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REPLY

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REPLY

Reply to Comments on 'Effect of heating rate on kinetic parameters of β-irradiated $Li_2B_4O_7$:Cu,Ag,P in TSL measurements'

A (Turkler) Ege[1,2], E (Ekdal) Tekin[1], T Karali[1], N Can[2] and M Prokić[3]

[1] Institute of Nuclear Sciences, Ege University, 35100 Bornova-Izmir, Turkey
[2] Department of Physics, Faculty of Arts and Sciences, Celal Bayar University, 45140 Muradiye-Manisa, Turkey
[3] Institute of Nuclear Sciences—Vinca, PO Box 522, 11001 Belgrade, Serbia and Montenegro

E-mail: arzu_aegean@hotmail.com

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Abstract
We appreciate the opportunity to respond to comments regarding the paper published by Ege *et al* (2007 Effect of heating rate on kinetic parameters of β-irradiated $Li_2B_4O_7$:Cu,Ag,P in TSL measurements *Meas. Sci. Technol.* **18** 889). We would like to thank the authors for taking the time to tell us about their opinion, but unfortunately we do not agree with them completely. In the article presented by Kumar and Chourasiya some comment is advanced to the analysis of the glow curves measured with different heating rates, presented in our recent study. According to our study, the area under the glow curve decreases with increasing heating rate in TL–temperature plots due to the quenching effects. Contrary to this, Kumar and Chourasiya suggest that this decrease is due to the normalization process. Here we hope to clarify any confusion regarding our published study.

Keywords: thermoluminescence, dosimetry

In the paper by Ege *et al* the effect of heating rate on the thermally stimulated luminescence (TSL) emission due to the temperature lag (TLA) between the TSL material and the heating element was investigated using $Li_2B_4O_7$:Cu,Ag,P dosimetric materials [1]. Moreover, variation in the TSL sensitivity of these dosimeters with different heating rates was investigated using the integrated area of the glow curve. It was observed that the sensitivity of the dosimeter was decreased by increasing heating rate due to the thermal quenching effect. Thermal quenching is a phenomenon in which the luminescence efficiency decreases as the temperature of the material increases. This phenomenon takes place due to the increased probability of non-radiative transitions at relatively high temperatures. Kumar and Chourasiya [2] state that '*The measurements carried out at different heating rates but at the same dose, the division of TL intensity with the respective heating rate is essential to conserve the area, and this normalization leads to the decrease of peak height with increasing heating rate, which is generally misinterpreted as a signature of thermal quenching and was definitely not followed by Ege et al in the measurement and further interpretation of the thermal quenching effect in $Li_2B_4O_7$:Cu,Ag,P. A more logical way to predict the presence of thermal quenching quantitatively would have been the observation of decrease of integrated counts (PMT current; mathematically the area under the TL–time plot or area under the TL/β–temperature plot) with increasing heating rate at constant dose.*' In our recent paper, in contrast to these comments, thermal quenching was determined using the integrated area of the glow curves rather than the variation of maximum value of the peak height both in the TL intensity (I) versus temperature and in the TL intensity versus time plots (figures 1 and 2). TL sensitivities of the glow peak of the $Li_2B_4O_7$:Cu,Ag,P dosimeter using the integrated areas of both TL intensity versus

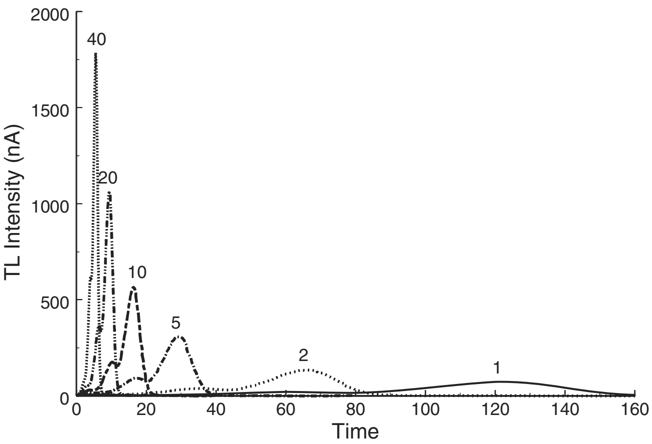

Figure 1. TL intensity versus time plots of $Li_2B_4O_7$:Cu,Ag,P irradiated with a ^{90}Sr β-source with the same dose. The spectra were recorded at different heating rates, namely 1, 2, 5, 10, 20 and 40 K s^{-1}, respectively.

