Title: Thermoluminescence dosimetry and microstructural characteristics of gamma-irradiated natural flake graphite

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Abstract: Thermoluminescence (TL) and microstructural analysis were conducted on natural flake graphite (NFG) to assess its suitability for radiotherapeutic x-ray dose measurements. The investigations encompassed the examination of TL glow curves, linearity, sensitivity, signal decay, and repeatability. NFG samples were exposed to ^{60}Co gamma radiation doses ranging from 2 Gy to 20 Gy. The microstructure of the irradiated NFG was probed using a 532 nm laser Raman spectrometer. Promisingly, the NFG exhibited remarkable characteristics, including a moderately higher response to dose (R^2 of about 96%), increased sensitivity at lower doses, and good repeatability (~4%). Nevertheless, its fading rate reached about 80% after 14 days of irradiation. Additionally, the NFG intensity ratios of defect (D) to graphite (G), denoted as I_D/I_G, closely mirrored the oscillatory pattern observed in 50 μm thick graphite sheets and were approximately 1.6 times lower than those of similar graphite sheets with comparable carbon content (about 98% carbon). These findings suggest that NFG holds potential for the development of an affordable, non-hygroscopic, and tissue-equivalent TL dosimeter, with possible applications in the medical field.

Keywords: Thermoluminescence (TL) Natural flake graphite (NFG) Radiation dosimetry 60Co gamma radiation Dose–response linearity

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