Multi-objective optimization strategies for radiation shielding performance of BZBB glasses using Bi2O3: A FLUKA Monte Carlo code calculations

ABSTRACT

Highly efficient gamma shielding of BZBB glasses with various Bi2O3concentrations inthe xBi2O3-30B2O3-(65-x)ZnO-5BaO, (5 ≤ x ≤ 25 mol%) were evaluated for their radiationshielding properties. The mresults have been evaluated via the NISTXCOM database andsimulated via FLUKA code. The simulation values by Monte Carlo code (FLUKA) have beenshown to converge and correlate with XCOM values. Shielding properties like HVL, MFP, Zeff,EBF, and EABF values have been computed. The values observed that mand Zeff increasewith increasing Bi2O3. 47.09, 48.91, 50.73, 52.54 and 54.36 (cm2/g) are the mvalues forBZBB1, BZBB2, BZBB3, BZBB4 and BZBB5 glasses at 15 keV. Also, the mvalues decreasewith increasing photon energy for all glass samples. Moreover, BZBB5 sample had the low-est HVL, MFP, EBF, and EABF values. That indicates to the addition of Bi2O3improves theradiation shielding properties of BZBB glasses. The obtained results were compared withthe most commonly shielding materials such as lead and concretes. It was concluded thatthe improved BZBB glasses with the addition of Bi2O3showed excellent shielding propertiescomparing with shielding materials. These results could be highly beneficial for fields suchas medical treatment facilities.

Keyword: Bismuth; Borate glasses; FLUKA code; Shielding properties