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Research Article

Synthesis, optical, structural, and radiation transmission properties of PbO/Bi_2O_3/B_2O_3/Fe_2O_3 glasses: An experimental and in silico study

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ABSTRACT

In this paper, a new glass combination containing PbO, Bi_2O_3, B_2O_3, and Fe_2O_3 has been synthesized, characterized, and studied in details for advanced optical and radiation shielding applications. The PbO excess was in the step of 10% at the expense of (Bi_2O_3+B_2O_3). The physical and optical parameters were experimentally measured for each prepared glass sample.The structure characterization of the glass specimens was performed by using both FTIR and XRD. Moreover, EPR spectra were studied to give a full understanding about the valence state and interaction of paramagnetic ions. Additionally, Monte Carlo method was utilized to design the simulation setup for studying the radiation propagation through the prepared samples. The obtained results indicate thatthe optical band gap values were found to be high with excess of PbO content. The EPR spectra have shown a high intense resonance signal at g ≈ 4.2 and mild intense signal located at g ≈ 2.1. The magnitudes of linear attenuation coefficients for the glasses at different energies shows that maximum (minimum) value of 290.39 (0.158), 322.67 (0.168), 367.13 (0.184), 431.04 (0.207), 502.32 (0.231), and 574.34 (0.0257) cm^{-1} was obtained for PBBF-0 – PBBF-50. This investigation lays the foundation for using the prepared glass system as a new candidate in advanced optical and shielding applications.