NEUTRON-GAMMA MIXED FIELD DOSIMETRY USING A ^{6}LiF:Mg,Cu,P THERMOLUMINESCENT DOSIMETER

by

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Satisfactory discrimination between the neutron and gamma components in a mixed neutron-gamma field is one of the most important objectives of neutron dosimetry. One of the common techniques for estimating gamma and neutron dose components in mixed neutron-gamma fields is the two peak method. This method has been applied using dosimeters such as LiF:Mg,Ti, but in the present work, a ^{6}LiF:Mg,Cu,P dosimeter has been used, whose thermoluminescence sensitivity is much higher than the LiF:Mg,Ti dosimeter, and therefore, if appropriate results are achieved, it can drastically reduce the dose estimation threshold. Applicability of ^{6}LiF:Mg,Cu,P for estimation of the gamma dose using the two peak method in a mixed thermal neutron-gamma radiation field was studied. The ratio of the area underneath the high temperature thermoluminescence glow peak to dosimetry peak of this phosphor in an Am-Be neutron field is 0.127, while this ratio in a pure gamma ray field of ^{137}Cs is 0.039. The calibration curves were obtained by separately irradiating ^{6}LiF:Mg,Cu,P chips with known gamma and neutron doses. Results show that ^{6}LiF:Mg,Cu,P can be used to estimate the contributions of neutron and gamma doses in a mixed neutron-gamma field by using the two peak method.

Key words: thermoluminescence, ^{6}LiF:Mg,Cu,P, dosimetry, two peak method, mixed field, neutron-gamma

INTRODUCTION

The radiation field around the neutron sources is always a mixed field of neutron and gamma rays. Satisfactory discrimination between the neutron and gamma components is one of the most important objectives of neutron dosimetry. Amongst different methods of mixed neutron-gamma dosimetry, thermoluminescent materials have been shown to be applicable and satisfactory [1, 2]. The widespread application of thermoluminescence dosimeters (TLD) is due to their small dimensions and tissue-equivalence for most radiations. Therefore, the fabrication of new thermoluminescence (TL) dosimeters with different samples and impurities is still ongoing. The two peak method is a common technique for estimating gamma and neutron dose components in a mixed neutron-gamma field. In this method two TL glow peaks of one phosphor having different sensitivities to low and high linear energy transition (LET) radiations are used for discrimination between neutron and gamma components in a mixed neutron-gamma radiation field. The CaF_2:Tm is one of such phosphors [3, 4]. However, the low relative neutron to gamma peak ratio does not allow it to be used for personal and accident dosimetry. Thin CaF_2:Tm dosimeters were also encapsulated in a hydrogen-rich material to increase the relative fast neutron sensitivity [5]. The two peak method using LiF:Mg,Ti has also been considered in neutron-gamma dosimetry [6, 7]. In this phosphor, discriminating between neutron and gamma doses is based on different responses of high temperature glow peaks to neutron and gamma radiation fields. Disadvantages in the use of high temperature peak ratios motivated Yussian and Horowitz to employ peak 4 to peak 5 ratios for estimation of the gamma dose in a mixed neutron-gamma field [8].

The LiF-based materials are attractive for personal and environmental dosimetry because of their suitable tissue equivalence, so that even in recent years, the construction of this dosimeter with different impurities has been carried out [9-11]. The LiF:Mg,Cu,P TL dosimeter was firstly prepared by Nakajima *et al*. [12]. The TL sensitivity of LiF:Mg,Cu,P to the gamma ray is about 30 times higher than that of LiF:Mg,Ti. The thermal stability of dosimeters of the LiF:Mg,Ti and LiF:Mg,Cu,P has been compared for the same storage temperatures and time storage periods and it is determined that the TL fading in TLD-100H (LiF:Mg,Cu,P) dosimeters is insignificant when compared to the fading