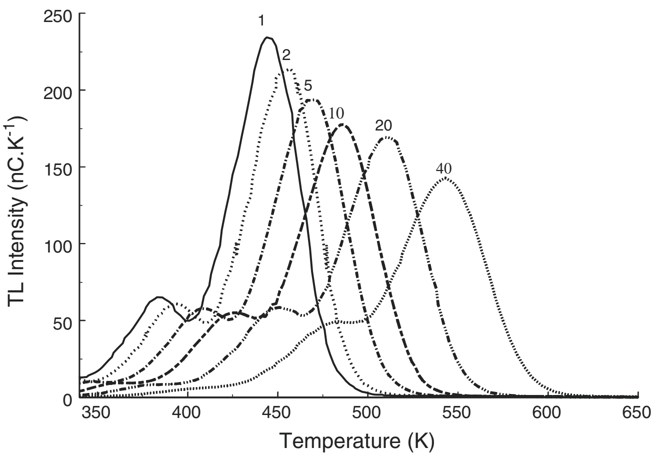

Figure 2. TL intensity versus temperature plots of $Li_2B_4O_7$:Cu,Ag,P irradiated with a ^{90}Sr β-source with the same dose. Note that the spectra have been taken at different heating rates [1].

temperature and versus time plots were found to be identical. In the paper, TL sensitivity obtained using the integrated area of the TL intensity versus temperature plot was presented [1].

In this study, it is also found that the integrated areas of both glow curves (TL intensity–temperature and TL intensity–time) were decreased by 20% at the heating rate of 40 K s^{-1} compared to that of 1 K s^{-1} because of the thermal quenching effect (figure 3). In the study of Ege *et al*, this was interpreted as an advantage for this material since the decrease

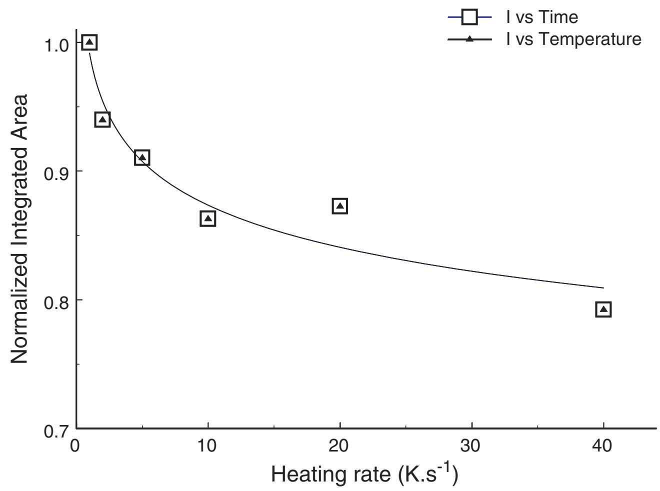

Figure 3. TL sensitivity of the glow peak of $Li_2B_4O_7$:Cu,Ag,P. (□) The integrated area from intensity versus time plots and (▲) the integrated area from *I* versus temperature plots normalized to the area obtained by the lowest heating rate.

is not significantly high compared with the studies of other dosimetric materials investigated for thermal quenching effects in the literature [3–5]. Petitfils *et al* show that the TL integrated area at 20 K s^{-1} decreased approximately by 70% compared with 1 K s^{-1} for CVD diamond [5]. It was found that TL sensitivity reduces up to 80% for Al_2O_3 and more than 50% for CaF_2:Mn compared with the lowest heating rates [3, 4]. In conclusion, we think that the comments of Kumar and Chourasiya on the study of Ege *et al* arose from misinterpretation.

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