International Journal of Luminescence and its applications
Volume 4(II), 04/04/2014, ISSN 2277 – 6362

Optical bleaching study of OSL signal in LMP exposed to different light sources

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Abstract

Optical bleaching studies were carried out on $LiMgPO_4$:Tb,B (LMP) phosphor. The aim of the study was to check whether there is induced optically stimulated luminescence (OSL) *signal generation in various light sources. Also, for reusability of any* OSL *based dosimeter, it is necessary to optimize the bleaching conditions. Bleaching experiments therefore were conducted to find out the most suitable light source. It was found that there is no light induced OSL signal generation in LMP. Also, sunlight is most suitable for bleaching the* OSL *signal of the LMP discs for their reusability.*

Keywords: *LMP, optical bleaching, OSL, light source.*

1.0 INTRODUCTION

In the present days, the OSL technique has been shown useful for radiation dosimetry along with archaeological and geological dating applications. The recently synthesized LiMgPO4:Tb,B (LMP) is a promising OSL dosimetric phosphor and comparable to commercially available Al_2O_3:C phosphor [1,2,3]. Field trial results of LMP based OSL dosimeters have found to be satisfactorily in personnel, environmental and food irradiation dosimetry.

Many OSL phosphors are known to induce OSL signal in various light sources, particularly due to UV component. To use the OSLDs based LMP in dosimetry applications, it is necessary to verify whether there is generation of light induced OSL signal. Optimization of fast bleaching technique is also required to reuse the OSL dosimeters after readout.

Studies were therefore carried out to assess the bleaching of OSL signal in LMP due to different light sources (red, sun light, tube light etc) of different intensities and also to study the effect of these wavelengths on generation of OSL signal.

1.1 EXPERIMENTAL METHODS

The phosphor was uniformly mixed with Polytetrafluoroethylene (PTFE), in 1:3 ratio. The mixture was then cold pressed to make pellets. This ensures the uniformity in the surface, consistency and reproducibility in the OSL read out. The diameter of pellets were 10 mm and thickness was 0.4 mm. LMP based discs having 3% variation in OSL sensitivity were selected for all experiments. Before each experiment, pellets were bleached up to its background level.

OSL measurements were carried out using an automatic Riso TL/OSL-DA-15 reader system [4]. It can accommodate up to 48 discs and has an attached β-irradiator (90Sr/90Y source, Dose rate: 1.22 Gy min-1). To prevent scattered stimulation light from reaching the PMT, detection filters are employed. The Riso reader is equipped with a 7.5 mm Hoya U-340 detection filter, which has a peak transmission around 340 nm (FWHM = 80 nm). The stimulation intensity was 72 mW/cm2 (90%) during CW-OSL measurement. A Delta OHM radiometer, model D09721, LUX LP 9021PHOT sensor, was used to determine the intensity of light used during exposure of samples for study.

Following experiments were conducted:

a) Initially experiment was carried out to check the bleaching of OSL signal exposed to the stray light of the dark room due to various LED components of PC etc., in which all OSL are recorded. The maximum intensity of the stray light on the working table was measured to be 1 lux.

b) In the next set of experiment, the effect of different light sources e.g. sun light, fluorescent light, blue light and red light on un-irradiated discs. The un-irradiated discs were exposed to 50000 lux of sun light for different time periods and OSL were recorded.

c) In the last set, experiment was carried out to study the bleaching of OSL signal due to different light sources on irradiated LMP discs. After irradiation, LMP discs were exposed to different light sources for the different time intervals and OSL were recorded. The different light sources used in bleaching studies are: (i) fluorescent light of intensity 450 lux, (ii) sun light of intensity 50000 lux, (iii) blue LED light of intensity 1000 lux, (iv) red LED light (1000 lux).

1.2 RESULTS AND DISCUSSION

a) The bleaching curve of OSL signal in LMP exposed to leakage light of the dark room is shown in Fig.1. The experiment shows that there is no bleaching effect on the OSL signal of LMP discs exposed to 20 mGy up to six hour. Therefore it can be safely assumed that there is no loss of OSL signal during working in the dark room.

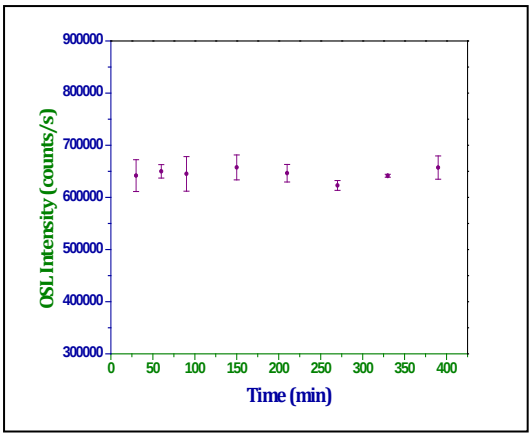

Fig. 1: Bleaching of OSL intensity exposed to stray light in dark room.

b) There was no induced OSL signal found when un-irradiated LMP discs were exposed to sun light, fluorescent light, blue light and red light.

c) Fig. 3 represents the bleaching curve of normalized OSL signal when discs irradiated to a test dose of 20 mGy and 100 mGy, exposed to fluorescent light of intensity 450 lux. It shows that 80% of the maximum OSL intensity was faded in first 15 min. and within about 2 h almost all the OSL single is bleached out to the background level. It is also found that similar bleaching curve has been obtained for both 20 and 100 mGy irradiation.