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of the TL response of the TLD-100 (LiF:Mg,Ti) dosimeters [13]. The TL sensitivities of LiF:Mg,Cu,P, TLD-600 and TLD-700 to thermal neutrons were compared and it was observed that the sensitivity of the TLD-600 to thermal neutrons is 80 times and two times greater than those of TLD-700 and LiF:Mg,Cu,P [14], respectively. Parisi *et al.* [15, 16] in two separate articles have studied the thermoluminescence properties of the LiF:Mg,Ti and LiF:Mg,Cu,P dosimeters in different LET irradiations. In another work, the response of ^{6}LiF:Mg, Cu,P and ^{7}LiF:Mg,Cu,P phosphors to the neutron and gamma in mixed radiation fields was studied by Wang *et al*. [17]. They established that TL sensitivities of ^{6}LiF:Mg,Cu,P and ^{7}LiF:Mg,Cu,P to a gamma ray are nearly the same as LiF:Mg,Cu,P, while the TL response of ^{6}LiF:Mg,Cu,P to thermal neutrons is nine times higher than that of ^{6}LiF:Mg,Ti. In this work, applicability of ^{6}LiF:Mg,Cu,P for estimation of the gamma dose in a mixed neutron-gamma radiation field using the two peak method is presented for the first time.

ANALYSIS OF THE TWO PEAK DOSIMETRY METHOD

The below presented formulism is similar to that employed by Yussian and Horowitz [8] in estimating the gamma dose in a mixed neutron-gamma field with LiF:Mg,Ti (TLD-100/600). In this study, we re-stated the formalism since the area underneath the main and high temperature glow peaks is employed rather than the intensity of glow peaks which has been used in [8].

The discrimination quality factor (DQF) can be defined in a mixed neutron-gamma field as following

$$\mathrm{DQF}_{\mathrm{H,D}} \quad \frac{R_{\mathrm{H,Dn}}}{R_{\mathrm{H,Dg}}} \tag{1}$$

where $R_{\mathrm{H,Dn}}$ is the ratio of intensity of the high temperature glow peak to the dosimetry glow peak in the TL glow curve of ^{6}LiF:Mg,Cu,P following neutron irradiation and $R_{\mathrm{H,Dg}}$ has the same description for gamma irradiation. Equation (1) can be reliably applicable at dose levels where $R_{\mathrm{H,D}}$ can be measured with an uncertainty of about 1 S_{D}. In the mixed field

$$S_{\mathrm{Dm}} \quad S_{\mathrm{Dg}} \quad S_{\mathrm{Dn}} \tag{2}$$

$$S_{\mathrm{Hm}} \quad S_{\mathrm{Hg}} \quad S_{\mathrm{Hn}} \tag{3}$$

in which S_{Dm}, S_{Dg}, and S_{Dn} are the areas of the dosimetry glow peak respectively in the mixed, gamma and neutron fields.

The S_{Hm}, S_{Hg}, and S_{Hn} are the peak areas of the high temperature glow peak in the mixed, gamma and neutron fields correspondingly.

Accurate determination of the parameter $X = S_{\mathrm{Dg}}/S_{\mathrm{Dm}}$ is an important step in the mixed field analysis. With defining the response ratios as $R_{\mathrm{H,Dg}} = S_{\mathrm{Hg}}/S_{\mathrm{Dg}}$ in the pure gamma field, $R_{\mathrm{H,Dn}} = S_{\mathrm{Hn}}/S_{\mathrm{Dn}}$ in the nearly-pure neutron field (Am-Be field) (including an unwanted small gamma component) and $R_{\mathrm{H,Dm}} = S_{\mathrm{Hm}}/S_{\mathrm{Dm}}$ in the neutron-gamma mixed field, the parameter X can be defined as

$$X \quad \frac{S_{\mathrm{D,g}}}{S_{\mathrm{Dm}}} \quad \frac{R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}}}{R_{\mathrm{H,Dg}} \quad R_{\mathrm{H,Dn}}} \tag{4}$$

It is worth noting in eq. 6 that in a pure neutron field, $R_{\mathrm{H,Dm}} = R_{\mathrm{H,Dn}}$ and therefore $X = 0$ and in a pure gamma field, $R_{\mathrm{H,Dm}} = R_{\mathrm{H,Dg}}$ and thus $X = 1$. Consequently, in a straight line showing the variation of $R_{\mathrm{H,Dm}}$ against X, by varying $R_{\mathrm{H,Dm}}$ between two limiting values of $R_{\mathrm{H,Dn}}$ and $R_{\mathrm{H,Dg}}$ the parameter X varies from 0 to 1. As a result, experimental determination of the $R_{\mathrm{H,Dm}}$ yield the parameter X from which the contribution of the gamma dose, D_{g}, can be evaluated via

