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Thermoluminescence and Structural Characterization of Natural Flake Graphite Under 6 MV Photon Exposure from Medical LINAC for Dosimetric Applications

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Natural flake graphite (NFG) is a cost-effective, carbon-rich material known for its high thermal stability and unique defect structures, offering considerable promise for application as a thermoluminescent dosimeter in the detection of ionizing radiation. This investigation focuses on the development of a thermoluminescence (TL) material for dosimetry that may improve the performance of current passive dosimeters. The study aims to analyze the essential TL characteristics of carbonaceous NFG. The dosimetric characteristics of commercially available NFG in response to X-ray photon-beams from Linac, at doses ranging between 2 Gy to 20 Gy, have been thoroughly investigated. The characteristics include TL glow curve, dose-response, sensitivity, energy dependency and fading. The results demonstrate that the NFG has a high linear response in the dose range under investigation and a higher sensitivity at lower doses. The NFG sample demonstrated remarkable reproducibility, with a standard variation of less than 3%. Fading study was performed under laboratory light and dark condition, revealed a minimum rate of fading for both condition. The SEM/EDX analysis confirms that NFG degrades microstructurally in a dose-dependent manner. X-ray diffraction (XRD) and Raman spectroscopy are used to evaluate the structural changes brought on by radiation doses. All of these investigations support the structural changes caused by photon irradiation. In conclusion, NFG exhibits great promise as a useful material for radiation dosimetry applications.

Keywords: Thermoluminescence (TL) Measurement, Raman Spectroscopy, X-ray Diffraction (XRD)

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