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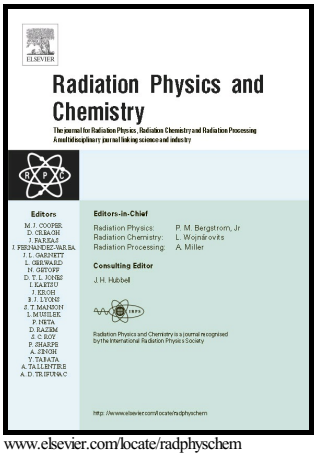

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The effect of different dopant concentration of tailor-made silica fibers in radiotherapy dosimetry

Mahfuza Begum[a,b*], A.K.M. Mizanur Rahman[a,c], H.T. Zubair[a], H.A. Abdul-Rashid[a], Z. Yusoff[a], Mahbuba Begum[c], M. Alkhorayef[d,e], K. Alzimami[d,e], D.A. Bradleye[e,f]

[a]Fiber Optics Research Centre, Faculty of Engineering, Multimedia University, Jalan Multimedia 63100, Cyberjaya, Malaysia.
[b]Health Physics & Radioactive Waste Management Unit, Institute of Nuclear Science and Technology, Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission, Ganakbari, Savar, Dhaka, Bangladesh.
[c]Health Physics Division, Atomic Energy Centre, Bangladesh Atomic Energy Commission, 4 Kazi Nazrul Islam Avenue, Shahbag, Dhaka-1000, Bangladesh.
[d]Department of Radiological Sciences, College of Applied Medical Sciences, King Saud University, PO Box 10219 Riyadh 11433, Saudi Arabia
[e]Department of Physics, University of Surrey, Guildford GU2 7XH, United Kingdom.
[f]Sunway University, Institute for Health Care Development, 46150 PJ, Malaysia.

[*]Corresponding author. Mahfuza Begum. Fax.: +88-02-7788245. mahfuzabaec14@gmail.com

Abstract

In thermoluminescence (TL) material dopant concentration has an important effect on their characteristics as a "radiation-sensor". The study investigates dosimetric properties of four different concentration (4 mol%, 5 mol%, 7 mol% and 25 mol%) tailor-made Ge-doped silica fibers. The intention is to seek development of alternative TL materials that offer exceptional advantages over existing passive systems of dosimetry, including improved spatial resolution, a water impervious nature and low cost. Photon beams (6 MV and 10 MV) from a clinical linear accelerator were used for irradiation of the fiber samples over radiation therapy doses, ranging from 0.5 Gy to 8 Gy. SEM-EDX analysis was also performed to investigate the homogeneity of distribution of Ge dopant concentration from the fiber samples. The results of measurement were also compared with two of the more commonly used standard TLDs, TLD-100 (LiF:Mg,Ti-7.5% ^{6}LiF) and TLD-700 ((^{7}LiF:Mg,Ti-99.9%^{7}LiF) chips respectively. The TL intensity of the fiber samples was found to strongly depend on Ge dopant concentration, with samples showing enhanced TL yields with decreasing Ge dopant concentration. 4 mol% Ge-doped silica fiber provided the greatest response whereas the 25 mol% samples showed the least, indicative of the well-known concentration quenching effects All fiber TLDs provided linear dose response over the delivered radiotherapy dose-range, the fibers also showing a weak dependence on photon beam energies in comparing the TL yields at 6 and 10 MV. The fading behavior of the different concentration Ge doped TLD-materials were also measured over a period of thirty (30) days subsequent to irradiation. The relative sensitivity of the samples with respect to standard TLD-100 were found to be 0.37, 0.26, 0.13 and 0.02 in respect of the 4 , 5, 7 and 25 mol% fibers. The