$$S_{\mathrm{Dn}} \quad a_{\mathrm{n}} D_{\mathrm{n}}, \qquad S_{\mathrm{Dg}} \quad a_{\mathrm{g}} D_{\mathrm{g}} \tag{5}$$

where a_{n} and a_{g} are the TL signal per unit absorbed dose for neutrons, D_{n}, and gamma rays, D_{g}, respectively. Using the definition U (ratio of gamma dose to total dose)

$$U \quad \frac{D_{\mathrm{g}}}{D_{\mathrm{T}}} \quad \frac{D_{\mathrm{g}}}{D_{\mathrm{g}} \quad D_{\mathrm{n}}} \tag{6}$$

where D_{T} is the total absorbed dose. It is straightforward to show that

$$U \quad \frac{\dfrac{S_{\mathrm{Dg}}}{a_{g}}}{\dfrac{S_{\mathrm{Dg}}}{a_{\mathrm{g}}} \quad \dfrac{S_{\mathrm{Dn}}}{a_{\mathrm{n}}}} \quad \frac{S_{\mathrm{Dg}}}{w \dfrac{S_{\mathrm{Dg}}}{w} \quad S_{\mathrm{Dn}}} \quad \frac{S_{\mathrm{Dm}}X}{w \dfrac{S_{\mathrm{Dm}}X}{w} \quad S_{\mathrm{Dm}} \quad S_{\mathrm{Dm}}X} \quad \frac{X}{X \quad w(1 \quad X)} \tag{7}$$

where $w = a_{\mathrm{g}}/a_{\mathrm{n}}$. It is most useful and applicable to express U as a function of the directly measurable response ratio, $R_{\mathrm{H,Dm}}$ in the mixed field by inserting the value of X from eq. (4) in eq. (7)

$$U \quad \frac{\dfrac{R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}}}{R_{\mathrm{H,Dg}} \quad R_{\mathrm{H,Dn}}}}{\dfrac{R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}}}{R_{\mathrm{H,Dg}} \quad R_{\mathrm{H,Dn}}} \quad w \quad 1 \quad \dfrac{R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}}}{R_{\mathrm{H,Dg}} \quad R_{\mathrm{H,Dn}}}} \quad \frac{R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}}}{(R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}})(1 \quad w) \quad w(R_{\mathrm{H,Dg}} \quad R_{\mathrm{H,Dn}})}$$

$$U \quad \frac{R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}}}{(R_{\mathrm{H,Dm}} \quad R_{\mathrm{H,Dn}})(1 \quad w) \quad (R_{\mathrm{H,Dg}} \quad R_{\mathrm{H,Dn}})w} \tag{8}$$

The $R_{H,D\,m}$, $R_{H,D\,n}$, and $R_{H,D\,g}$ can be determined from the TL glow curves in the mixed field, thermalized neutrons of Am-Be and pure gamma fields, respectively. Therefore eq. (8) can be used to determine U. Of course, w is known from calibration of the dosimeters to known doses of pure gamma and neutron radiations. Finally eq. (8) gives $R_{H,D\,m}$ as a function of U

$$R_{H,Dm} \quad \frac{R_{H,Dn}(1 \;\; U) \;\; UR_{H,Dg}w}{1 \;\; U(1 \;\; w)} \qquad (9)$$

with drawing the $R_{H,D\,m}$ as a function of U by using eq. (9) and measured response ratios, their closeness can be examined.

MATERIALS AND IRRADIATIONS

The dosimeters employed herein were MCP-6 (^{6}LiF:Mg,Cu,P) were prepared by the Microlab Company, Poland. LiF:Mg,Cu,P TL phosphor is manufactured under the code name MCP) round chips with a diameter of 5 mm and thickness of 1 mm. Gamma irradiations were performed using a ^{137}Cs source. The thermal neutron facility was an Am-Be neutron source. Seven dosimeters were used to perform irradiation in each specific dose and in the next steps, the same dosimeters were irradiated in different ratios of neutrons and gamma and the average values obtained were used in the calculations. A polyethylene moderator was used to produce a thermal neutron flux. Therefore the results of this study can be applicable to estimate the contribution of thermal neutrons in a mixed field regardless of the neutron source. All the neutron irradiations were carried out at the SSDL center, Karaj-Iran.

