Exploration of gamma radiation shielding features for titanate bismuth borotellurite glasses using relevant software program and Monte Carlo simulation code

ABSTRACT

In this work, gamma radiation shielding parameters for six titanate bismuth borotellurite glasses were investigated. The mass attenuation coefficients (μ/ρ) have been calculated using XCOM software and MCNP5 code within the photon energy range 0.015–10 MeV. The (μ/ρ) values were then used to calculate the effective atomic number (Zeff), electron density (Ne), mean free path (MFP) and half-value layer (HVL) values. By using the Geometric progression (G–P) method, the exposure buildup factor (EBF) values at 0.015 MeV–15 MeV photon energy range, with penetration depths up to 40 mfp at intervals 1, 5, 10, 20, 30, and 40 mfp were evaluated. The 30 TeO2–30 B2O3–30 Bi2O3–10 TiO2 (mol %) glass possesses better gamma ray shielding effectiveness due to a higher value of (μ/ρ), Zeff and lower values of HVL and MFP. The studied glasses exhibit excellent gamma ray shielding features compared to different types of concretes.

Keyword: Radiation shielding; XCOM; MCNP5 code; Mass attenuation coefficient; Mean free path; Half-value layer