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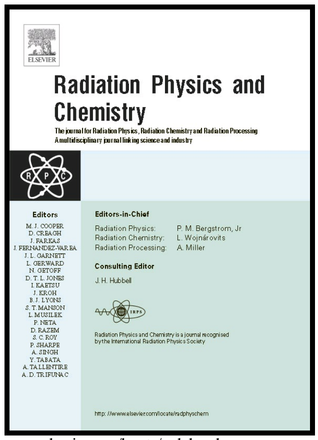

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Evaluation of gamma-ray attenuation properties of bismuth borate glass systems using Monte Carlo method

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ABSTRACT

A Monte Carlo method was developed to investigate radiation shielding properties of bismuth borate glass. The mass attenuation coefficients and half-value layer parameters were determined for different fractional amounts of Bi_2O_3 in the glass samples for the 356, 662, 1173 and 1332 keV photon energies. A comparison of the theoretical and experimental attenuation coefficients is presented.

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Keywords

Monte Carlo; mass attenuation coefficient; bismuth borate glass systems; radiation shielding; half-value layer

1. Introduction

Knowledge of mass attenuation coefficients of elements, compounds and mixtures is of great significance in both applied and fundamental science. They are invaluable in many applied fields, such as nuclear diagnostics, radiation protection, nuclear medicine and radiation dosimetry. The mass attenuation coefficient is a measure of the average number of interactions between incident photons and matter that occur in a given mass thickness of the substance under investigation (Hubbell, 1999; Demir et al., 2012; Tellili et al., 2013). Hence, it is one of the basic quantities required for determining the penetration of gamma-ray photons in matter (Medhat, 2012). The mass attenuation coefficient is dependent on the energy of the incident gamma radiation and the elemental composition of the attenuator material.