Pre-irradiation annealing was completed at 240 °C for 10 minutes using a programmable oven with temperature accuracy of 1 °C and then the chips were cooled rapidly to room temperature (75 per minutes). The readout procedure was accomplished by heating the samples from 50 per seconds to a maximum temperature of 300 °C with a heating rate of 1 °Cs^{-1} in a Harshaw TLD reader model 4500, where a heater strip is used for warming the chips with a precision of 1 °C.

RESULTS AND DISCUSSION

The glow curves of ^{6}LiF:Mg,Cu,P irradiated by a ^{137}Cs gamma ray (30 mGy) and thermalized neutrons from Am-Be radiation fields (6 mGy) are shown in fig. 1. The aim of this work is to validate that the ratio of areas of high temperature to the main glow peak of MCP can be used for identifying the contribution of the gamma dose in a mixed thermal neutron-gamma field. The presented method was employed for the linear dose response area. Therefore the ratio of neutron to gamma dose can be varied by keeping one component constant and changing the other component in the linear dose response region. Obviously, the ^{6}LiF:Mg,Cu,P dosimeter is much more sensitive to the gamma ray than the neutron, but it still has a good response to neutron irradiation.

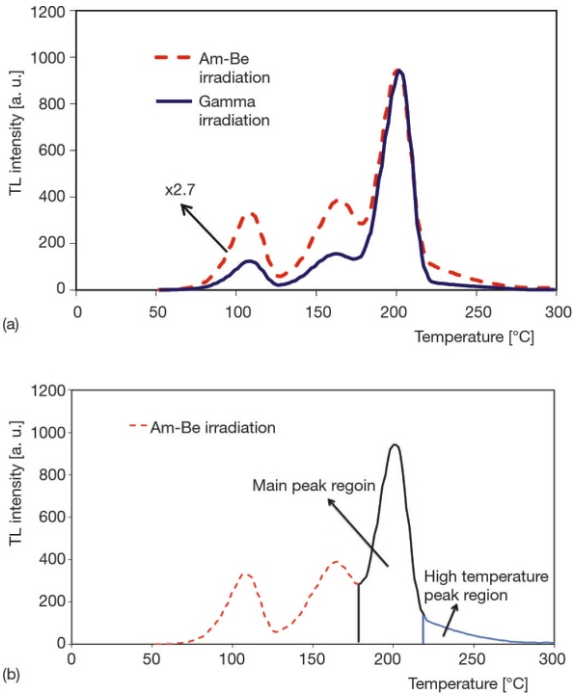

Figure 1. (a) The TL glow curves of ^{6}LiF:Mg,Cu,P in a 30 mGy dose of a pure gamma ray from ^{137}Cs and 6 mGy nearly pure neutron from an Am-Be source (b) The regions of main and high temperature peaks. For better comparison of neutron and gamma curves, the intensity of the neutron curve was multiplied by 2.7

More interesting are the different responses of the component glow peaks to low and high LET radiations which make it possible to extend the discrimination of gamma and neutron components at protection level doses.

The calibration of TLD resulted in the response ratios of $R_{H,Dn}$ = 0.127 0.006 and $R_{H,Dg}$ = 0.039 0.002. From eq. (1), the discrimination quality factor (DQF) was obtained to be 3.25 0.11 using the above values for $R_{H,D\,n}$ and $R_{H,D\,g}$ which shows that the difference between relative sensitivities of the high temperature peak and dosimetry peak in pure gamma and Am-Be neutron fields are considerable. This result can be compared with DQF of 2.6 reported for the ratios of intensities of peak 4 to peak 5 in TLD-100 and 2.5 for CaF2:Tm [8]. Accurate determination of the response ratios makes it possible to use the two peak method for discriminating between the gamma and neutron dose in a mixed field with the ^{6}LiF:Mg,Cu,P phosphor. With finding a_n and a_g values and using eq. (5), w was determined from the equation $w = a_g/a_n$ as

$$w = 0.68 \;\; 0.10$$

After identifying $R_{H,Dn}$ and $R_{H,Dg}$ values, for testing the validity of two peak technique,

^{6}LiF:Mg,Cu,P chips were separately exposed to known gamma and neutron doses. The irradiation was started with a gamma dose component from 10 % out of the total dose and this ratio increased up to 80 % over eight steps. Some of the TL glow curves recorded following irradiation in a mixed field are shown in fig. 2. Using the peak areas obtained from irradiating the chips in a mixed field, $R_{H,Dm}$ values were determined. Then using equation $X = S_{Dg}/S_{Dm}$, the parameter X was identified. Figure 3 shows the measured values of X for eight representative mixed fields with different gamma dose components. The consistency between the expected values of the response ratios and measured values of X is striking. The results obtained, demonstrate that the two peak method can reliably be applied for estimating the gamma dose in a mixed neutron-gamma field using ^{6}LiF:Mg,Cu,P.

