




Photon and neutron absorbing capacity of titanate-reinforced borate glasses: $B_2O_3-Li_2O-Al_2O_3-TiO_2$

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ABSTRACT

The photon and neutron absorbing capacity of titanate-doped borate glasses: $65B_2O_3-30Li_2O-5Al_2O_3-xTiO_2$: $x = 0-30$ mol% coded as G1–G7 were investigated via WinXCOM and EXABCal computer codes. Mass (μ_m) and linear (LAC) attenuation coefficients, mean-free path (MFP), half-value thickness (HVT), buildup factors (EABUF and EBUF), and the relative fast neutron absorbing efficacy were investigated. The maximum value of μ_m at 15 keV was 1.68, 2.976, 4.119, 5.134, 6.042, 6.856, and 7.593 cm^2/g for G1, G2, G3, G4, G5, G6, and G7, respectively. For energies below 0.1 MeV and above 10 meV, μ_m values vary according to the order $(G1)_{\mu_m} < (G2)_{\mu_m} < (G3)_{\mu_m} < (G4)_{\mu_m} < (G5)_{\mu_m} < (G6)_{\mu_m} < (G7)_{\mu_m}$. Values of LAC followed the order: $(G7)_{LAC} > (G6)_{LAC} > (G5)_{LAC} > (G4)_{LAC} > (G3)_{LAC} > (G2)_{LAC} > (G1)_{LAC}$. The trend of the MFP increases among the glasses follows a reverse order as that of LAC: $(G1)_{MFP} > (G2)_{MFP} > (G3)_{MFP} > (G4)_{MFP} > (G5)_{MFP} > (G6)_{MFP} > (G7)_{MFP}$. The HVT of the glasses follow the order: $(G1)_{HVT} > (G2)_{HVT} > (G3)_{HVT} > (G4)_{HVT} > (G5)_{HVT} > (G6)_{HVT} > (G7)_{HVT}$. EABUF and EBUF increase in the order $(G1)_{(EABUF, EBUF)} > (G2)_{(EABUF, EBUF)} > (G3)_{(EABUF, EBUF)} > (G4)_{(EABUF, EBUF)} > (G5)_{(EABUF, EBUF)} > (G6)_{(EABUF, EBUF)} > (G7)_{(EABUF, EBUF)}$. The investigated glasses (G1–G7) are better fast neutron absorbers compared to ordinary concrete and water. Results revealed that higher titanate doping concentrations produced better photon and fast neutron shielding capacities. Therefore, the investigated glasses showed superior shielding efficacy when compared with some traditional shielding materials; consequently, the G1–G7 glasses are recommended for use as ionizing radiation shields.

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