**Physical properties, optical band gaps and radiation shielding parameters exploration for $Dy^{3+}$-doped alkali/mixed alkali multicomponent borate glasses**


ABSTRACT

Six compositions of 1 mol % $Dy^{3+}$-doped multicomponent borate glasses containing single $Li_2O$, $Na_2O$, $K_2O$ and mixed $Li_2O$–$Na_2O$, $Li_2O$–$K_2O$, and $Na_2O$–$K_2O$ oxides have been synthesized by well-known melt-quenching technique. Following the measured density and refractive index values, various physical parameters were estimated for all the glass samples and differences in them are correlated with structural changes. To explore optical properties like absorption edge (λcut-off), optical band gap energy (Eopt), and Urbach energy (ΔE), optical absorption spectra were recorded for all the glasses. The Eg has been calculated using Davis and Mott theory for direct allowed, and indirect allowed transitions and the results were reported. The Eg values are also estimated using absorption spectrum fitting (ASF) method. The optical parameters variations have also been associated with the structural changes occurring in the glasses with different alkali/mixed alkali oxides content presence. The shielding properties of the prepared glasses were studied in terms of effective atomic numbers (Zeff), mean free path (MFP), half value layer (HVL) and macroscopic effective removal cross-section (ΣR). From these results, it was found that Potassium (K) glass shows superior gamma ray shielding properties due to a higher value of Zeff and lower values of both MFP and HVL. These results indicate that the prepared glasses might be utilized in place of some common shielding materials to shield γ-rays and neutrons.



**Keyword:** $Dy^{3+}$; Borate glasses; Optical basicity; Optical band gap; Radiation shielding; Mass attenuation coefficient; Half-value layer