Figure 4 shows the variation of the response ratio as a function of U in the mixed field using eq. (9).

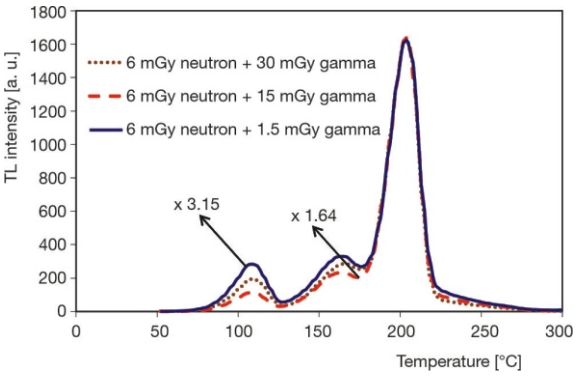

Figure 2. Typical glow curves and their components following irradiation to the mixed neutron-gamma field with known gamma and neutron dose components of 30 mGy gamma and 6 mGy neutron, 15 mGy gamma and 6 mGy neutron (multiplied by 1.64) and 1.5 mGy gamma and 6 mGy neutron (multiplied by 3.15)

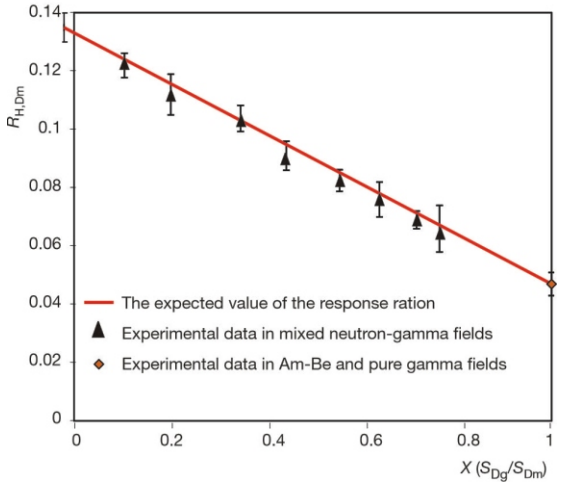

Figure 3. The response ratio for the mixed field as a function of X for eight representative mixed fields of varying gamma dose components

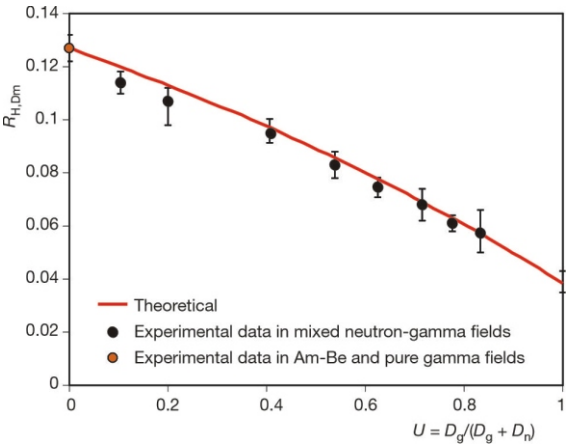

Figure 4. Values of the response ratio ($R_{H,Dm}$) as a function of U in the mixed field

Table 1. Measured and calculated $R_{H,Dm}$ and u for different values of the gamma dose in a mixed neutron-gamma field

D_n [mGy]	D_g [mGy]	$U = D_g(D_g + D_n)$	$R_{H,Dm}$ measured	$R_{H,Dm}$ theoretical	Difference [%]
0.7	6	0.104	0.114	0.118	3.5
1.5	6	0.200	0.105	0.112	6.6
4.1	6	0.406	0.096	0.097	1.0
7.0	6	0.538	0.083	0.085	2.4
10.0	6	0.625	0.074	0.077	4.0
15.0	6	0.715	0.068	0.069	1.5
20.8	6	0.776	0.061	0.063	3.3
30.0	6	0.833	0.058	0.056	3.6

