UNIVERSITI TEKNOLOGI MARA

ELASTIC AND STRUCTURAL STUDIES ON $(95\text{-}x)TeO_2\text{-}5La_2O_3\text{-}xTiO_2$ LANTHANUM TELLURITE AND $xLi_2O\text{-}(100\text{-}x)[0.65GeO_2 \cdot 0.35PbO]$ LEAD GERMANATE GLASSES

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of the requirements for the degree of
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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 9th December 2015 to conduct the final examination of Izyan Nuraini Binti Sapian on her Master of Science thesis entitled "Elastic and Structural Studies on $(95\text{-}x)TeO_2\text{-}5La_2O_3\text{-}xTiO_2$ Lanthanum Tellurite and $xLi_2O\text{-}(100\text{-}x)[0.65GeO_2 \cdot 0.35PbO]$ Lead Germanate Glasses" in accordance with Universiti Teknologi MARA act 1976 (Akta 173). The panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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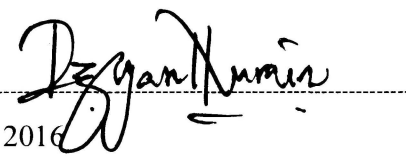
Signature of Student	:	
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ABSTRACT

Lanthanum tellurite and lead germanate glasses with compositions (95-x)TeO_2-5La_2O_3-$x$$TiO_2$ (x = 0 mol% to 20 mol%) and $x$$Li_2O$-(100-$x$)[0.65$GeO_2$·0.35PbO] ($x$ = 0 mol% to 40 mol%) were prepared by the melt quenching method, respectively. Elastic and structural properties of the glasses were studied by measuring sound velocity using the pulse-echo-overlap technique and Fourier Transform Infrared (FTIR) spectroscopy, respectively. For (95-x)TeO_2-5La_2O_3-$x$$TiO_2$ (x = 0 mol% to 20 mol%) samples, ultrasonic velocity measurements showed both independent moduli (C_L and μ) and related elastic moduli such as bulk modulus (K_e), Young's modulus, hardness and Debye temperature were observed to increase gradually for x < 15 mol% followed by a large increase at x = 20 mol% addition of TiO_2. The results obtained showed that this glass system becomes more stable, rigid and stiffer with addition of TiO_2. Structural analysis showed increase in bridging-oxygen (BO) compared to non-bridging oxygen (NBO). Differential Scanning Calorimetry (DSC) measurements showed T_g increased with addition of TiO_2 and confirms the increasing rigidity of the network. Theoretical analysis using bulk compression and ring deformation models showed a gradual increase in ratio of ideal bulk modulus compared to experimental bulk modulus, K_{bc}/K_e for x < 15 mol% before a sudden drop at x = 20 mol%. The drop indicates decrease in ring deformation or bending. Although some deformation or bending may take place during compression, the main compression mechanism was still mainly isotropic ring compression. On the other hand, for $x$$Li_2O$-(100-$x$)[0.65$GeO_2$·0.35PbO] ($x$ = 0 mol% to 40mol%) samples showed increase in density to a maximum at x = 10 mol% before decreasing indicates presence of the germanate anomaly. Both longitudinal and shear velocities, as well as both independent longitudinal (C_L) and shear (μ) moduli, also showed similar non-linear behaviors, with maximum values at x = 10 mol%. The increase in independent moduli at x < 10 mol% is suggested to be related to the germanate anomaly, in which formation of smaller three-membered GeO_4 rings connected to $GeO^{2-}{}_6$ units leads to an increase in the rigidity and stiffness of the glass network. Meanwhile, the decrease in the elastic moduli for x > 20 mol% is suggested to be due to weakening of the glass network by progressive depolymerization of three-membered GeO_4 rings in the germanate network through formation of non-bridging oxygen. In addition, bulk modulus, K_e, Young's modulus, and Debye temperature also showed similar behaviors as C_L and μ. Analysis using bulk compression and ring deformation models showed the ratio of theoretical K_e over experimental K_{bc} and average ring size were also affected by the germanate anomaly, and the closest to ideal isotropic compression was at x = 10 mol%.

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