A comparative study of the experimental and the theoretical elastic data of Tm^{3+} doped zinc borotellurite glass

ABSTRACT

A series of glass samples with composition $\{[(TeO_2)_{0.7}(B_2O_3)_{0.3}]_{0.7}[ZnO]_{0.3}\}_{1-x}\{Tm_2O_3\}_x$ was prepared by using the melt-quenching technique. Then, the samples were characterized by using the densimeter, FTIR and ultrasound technique. The variations of density, molar volume, ultrasonic velocity, elastic moduli, and Poisson's ratio were discussed and correlated with the composition of the glass samples and the FTIR spectra. It was found that the addition of thulium caused bridging and non-bridging oxygen to be formed at the same time due to the different effect that occur to tellurite and borate network as thulium is added. As thulium is varied from 1 until 3 mol%, bridging oxygens had been found to occur at a high rate and caused the ultrasonic velocity to increase. Nonetheless, when thulium oxide exceeded 3 mol%, non-bridging oxygens formed at a high rate. As a result, ultrasonic velocity was reduced. Furthermore, the values of elastic moduli (including bulk, shear, Young's modulus, and Poisson's ratio) were compared with the data that were calculated theoretically by using bulk compression, Makishima-Mackenzie, and Rocherulle models.

Keyword: Borotellurite glass; Bulk compression model; Makishima-Mackenzie model; Rocherulle model; Thulium