

Title: Investigation of structural and TL kinetic parameters of smartphone screen protector glasses for applications in retrospective dosimetry

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Abstract: The study evaluated the structural and thermoluminescence (TL) kinetic parameters of smartphone screen protector glasses in order to use them for post-accident dose reconstruction from unplanned nuclear events. The fact that most individuals use mobile phones in working environments including nuclear power plant sites, served as the impetus for the study. The TL glow curves indicate the physical properties of the defects involved in the luminescence process; therefore, they have been analyzed to study the TL kinetic parameters by employing peak shape, initial rise and glow curve deconvolution method within the dose ranges from 2 to 50 Gy. The geometric factor (μg) ranges between 0.46 and 0.56, suggesting that Chen's general-order method can be used to compute the kinetic parameters, including activation energy (E), frequency factor (s) and trap lifetime (τ). The examined trapping parameters ($E = 0.33\text{--}0.57$ eV, $s = 5.22\text{E}+03\text{--}8.65\text{E}+06$ s $^{-1}$ for peak shape and $E = 0.36\text{--}0.96$ eV, $s = 2.90\text{E}+04\text{--}1.88\text{E}+11$ s $^{-1}$ for initial rise methods) suggest promise for TL dosimetry applications. Additionally, the observed lifetime ($\tau = 4.88\text{E}+5$ s) implies the feasibility of dose reconstruction even several days after an accident, making it suitable for retrospective dosimetry. Micro-Raman spectroscopy revealed a clear correlation between increasing gamma radiation dose and microstructural damage. The analysis of intensity ratio (ID/ISi) for other components to silica, along with the area of deconvoluted micro-Raman spectra in high-frequency regions, indicated dose-dependent structural modifications and internal defect annealing. Further confirmation of structural alterations within the studied dose range was obtained through the analysis of crystallite size (L_c), dislocation density (δ), lattice strain (ϵ) and FWHM (Full Width at Half Maximum) from XRD (X-ray diffraction) patterns. These findings collectively suggest the potential of smartphone screen protector glass as a viable material for emergency dosimetry applications.

Keywords: Thermoluminescence (TL), Retrospective dosimetry, Dose reconstruction, Gamma irradiation, Micro-Raman spectroscopy, X-ray diffraction (XRD)

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