1] Y.S. Horowitz, D. Yossian, Radiat. Prot. Dosim. 60, 1 (1995).
[2] R. Chen, S. W. S. McKeever. Theory of thermoluminescence and related phenomena (World Scientific, Singapore, 1997).
[3] A. Chruścińska, J. Lumin. 62, 115 (1994).