Also measured $R_{H,Dm}$ for each gamma and neutron doses are shown in tab. 1. In this table, you can see the number of different doses of gamma and neutrons. Parameter 1 has been changed in different gamma and neutron ratios from 0.104 to 0.833 in 8 steps. The values obtained for the ratio of peaks 1, which are measured from the experimental results, are comparable to the values obtained from the defined theoretical relations. It can be seen that the maximum difference between these values is 6.6 %. So, ^{6}LiF:Mg,Cu,P can be successfully used to estimate the gamma dose in mixed radiation fields by the use of the two peak technique. Using ^{6}LiF:Mg,Cu,P, this method is applicable for radiation fields with gamma dose components up to 80 % out of the total dose.

CONCLUSIONS

It was shown that the two peak method can effectively be applied to estimate the gamma dose in a mixed neutron-gamma field using ^{6}LiF:Mg,Cu,P. The technique was successfully applied to radiation fields with a gamma component up to 80 % of the total dose which is an improvement in mixed field dosimetry by the two peak method. Because of high sensitivity of ^{6}LiF:Mg,Cu,P to a gamma ray, the lowest detectable

gamma dose in a mixed field using this phosphor can be reduced to lower than 1.5 mGy. The results show that the ratio of areas of high temperature to the main glow peak of MCP can be used for identifying the contribution of the neutron dose in a mixed thermal neutron-gamma field.

As was pointed out in the introduction section, the sensitivity of the ^{6}LiF:Mg,Cu,P to the thermal neutron is about 9 times higher than that of ^{6}LiF:Mg,Ti and the TL response of ^{6}LiF:Mg,Cu,P to gamma rays is about 30 times stronger than the ^{6}LiF:Mg,Ti. This enables us to reduce the lowest detectable neutron and gamma components in the mixed neutron-gamma field using the two peak method compared to ^{6}LiF:Mg,Ti and this is of crucial importance in radiation protection dose levels.

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AUTHORS' CONTRIBUTIONS

E. Sadeghi and M. Zahedifar conceived of the presented idea and supervised the project. P. Rezaii carried out the characterization tests and prepared the figures, and E. Sadeghi wrote the manuscript.

