Contribution ID: **25204** Type: **Extended Abstract**

Nuclear Radiation attenuation and Elasto-Mechanical Properties of La2O3 based Boro-Silicate Glasses: Comparative Analysis

Tuesday, 4 November 2025 11:00 (15 minutes)

The study was conducted to explore the effects of lanthanum oxide (La_2O_3) on the physical, mechanical, and nuclear shielding properties of six Boro-Silicate glass compositions (S1 to S6), with La_2O_3 concentrations ranging from 10 to 35 mol%. Mechanical properties, including Young's modulus, bulk, shear, longitudinal moduli, microhardness, and Poisson's ratio, were evaluated using the Makishima–Mackenzie model. Results show that increasing La_2O_3 content enhances the glass density and elastic properties, while slightly reducing microhardness due to increased network rigidity. Gamma-ray shielding characteristics were investigated across the 0.015–15 MeV energy range using both the MCNP5 simulation code and XCOM software. Key parameters assessed included mass attenuation coefficient (μm), half-value layer (HVL), effective atomic number (Zeff), radiation protection efficiency (RPE), and buildup factors (EBF and EABF). The S6 composition ($45B_2O_3$–$10SiO_2$–$10CaO$–$35La_2O_3$) exhibited the best performance, achieving the highest μm, Zeff, and RPE, and the lowest HVL, EBF, and EABF offering 100% X-ray attenuation between 10–150 keV and excellent gamma shielding at higher energies. Neutron shielding capability was evaluated through the macroscopic effective removal cross-section (ΣR), with S1 showing the highest value and S6 performing comparably to conventional materials like graphite, concrete, and basalt magnetite. Additionally, the mass stopping power (MSP) and projected range (PR) of protons and alpha particles were analyzed using the SRIM code across 0.01–15 MeV. The S6 glass again demonstrated superior performance, with the lowest MSP and shortest particle ranges. Overall, these results confirm that La_2O_3-doped Boro-Silicate glasses, particularly the S6 composition, are highly effective for shielding against X/gamma rays, neutrons, and heavy ions. Their versatility makes them suitable for use in medical diagnostics, nuclear waste containment, and radiation protection infrastructure.

Technical Track

Nuclear Applications and Radiation Processing

Primary author: Dr MITWALLI, Mohamed (Interdisciplinary Research Center for Advanced Materials, King Fahd University of Petroleum and Minerals, 31261, Dhahran, Saudi Arabia)

Session Classification: Nuclear Applications and Radiation Processing