INTRINSIC DOSIMETRY: PROPERTIES AND MECHANISMS OF THERMOLUMINESCENCE IN COMMERCIAL BOROSILICATE GLASS

Richard A. Clark

Dr. J. David Robertson, Dissertation Supervisor

ABSTRACT

Intrinsic dosimetry is the method of measuring total absorbed dose received by the walls of a container holding radioactive material. By considering the total absorbed dose received by a container in tandem with the physical characteristics of the radioactive material housed within that container, this method has the potential to provide enhanced pathway information regarding the history of the container and its radioactive contents. The latest in a series of experiments designed to validate and demonstrate this newly developed tool are reported.

Thermoluminescence (TL) dosimetry was used to measure dose effects on raw stock borosilicate container glass up to 70 days after gamma ray, x-ray, beta particle or ultraviolet irradiations at doses from 0.15 to 20 Gy. The TL glow curve when irradiated with $^{60}$Co was separated into five peaks: two relatively unstable peaks centered near 120 and 165°C, and three relatively stable peaks centered near 225, 285, and 360°C. Depending on the borosilicate glass source, the minimum measurable dose using this technique is 0.15-0.5 Gy, which is roughly equivalent to a 24 hr irradiation at 1 cm from a 48-160 ng source of $^{60}$Co. Differences in TL glow curve shape and intensity were observed for the glasses from different geographical origins. These differences can be explained by changes in the intensities of the five peaks. Electron paramagnetic resonance (EPR) and multivariate statistical methods were used to relate the TL intensity and peaks to electron/hole traps and compositional variations.