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120-1 PTTL and PTOSL of TLD-100 exposed to 60Co and lightning with LEDs

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Abstract:

The photo-transfer effect in a phosphor material occurs when displacement of the electrons occurs from deep traps to the shallow traps after its lightning. To verify this effect, the material must be irradiated, thermally treated and exposed to light; after these three phases, its signal is evaluated. LiF:Mg,Ti, commercialized as TLD-100, is the most studied dosimetric material for different applications at the radiation dosimetry research field. The photo-transfer phenomenon can be observed in a luminescent response of certain materials; the phototransferred thermoluminescence (PTTL) and the phototransferred optically stimulated luminescence (PTOSL) are two techniques which allow the study of this effect [1,2]. The primary objective of this work is to verify the presence of PTTL and PTOSL responses of the LiF:Mg,Ti (TLD-100) dosimeters with irradiation in a ^{60}Co beam and illumination with light-emitting diode (LEDs), and the possibility of application of them in high-dose dosimetry. The luminescence of LiF:Mg,Ti dosimeters was analyzed according to the three steps: 1) TL and OSL after irradiation; 2) TL and OSL after irradiation and post-irradiation thermal treatment (PITT); and 3) PTTL and PTOSL after irradiation, PITT and lightning with LEDs. The irradiations were performed using a ^{60}Co source (absorbed dose of 1 kGy), and all the measurements were taken using the Risø reader system, model TL/OSL-DA-20. For the first step, the TL response occurred with a most intense emission dosimetric peak at about 260ºC with intensity of about 1.5×10^5 counts; for the OSL response, the beginning of the decay occurred at about 3.2×10^4 counts. After PITT (second step), the previous TL dosimetric peak did not remain visible, indicating that the traps corresponding to this peak were emptied; for the OSL case, there was not any type of decay, which shows that PITT caused the emission of electrons from traps related to the OSL signal. In the third step, it was possible to measure the PTTL response, because that initial peak, at about 260ºC, rised after lightning (in about 400 counts); the same occurred with the PTOSL response, since the initial signal of the decay increased compared to that of the second stage, and in this third step the result was about 500 counts. The data revealed the presence of photo-transfer effect in the both PTTL and PTOSL responses, and the possibility of using this material with these techniques in high-dose dosimetry. In order to improve this study, giving more consistency to the results, new experimental analyses will be undertaken, as the response in function of the irradiance, wavelength and illumination time.

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Keywords:

Radiation dosimetry, LiF:Mg,Ti, 60Co source, Phototransferred luminescence