REFERENCES

[1] Becker, F., *et al*., Dosimetry in Mixed Gamma-Neutron Radiation Felds and Energy Compensation Filters for CaF_2:Tm TL Detectors, *Radiat. Meas., 43* (2008), 2-4, pp. 921-924
[2] Hampel, G., *et al*., Selective Assessment of the Fast Neutron Component in Mixed Neutron-Gamma Feld Using TLD Activation, *Radiat. Phys. Chem., 67* (2003), 3, pp. 581-585
[3] Yudelev, M., *et al*., Thermoluminescence Dosimetry in Mixed Neutron-Gamma Radiation Beam, *Radiat. Prot. Dosim., 110* (2004), 1-4, pp. 613-617
[4] Rank, E. X., Theus, R. B., Neutron Dosimetry with CaF_2:Tm, *IEEE Trans. Nucl. Sci., 26* (1979), 1, pp, 1590-1592
[5] Pradhan, A. S., *et al*., Fast Neutron Response of CaF_2:Tm Teflon TLD Disc of Different Thicknesses, *Radiat. Prot. Dosim., 15* (1986), 4, pp. 233-236
[6] Meissner, P., *et al*., Applicability of TLD-700 Detectors for Dosimetry in d(14) 1 Be Neutrons Fields, *Radiat. Prot. Dosim., 23* (1988), 1-4, pp. 421-424
[7] Weinstein, M., *et al*., On Neutron-Gamma Mixed Field Dosimetry with LiF:Mg,Ti at Radiation Protection, *Radiat. Prot. Dosim., 119* (2006), 1-4, pp. 314-318
[8] Youssian, D., Horowitz, Y. S., Estimation of Gamma Dose in Neutron Dosimetry Using Peak 4 to Peak 5 Ratios in LiF:Mg,Ti (TLD-100/600), *Radiat. Prot. Dosim., 77* (1998), 3, pp. 151-158
[9] Sadeghi, E., *et al*., Synthesis and Dosimetry Features of Novel Sensitive Thermoluminescent Phosphor of LiF Doped with Mg and Dy Impurities, *Appl. Radiat. Isot,. 136* (2018), pp. 111-117
[10] Gopal, J. N., *et al*., Radiophotoluminescence and Thermoluminescence Characteristics of Undoped and Mg Doped LiF Phosphor in the High Dose Region, *Radiat. Meas., 109* (2018), Feb., pp. 24-34
[11] Shoushtari, M. K., *et al*., Preparation and Thermoluminescent Dosimetry Features of High Sensitivity LiF:Mg,Ce phosphor, *Nucl. Instrum Methods Phys. Res. A., 887* (2018), Apr., pp. 128-132
[12] Nakajima, T., *et al*., Development of a New Highly Sensitive LiF Thermoluminescence Dosimeter and its Applications, *Nucl. Instrum Methods., 157* (1978), 1, pp. 155-162
[13] Pereira, J., *et al*., Fading Effect of LiF:Mg,Ti and LiF:Mg,Cu,P Ext-Rad and Whole-Body Detectors, *Radiat. Prot. Dosim., 170* (2015), 1-4, pp. 177-180
[14] Triolo, A., *et al*., Neutron-Gamma Mixed Field Measurements by Means of MCP-TLD600 Dosimeter Pair, *Nucl. Instrum Methods Phys. Res. B., 264* (2007), 1, pp. 183-188
[15] Parisi, A., *et al*., The Influence of the Dose Assessment Method on the LET Dependence of the Relative Luminescence Efficiency of LiF:Mg,Ti and LiF:Mg,Cu,P, *Radiat. Meas., 98* (2017), March, pp. 34-40
[16] Parisi, A., *et al*., Deconvolution Study on the Glow Curve Structure of LiF:Mg,Ti and LiF:Mg,Cu,P Thermoluminescent Detectors Exposed to ^{1}H, ^{4}He and ^{12}C Ion Beams, *Nucl Instrum Methods Phys. Res. B., 407* (2017), Sept., pp. 222-229
[17] Wang, S. S., *et al*., Thermoluminescent Response of ^{6}LiF:Mg,Cu,P and ^{7}LiF:Mg,Cu,P TL Chips in Neutron and Gamma Ray Mixed Radiation Fields, *Radiat. Prot. Dosim., 33* (1990), 1-4, pp. 247-250

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ДОЗИМЕТРИЈА НЕУТРОН-ГАМА МЕШОВИТОГ ПОЉА КОРИШЋЕЊЕМ ТЕРМОЛУМИНИСЦЕНТНОГ ДОЗИМЕТРА ^{6}LiF:Mg,Cu,P

Задовољавајућа дискриминација између неутронских и гама компоненти у мешовитом неутронско-гама пољу, један је од најважнијих циљева неутронске дозиметрије. Метода два пика је уобичајена техника за процену компонената дозе гама зрачења и неутрона у овим пољима. Ова метода примењена је коришћењем дозиметара као што су LiF:Mg,Ti, али је у овом раду коришћен дозиметар ^{6}LiF:Mg,Cu,P чија је термолуминисценциона осетљивост много већа од дозиметра LiF:Mg,Ti, и стога, ако се постигну одговарајући резултати, може драстично смањити праг процене дозе. Отуда је проучавана применљивост ^{6}LiF:Mg,Cu,P за процену гама дозе методом два пика у мешовитом пољу термичког неутрона и гама зрачења. Однос површине испод пика високотемпературног термолуминисценционог исијавања према дозиметријском пику фосфора у Am-Be неутронском пољу је 0,127, док овај однос у пољу чистог гама зрачења од ^{137}Cs износи 0,039. Калибрационе криве добијене су одвојеним озрачивањем ^{6}LiF:Mg,Cu,P чипова познатим дозама гама зрачења и неутрона. Резултати показују да се ^{6}LiF:Mg,Cu,P може користити за процену доприноса доза неутрона и гама зрачења у мешовитом неутронско-гама пољу коришћењем методе два пика.

Кључне речи: термолуминисценција, ^{6}LiF:Mg,Cu,P, дозиметрија, метода два пика, мешовито поље, неутрон-гама