



Characterization of Optically Stimulated Luminescence response of LiF:Mg,Ti and microLiF:Mg,Ti dosimeters for beta radiation

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INTRODUCTION

The first use of optically stimulated luminescence, OSL, as a dosimeter was to measure luminescence from quartz for dating sediments and artifacts from archeological samples exposed to background radiation for thousands of years. The use of synthetic materials for OSL has greatly improved the sensitivity of the method; it has now been used for about 10 years as a method for monitoring occupational radiation dose.

OSL dosimeters have been a replacement for personnel dose monitoring with film badges. The OSL material has now been fabricated into a dosimeter that can be used for *in vivo* dosimetry of radiation therapy patients.

OBJECTIVES

This work aims to study the application of OSL technique using dosimeters of lithium fluoride doped with magnesium and titanium (LiF:Mg,Ti and microLiF:Mg,Ti) produced by Harshaw Chemical Company for application in beta dosimetry.

MATERIALS AND METHODS

Dosimetric TL materials:

- 50 LiF:Mg,Ti (TLD-100) produced by Harshaw;
- 50 microLiF:Mg,Ti (TLD-100) produced by Harshaw.

Irradiation systems:

- Gamma radiation: ⁶⁰Co:
 - Laboratory of Dosimetric Materials/IPEN;
 - A=0.656 GBq on 09/12/2008.
- Beta radiation: ⁹⁰Sr-⁹⁰Y:
 - OSL Laboratory of GMR-IPEN;
 - Risø TL/OSL DA-20;
 - Dose rate = 0.1 Gy/s.

Equipments:

- Furnace Vulcan 3-550 PD;
- Surgical heater Fanem 315-IEA 11200;
- OSL reader: Risø TL/OSL DA-20.

Dose-response curves:

- ⁶⁰Co gamma source:
 - in air and under electronic equilibrium conditions;
 - Sensitivities: TL ± 5%.
- Beta radiation of an ⁹⁰Sr-⁹⁰Y :
 - Absorbed doses: 0.5; 1; 2; 5; 10 and 15 Gy (calibration curves);
 - OSL response curves;
 - OSL fading curves.

OSL readings:

- OSL reader: Risø TL/OSL DA-20;
- OSL evaluation: average of five OSL readings;
- Error bars: standard deviation of the mean (1σ);
- Confidence level: 95%.

RESULTS

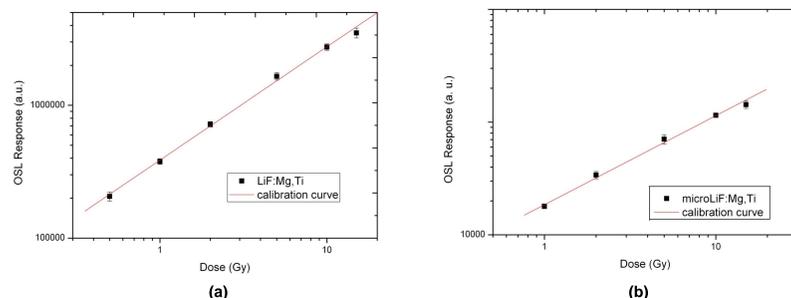


Fig. 1: OSL dose-response curve to beta radiation of an ⁹⁰Sr-⁹⁰Y source of: (a) LiF:Mg,Ti; (b) microLiF:Mg,Ti.

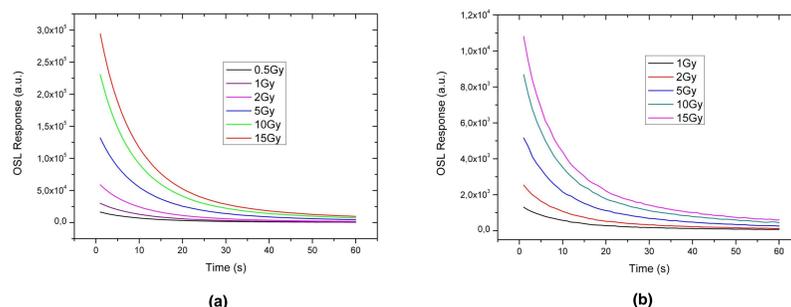


Fig. 2: OSL response curves according to beta radiation doses of ⁹⁰Sr/⁹⁰Y of: (a) LiF:Mg,Ti; (b) microLiF:Mg,Ti

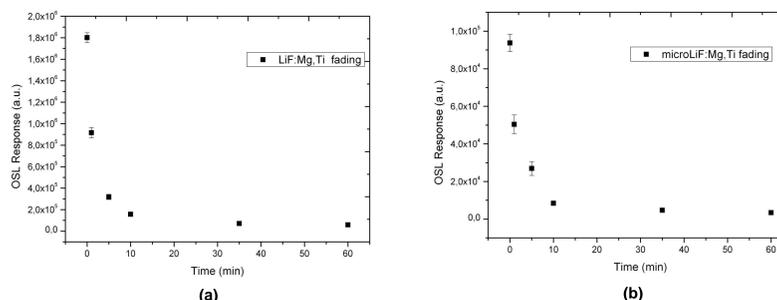


Fig. 3: OSL fading curve for reading time up to 1 hour after irradiation. of the: (a) LiF:Mg,Ti; (b) microLiF:Mg,Ti

Table 1: OSL response reproducibilities (± %).

Dose (Gy)	LiF:Mg,Ti	microLiF:Mg,Ti
	Reproducibility (±%)	
0.5	0.69	4.04
1	1.11	4.52
2	0.84	4.21
5	3.41	4.57
10	1.20	2.70
15	1.48	4.89

DISCUSSIONS and CONCLUSIONS

Dose-response curves:

- Linear behavior: 0.5 to 5 Gy;
- Beginning of supralinearity behavior: Doses > 15 Gy;
- Further studies: analyze the supralinear behaviour of LiF:Mg,Ti and microLiF:Mg,Ti.

OSL response curves:

- OSL signal is proportional to the radiation dose.

Fading:

- first 10 min after irradiation;
- after 1 hour: signal remains constant

Reproducibilities:

- Better than ± 4.89%.

LiF:Mg,Ti and microLiF:Mg,Ti:

- Reproducibility and OSL response curve: LiF can be applied to beta dosimetry.

Acknowledgements