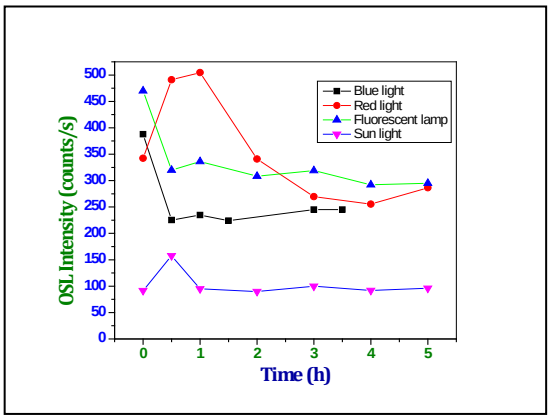

Fig. 2: Bleaching of non-irradiated LMP exposed to Blue, red, fluorescent lamp and sun light.

The bleaching curve of normalized OSL signal due to sun light exposure (50000 lux) for 20 and 100 mGy irradiation is shown in Fig. 4.. It is found that the OSL signal was bleached out to background level within 3 min.

Fig. 5 shows the bleaching curve of OSL signal when discs irradiated to a test dose of 20 mGy, exposed to blue light of intensity 1000 lux. It is found that the OSL signal was bleached out to background level within 1 hour.

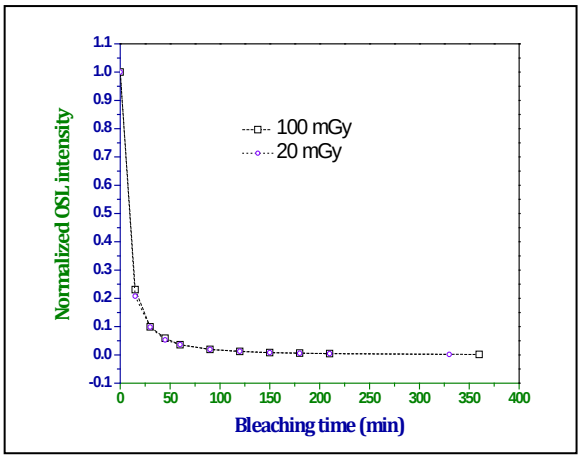

Fig. 3: Bleaching of OSL intensity exposed to fluorescent lamp.

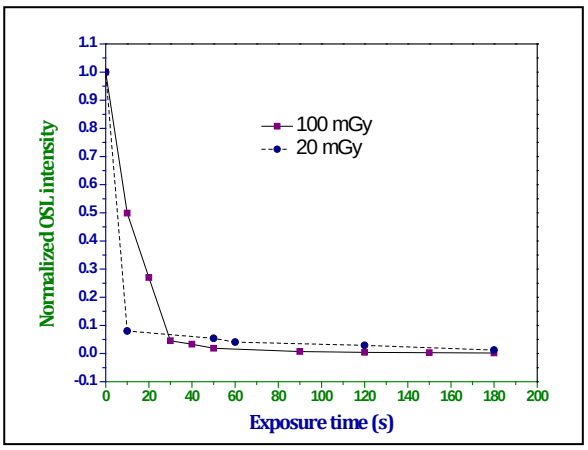

Fig. 4: Bleaching of OSL intensity exposed to sun light.

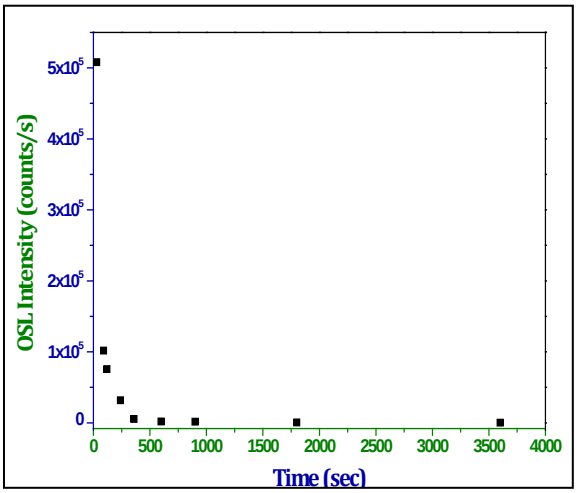

Fig. 5: Bleaching of OSL intensity exposed to blue light.

There is no effect of red light on the OSL signal as shown in Fig. 6.

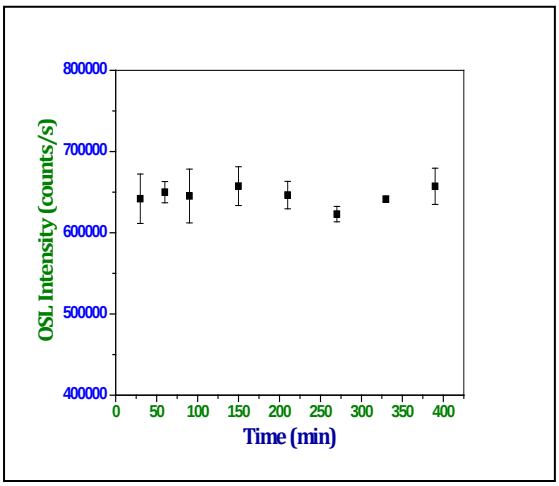

Fig. 6: Bleaching of OSL intensity exposed to red light.

2.0 CONCLUSION

There is no light (blue, red, fluorescence and sun light) induced OSL signal buildup in un-irradiated LMP discs. It is recommended that LMP based OSL dosimeters should be readout at the dark room to avoid the OSL signal decay. The red light od 1000 lux does not bleach the OSL signal. Sunlight is most suitable for bleaching the OSL signal of the LMP discs for their reusability. It is due to the fact that the sun light is highly intense and consists of wide electromagnetic spectrum. Blue LED light of intensity more than 1000 lux can be used for the routine purpose bleaching.

ACKNOWLEDGEMENT

The authors are grateful to Dr. D. N. Sharma, Director, HS&EG, BARC for their encouragement during this work.

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