

Elastic properties of TeO₂-B₂O₃—ZnO-Gd₂O₃ glasses using non-destructive ultrasonic technique

ABSTRACT

The addition of Gd₂O₃ causes the glass system to be highly ionic resulting in increasing rigidity and the tendency of devitrification. Gd₂O₃ affects the strength governing the elastic properties of the glass. The elastic moduli of the prepared glasses are expected to increase with the addition of the Gd₂O₃ due to increasing net molecular weight of prepared glass resulting in strong connectivity and more compactness of the glass network. The objective of this present work is to study the elastic properties of TeO₂-B₂O₃-ZnO doped Gd₂O₃ using a non-destructive ultrasonic technique. A series of $\{[(\text{TeO}_2)_{0.7}(\text{B}_2\text{O}_3)_{0.3}]_{0.7}(\text{ZnO})_{0.3}\}_{1-x}(\text{Gd}_2\text{O}_3)_x$ glasses with $x = 0.01, 0.02, 0.03, 0.04$ and 0.05 mol were prepared by conventional melt-quenching method. Both longitudinal and shear ultrasonic velocities were measured using a pulse-echo method at a frequency of 5 MHz at room temperature. The elastic moduli (longitudinal modulus, shear modulus, Young's modulus and Bulk modulus), Poisson's ratio, Debye temperature, micro-hardness and softening temperature have also been quantified. The experimental results show that the elastic properties depend on the composition of the glass systems and the role of Gd₂O₃ inside the glass network.

Keyword: Gadolinium ion; Zinc Borotellurite glass; Elastic moduli; Poisson's ratio; Debye temperature; Microhardness; Softening temperature