

Influence of lead and zinc oxides on the radiation shielding properties of tellurite glass systems

ABSTRACT

The radiation shielding properties of $x\text{PbO}-(100-x)\text{TeO}_2$, $x = 10, 20, \text{ and } 30$ mol% binary glasses and $y[\text{ZnO}]-[100-y][70(\text{TeO}_2)-30(\text{PbO})]$ $y = 15, 20, \text{ and } 25$ mol% ternary glasses were investigated using Geant4 simulations and the newly developed Phy-X/PSD program. The glasses' gamma shielding abilities were assessed using their mass attenuation coefficient (μ/ρ), mean free path (MFP), effective atomic number (Z_{eff}), and half value layer (HVL) values. The neutron shielding ability was evaluated by determining the removal cross-section (RCS) values, which were 0.097, 0.101, and 0.103 cm^{-1} for binary PbO-TeO₂ (PT) glasses and 0.118, 0.116, and 0.114 cm^{-1} for ternary ZnO-PbO-TeO₂ (PTZ) glasses. The gamma and neutron shielding features of the glasses were compared with those of various ordinary concretes and Pb-free, Pb-based, and commercial glasses. The addition of PbO changed the gamma and neutron properties of the PT glasses, while the addition of ZnO demonstrated a different trend in the gamma properties of the PTZ glass system.

Keyword: Shielding properties; Tellurite glass; Lead oxide; Zinc oxide; Geant4; Phy-X/PSD