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Phototransfer of charges from deep traps of Al_2O_3:C radiation detectors

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The optically stimulated luminescence (OSL) technique using Al_2O_3:C detectors has already been applied for UV dosimetry. The phototransferred optically stimulated luminescence (PTOSL) involves the production of OSL by phototransfer of charges from deeper, filled traps to shallow empty traps. Thus, initially the deeper traps of Al_2O_3:C are filled with a pre-dose of radiation, and subsequently the sample is optically pre-treated to remove any trapped charge of the dosimetry traps. The charge can be transferred from the deep traps to the dosimetry traps by exposing the samples to ultraviolet radiation (UVR). The effects of deep trap filling using Al_2O_3:C samples irradiated with UV was verified by Yukihara et al. [1]. The objective of this work was to study the PTOSL response of commercial detectors in relation to their parameters as wavelength, irradiance and angular dependence.

Al_2O_3:C InLight™ detectors commercially available of Landauer were used for this study. The pre-conditioning parameters were a pre-dose of 1Gy (^{60}Co) and 30 min of optical treatment to remove all of the trapped charges from the dosimetry traps. The exposure of the detector to UVR was performed at a set-up consisting of a mercury short arc lamp, OSRAM HBO 200W/2, a Bausch-Lomb double grating monochromator, model GM 200. The irradiance measurements of the UV light were taken with a Delta OHM radiometer, model DO 9721, and LP 9021 series UV sensors. The Landauer microStar System reader and associated software were utilized for these OSL measurements. The ionizing radiation system utilized in the study for the stimulation of PTOSL signal was a ^{60}Co teletherapy source of Keleket Barnes Flexaray, USA, model IS.

The PTOSL response of these detectors presented a maximum sensitivity at 330 nm. In relation to UVR these detectors presented sublinear response until 0.37 $W.m^{-2}$; above 0.80 $W.m^{-2}$, the PTOSL showed a tendency to saturation. A percentual loss of 18.1% of the PTOSL response was observed for the angular dependence (UV light beam) between 0º and ± 60º.

The pre-conditioning parameters of the detectors were essential for the UVR to transfer the charges from deep traps to shallow traps producing a greater stimulus of the PTOSL signal. The procedures and practices adopted in this study were satisfactory.

[1] E. G. Yukihara, V. H. Whitley, J. C. Polf, D. M. Klein, S. W. S. McKeever, A. E. Akselrod, M. S. Akselrod, The effects of deep trap population on thermoluminescence of Al_2O_3:C. Radiat. Meas. 37 (2003) 627 - 638.