

Moderated and Fast Neutrons Dosimetry Using Radiometric GafchromicTM EBT3 Film

Omar M. Kotb¹, Elsayed K. Elmaghraby^{2*}, M. El Ghazaly¹, Amal Mohamed^{3,1}

¹*Department of Physics, Faculty of Science, PO 44519, Zagazig University, Zagazig, Egypt*

²*Experimental Nuclear Physics Department, Nuclear Research Centre, Egyptian Atomic Energy Authority, Cairo 13759, Egypt*

³*Physics Department, Faculty of Science, Umm Al-Qura University, Makkah, Saudi Arabia*

*Corresponding author: e.m.k.elmaghraby@gmail.com

The dosimetric response of the GafchromicTM EBT3 film upon exposure to moderated neutrons and fast neutrons were investigated. The moderated neutrons are from two Am-Be sources with an average flux of $2.3 \times 10^4 \text{ cm}^{-2} \text{ s}^{-1}$ while the fast neutrons were obtained by direct exposure to the neutrons from Am-Be source having standard spectral emission probability with neutron yield of $1.1 \times 10^7 \text{ s}^{-1}$. EBT3 radiochromic films were irradiated in both the moderated and fast neutron fields for different durations. Thereafter, GafchromicTM EBT3 films were scanned with flatbed scanner and the resulted RGB images were separated to color channels Red, Green, Blue. The dynamic ranges of the EBT3 GafchromicTM films irradiated with moderated neutrons are approximately equal to, 136 ± 3 , 125 ± 2 , 89 ± 2 , and 26 ± 6 for red, green, grey, and blue color respectively, while in the case of fast neutrons irradiation, the dynamic ranges are 83 ± 2 , 73 ± 3 , 40 ± 1 , and 37 ± 3 , in their respective order. UV-Vis absorbance spectra at the two characteristic peaks of $632 \pm 2 \text{ nm}$ and $580 \pm 2 \text{ nm}$ of irradiated GafchromicTM EBT3 film show a wider dynamic range but lower sensitivity comparing with flatbed scanner. The results reveal that the response of GafchromicTM EBT3 film to both moderated neutrons and fast neutrons is almost the same. The indirect and direct energy band gaps of the GafchromicTM EBT3 films irradiated with moderated neutrons and fast neutrons in the range of applied irradiation time exhibit insignificant change. By contrast, Urbach's energy shows a continuous decrease with the increment of irradiation time.

Keywords; Moderated neutrons, Fast neutrons, GafchromicTM EBT3 film, Flatbed scanner, UV-Vis spectrophotometer, Radiation dosimetry.