RELATIVE EFFICIENCY OF TLD-100 GLOW PEAKS INDUCED BY X-RAYS OF 20 KV–300 KV, ^{137}CS AND ^{60}CO GAMMA

ARZAGA-BARAJAS, E.[1], and MASSILLON-JL, G[1,a].

[1]Instituto de Física, Universidad Nacional Autónoma de México, 04510 CdMx, Mexico. *BSc. Thesis work.*
[a]Corresponding Author, massillon@fisica.unam.mx

Introduction: Thermoluminiscent dosimeter LiF:Mg,Ti (known commercially as TLD-100) has been considered as the "gold standard" dosimeter to measure absorbed dose from low-energy photon fields used in medical applications. TLD-100 dosimeters are commonly calibrated using high energy beams, such as 6 MV X-rays of ^{60}Co gamma, since low-energy reference photon beams are not always avaible for such task. The relative efficiency (dosimeter response per absorbed dose for the field of interest, relative to the same quantity for a reference field) can be used to convert the absorbed dose calibration from high energy beams to low-energy photon beams used in the clinic.

Material and method: The glow curves analyzed come from a previous work [1], where TLD-100 chips were exposed to ISO-4073N X-ray beams between 20 kV and 300 kV, ^{137}Cs and ^{60}Co gamma. The dosimeters were irradiated in various phantom materials (air, polymethyl methacrylate, polystyrene, lithium fluoride and solid water), having 4 dosimeters irradiated individually on a beam-phantom combination. The experimental glow curves were deconvoluted into nine peaks (see Fig. 1) by the use of an algorithm based on the Podgorsak approximation of the first-order kinetics model [2]. A strict deconvolution protocol was performed, with set peak parameters based on the literature [3,4]. The thermoluminiscent glow peak areas were thus obtained. The relative efficiency, *RE*, of the peaks was compared as a function of the effective photon energy for each phantom material.

Results: The *RE* of the low temperature peaks (4 and 5) exhibit a different behaviour compared to those of high temperature peaks (6a to 9), suggesting that the signal from the TLD-100 dosimeters can be divided into two components. For a given photon energy, the *RE* of the high-temperature peaks is usually higher that its low-temperature counterparts. The *RE* of all of the peaks shows a region with a minimum and a maximum, which corresponds to the transition of the interaction probability between the photoelectric and the Compton effects. The influence of the phantom material on the glow peaks is also observed: *RE* obtained from air irradiations are generally lower compared to that obtained from other phantom materials. This can be seen as a consequence of the backscatter effect presented in the materials with higher effective atomic number compared to air. The degree of the phantom influence is more pronounced on the high temperature peaks than the low temperature peaks.

Conclusions: The results indicate that the TLD-100 glow peaks (and, therefore, the glow curve as a whole) are not only affected by the effective energy of the photon beams but also by the phantom materials the dosimeters are situated during irradiation. Both factors have to be considered when using *RE* values, like the ones obtained in this work, to perform an adequate absorbed dose conversion.

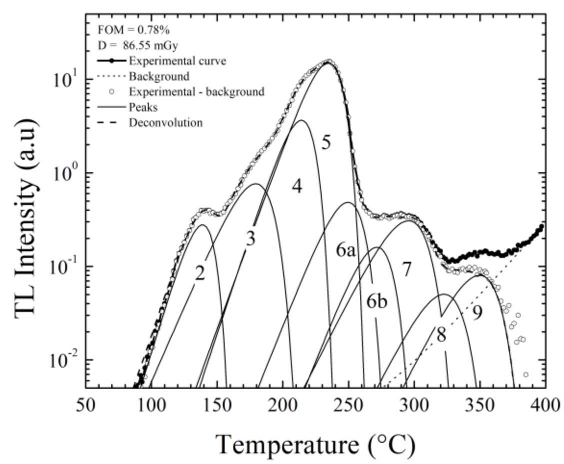

Figure 1: Deconvoluted glow curve of a TLD-100 dosimeter situated in a solid water phantom exposed to 200 kV X-rays. Note the semi-log display.

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