First Latin-American Congress
on Solid State Dosimetry and Radiation Measurements
13-17 September, 2021

DETERMINATION OF KINETIC PARAMETERS OF THE MAIN THERMOLUMINESCENCE GLOW PEAK IN Al_2O_3:C, Mg USING DIFFERENT METHODS.

MUNOZ, J.M.[1], YOSHIMURA, E.M.[2], and TRINDADE, N.M..[1, 2]

[1]Departamento de Física, Instituto Federal de Educação, Ciência e Tecnologia de São Paulo, 01109-010 São Paulo, SP, Brazil, j.munoz@aluno.ifsp.edu.br
[2]Instituto de Física, Universidade de São Paulo, 05508-090 São Paulo, SP, Brazil

Introduction: Carbon and magnesium doped aluminum oxide crystals (Al_2O_3:C,Mg) is extensively investigated for dosimetric applications due to its good physics characteristics as a dosimeter, and its wide-range applicability to radiations, with highlight to neutron dosimetry. The aim of this research is to investigate with various computational method the thermoluminescence (TL) properties of Al_2O_3:C,Mg when exposed to beta radiation. From the TL glow curve, it is possible to obtain kinetic parameters, such as activation energy, frequency factor, peak kinetic order and the concentration of trapped charges in the process. These parameters are commonly used to mathematically describe the obtained curves during the TL phenomena, and to relate the physical rate of the interaction between charges and traps.

Material and method: The single crystal sample of Al_2O_3:C, Mg was produced by the Czochralski method, provided by the Landauer Crystal Growth Division (Stillwater, OK, USA). The sample was cut in the shape of a rectangular parallelepiped of dimensions 8×1.6×0.5 mm³, with a polished side and mass of 48 mg.

The material was exposed to beta radiation through a source of $^{90}Sr/^{90}Y$ (10 mGy/s) at room temperature, ranging from 0.1 to 0.6 Gy. TL measurements were performed on the commercial reader TL/OSL Risø (model DA-20) produced by the Risø DTU, Denmark, using an ultraviolet filter, Hoya U-340 (thickness of 7.5 mm; transmission window within 290-370 nm), and a mask of 5 mm. After each radiation exposure, the material was heated (1 K/s) from 273 K to 573 K, and after each reading, a TL background (5 K/s) reading was performed. All measurements were carried out in nitrogen atmosphere to prevent spurious signals.

The kinetic parameters were obtained by various methods well described in literature [1], as so by computational deconvolution methods using the open access softwares Glowfit, TLAnal, TGCD and TLDECOXCEL.

Results: The TL dosimetric peak was detected in ~450 K, as presented in Figure 1.

Conclusions: All methods presented good applicability to the determination of kinetic parameters for Al_2O_3:C,Mg exposed to beta radiation. The parameters obtained are similar to the values described in literature, showing the quality of the adjustments based on the deconvolution methods used.

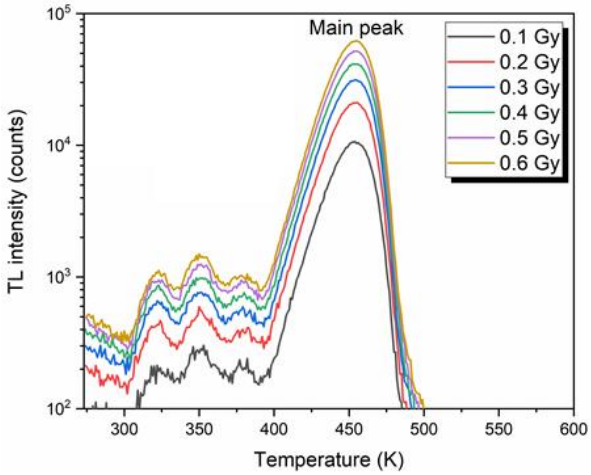

Figure 1: TL response of the material Al_2O_3:C,Mg exposed from 0.1 to 0.6 Gy of beta radiation.

References:

1. J.M. Kalita, M.L. Chithambo, *Nucl. Instruments Methods Phys. Res. Sect. B Beam Interact. with Mater. Atoms.* 394 (2017) 12–19. https://doi.org/10.1016/j.nimb.2016.12.027.