XXXII Panhellenic Conference on Solid State Physics and Materials Science
Conference Center "Carolos Papoulias", 18-21 September 2016, Ioannina, Greece

Radiophotoluminescence for medical dosimetry

M.Karampiperi [1,2], J.P. Oliveira [1,3], F. Vanhavere[1],L.F.Nascimento[1]
[1]*Radiation Protection Dosimetry and Calibration (RDC), Belgian Nuclear Research Centre (SCK-CEN), Belgium*
[2]*Physics department,Aristotle University of Thessaloniki (AUTh), Greece*
[3]*Physics department, University of Sao Paulo (USP), Brazil*

Introduction : Aluminium oxide doped with carbon and magnesium (Al_2O_3:C,Mg) can be used for radiophotoluminescence (RPL), a non-destructive method of luminescence[1] and for optically stimulated luminescence(OSL). The oxygen vacancies and the magnesium impurities cause the luminescent centers at 335 and 620nm, with emission at 750nm and lifetime 75 ±5ns [2].The aim of the project is to construct a reader for this material, with application in dosimetry (radiotherapy beams).

Materials and Methods : The samples from the Al_2O_3:C,Mg paper had 1mm thickness and 7mm diameter. The reader consists of UV LEDs and one red laser,filters and a multi-pixel photon counter (MPPC) detector. The samples were illuminated with the stimulation light and the luminescence is measured by the detector. The dose response is cumulative as the material cannot be bleached or annealed. Both β- and γ – sources were used for the irradiation.

Results and Discussion : Excitation with the red laser shows linear response from 160mGy to 20Gy while with the UV excitation the linearity is from 800mGy to 40Gy (Figure 1). The counts in the y-axe, represent the RPL counts, which is the total counts subtracted with the background coming from the zero dose.

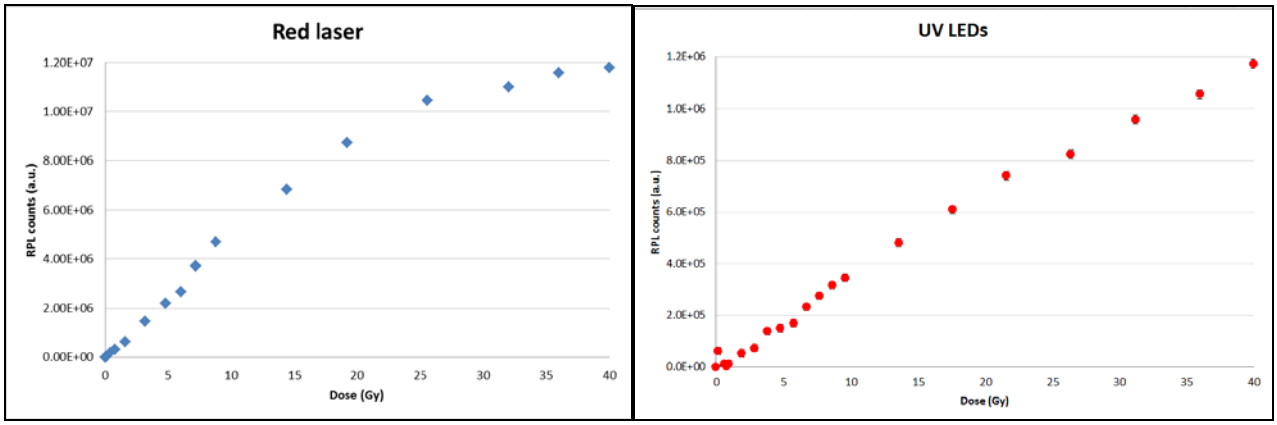

Figure 1 : Cumulative dose response for excitation source a) red laser and b) UV LEDs.

It is very important to be able to readout high doses, as the RPL technique is non-destructive, so the equivalent dose is added after each irradiation. However, the dose is given over different sessions, so the reader should separate low doses also. The UV exposure by the UV LEDs also add an OSL signal to the sample. The experiments showed that a pre-exposure by UV light is able to stabilize the OSL signal produced by ionizing radiation (which is not very reproducible alone), which gives opportunities to combine both the RPL and OSL signal after UV exposure.

References : [1] Ahmed, M. F., et al. "Comparison between different readout approaches for aluminum oxide radiophotoluminescent crystals." *Radiation Measurements*56 (2013): 361-364.
[2] Akselrod, Mark S., and Anna E. Akselrod. "New Al2O3: C, Mg crystals for radiophotoluminescent dosimetry and optical imaging." *Radiation protection dosimetry* 119.1-4 (2006): 218-221.