Mass Attenuation Coefficient of Some Bismuth-Based Alloys for Gamma-Ray Shielding: Theoretical and Experimental Approach

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Abstract

Bismuth-based alloys have gained significant attention for their potential use in gamma-ray shielding applications due to their high atomic number and non-toxic nature compared to conventional lead-based materials. In this study, the mass attenuation coefficient (MAC) of bismuth-based alloys was determined using both theoretical and experimental approaches. Theoretical values were obtained using the WinXCom software, which provides photon interaction cross-sections for various energies. Experimentally, the mass attenuation coefficient was measured using the narrow beam geometry method with gamma-ray sources of varying energies. The results from both methods were analyzed and compared to assess the accuracy of WinXCom in predicting attenuation properties. Further, the role of preliminary computations of optimum thickness range for alloy samples play a vital role in obtaining accurate results. The findings indicate that bismuth-based alloys exhibit promising attenuation characteristics, making them viable candidates for radiation shielding applications in medical, industrial, and nuclear environments.

Keywords: Gamma-rays; bismuth-based alloys; lead free alloys; radiation shielding; mass attenuation coefficient.