

Dosimetric Application of α -Al₂O₃:C for Food Irradiation Using TA-OSL

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Abstract : α -Al₂O₃:C has been reported to have deeper traps at 600°C and 900°C respectively. These traps have been reported to be accessed at relatively earlier temperatures (122 and 322 °C respectively) using thermally assisted OSL (TA-OSL). In this work, the dose response of α -Al₂O₃:C was studied in the dose range of 10Gy to 10kGy for its application in food irradiation in low (upto 1kGy) and medium(1 to 10kGy) dose range. The TOL (Thermo-optically stimulated luminescence) measurements were carried out on Risø TL/OSL, TL-DA-15 system having a blue light-emitting diodes ($\lambda=470 \pm 30\text{nm}$) stimulation source with power level set at the 90% of the maximum stimulation intensity for the blue LEDs (40 mW/cm²). The observations were carried out on commercial α -Al₂O₃:C phosphor. The TOL experiments were carried out with number of active channel (300) and inactive channel (1). Using these settings, the sample is subjected to linear thermal heating and constant optical stimulation. The detection filter used in all observations was a Hoya U-340 (Ip ~ 340 nm, FWHM ~ 80 nm). Irradiation of the samples was carried out using a 90Sr/90Y β -source housed in the system. A heating rate of 2 °C/s was preferred in TL measurements so as to reduce the temperature lag between the heater plate and the samples. To study the dose response of deep traps of α -Al₂O₃:C, samples were irradiated with various dose ranging from 10 Gy to 10 kGy. For each set of dose, three samples were irradiated. In order to record the TA-OSL, initially TL was recorded up to a temperature of 400°C, to deplete the signal due to 185°C main dosimetry TL peak in α -Al₂O₃:C, which is also associated with the basic OSL traps. After taking TL readout, the sample was subsequently subjected to TOL measurement. As a result, two well-defined TA-OSL peaks at 121°C and at 232°C occur in time as well as temperature domain which are different from the main dosimetric TL peak which occurs at ~ 185°C. The linearity of the integrated TOL signal has been measured as a function of absorbed dose and found to be linear upto 10kGy. Thus, it can be used for low and intermediate dose range of for its application in food irradiation. The deep energy level defects of α -Al₂O₃:C phosphor can be accessed using TOL section of Risø reader system.

Keywords : α -Al₂O₃:C, deep traps, food irradiation, TA-OSL

Conference Title : ICRPPD 2016 : International Conference on Radiological Physics and Radiation Dosimetry

Conference Location : London, United Kingdom

Conference Dates : May 23-24, 2016