Public Abstract
First Name:Richard
Middle Name:Aaron
Last Name:Clark
Adviser's First Name:John
Adviser's Last Name:Robertson
Co-Adviser's First Name:
Co-Adviser's Last Name:
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Title:Intrinsic Dosimetry: Properties and Mechanisms of Thermoluminescence in Commercial Borosilicate Glass

Dosimetry has previously been used to measure the dose delivered to materials with applications to post-detonation nuclear forensics and emergency response following an accident or nuclear attack. In these instances dosimetry was used to measure delivered dose independent of information regarding the radiation source, and usually to material surfaces open to the environment. In the past, traffickers of nuclear materials have used glass vials for storage and transport. In these instances, the dose is delivered to the walls of glass containers holding radioactive material, and both the measured dose and the attributes (amount and type) of the radioactive material may be considered together in order to acquire further details about the sample's history. This situation defines intrinsic dosimetry–the measurement of the total absorbed dose received by the walls of a container holding radioactive material. Intrinsic dosimetry is intended to be used as an interrogation tool for interdicted or newly discovered waste containers of unknown origin or history, for the purpose of acquiring pathway information between loss of control of the radioactive material and discovery of the container.

In this research, 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 resulting TL glow curves were 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.

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