Published: 09 September 2021

Investigation of mechanical, photon buildup factors, and neutron-sensing properties of B_2O_3–Al_2O_3–Li_2O–CuO glasses

Y. S. Rammah, F. I. El-Agawany, M. M. Hessien, I. O. Olarinoye, A. M. Abdelghany & M. S. Shams

Journal of Materials Science: Materials in Electronics **32**, 24401–24414 (2021)

Abstract

Mechanical, gamma-ray buildup factors, and neutron-sensing properties of cupric alumino lithium borate glasses of the form xCuO–(20–x)Li_2O–60B_2O_3–20Al_2O_3: x = 0.0, 0.2, 0.4, 0.8, 1.2, 1.6, 2.0, and 2.4 mol% have been examined. The bond compression values of Young's (E_{B-C}) elastic modulus were enhanced from 94.739 to 98.959 GPa, from 36.267 to 37.909 GPa for shear (S_{B-C}), and from 129.739 to 135.081 GPa for longitudinal (L_{B-C}). Poisson's ratio (σ_{B-C}) for BLiAlCu glasses was decreased from 0.3061 to 0.3051. Makishima–Mackenzie elastic moduli showed that the replacement of CuO by Li_2O leads to a slight increase of values of (E_{M-M}) from 54.269 to 55.321 GPa, (K_{M-}

$_M$) from 31.931 to 33.448 GPa, and (S_{M-M}) from 22.301 to 22.592 (GPa). Poisson's ratio (σ_{M-M}) for glasses was increased from 0.216 to 0.224. The position of the EABUF and EBUF peaks vary with depth and chemical composition of the glasses; however, all the peaks appear within 0.08 and 0.15 MeV and shifting to higher energy as depth increases. Comparing the BUFs for the different glasses, it is apparent that BUFs decreases with increase in Cu content of the glass system at low energies. Hence, $(BUFs)_{BLiAlCu0.0} > (BUFs)_{BLiAlCu0.4} > (BUFs)_{BLiAlCu0.8} > (BUFs)_{BLiAlCu1.2} > (BUFs)_{BLiAlCu1.6} > (BUFs)_{BLiAlCu2.0} > (BUFs)_{BLiAlCu2.4}$ at 0.015. The increase of CuO content of the glasses leads to improve in the fast neutron removal capacity.