A new type of microdosimeter based on 3D computer optical memories

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Three dimensional computer optical memories (3D OM) are a new type of high-density high-speed data storage medium. Digital data is stored in the volume of a polymer matrix loaded with photochromic molecules. Both data storage and retrieval are achieved using crossed laser beams that are capable of inducing reversible transformations in the photochromic material. In this work it is shown that not only laser light but also ionizing radiation is capable of transforming the photochromic molecules from one isomeric form of the molecule to another. This forms the basis of a new type of radiation measurement technique where the OM element acts as a three-dimensional microdosimeter. It is shown both theoretically and experimentally, that heavy charged particles (HCP) and neutrons are capable of changing the information originally stored on the OM element. The magnitude and the spatial distribution of these changes are used as a measure of the absorbed dose, particle type, and energy. The effects of exposure on 3D OM materials have been investigated for a variety of particle types and energies, including protons, alpha particles and carbon ions. The exposed materials are observed to fluoresce when exposed to laser light. It is shown that the microscopic spatial distribution of the fluorescence is dependent on both the particle type and energy of the incident particle.