UNIVERSITI TEKNOLOGI MARA
Institut Pengajian Siswazah

THE DOCTORAL RESEARCH ABSTRACTS

Volume: 14, October 2018

14th ISSUE

IGS Biannual Publication

Name : NURUL SYAHIDAH BINTI SABRI

Title : STRUCTURAL, ELASTIC AND OPTICAL PROPERTIES OF xSrO10PbO-(90-x)B2O3, xPbO-30SrO-(70x)B2O3 AND xSrO-(90-x)B2O3-2CeO28Al2O3 BORATE GLASSES IN BORATE ANOMALY REGION

Supervisor : DR. MAHESH KUMAR TALARI **(MS)**

PROF. DR. AHMAD KAMAL HAYATI YAHYA **(CS)**

Glass samples with the composition of xSrO-10PbO-(90-x)B2O3 (x = 20-45), xPbO-30SrO-(70-x)B2O3 (x = 0-25) and xSrO-(90-x)B2O3-2CeO2-8Al2O3 (x = 25-50 mol%) were prepared by melt-quenching method to elucidate the structural, elastic and optical behavior in borate anomaly region. Characterization techniques like X-ray diffraction (XRD), Fourier transforms infra-red spectroscopy (FTIR), ultrasonic measurement, UV–Visible and Luminescence (for SrO-B2O3-CeO2-Al2O3) spectroscopes are employed in the present work. XRD data showed amorphous nature for SrO-PbO-B2O3 samples while mixed crystalline/amorphous phases for the SrO-B2O3-CeO2-Al2O3 samples at x > 35 mol%. FESEM image and EDX analysis revealed that the samples contained Ce-rich crystalline phase and Ce depleted glass phase. FTIR analysis revealed the presence of BO4 and BO3 vibration groups. Variation of SrO in SrO-PbO-B2O3 and SrO-B2O3-CeO2-Al2O3 samples has resulted in increased ultrasonic velocities, elastic moduli (CL, μ, K and Y), hardness (H), Debye temperature (θD) at lower SrO content but decreased for higher SrO addition. The increase in the elastic moduli indicates the increase of network rigidity of the glass system, related to the borate anomaly where the coordination number increased with the addition of SrO. At higher SrO additions in SrO-PbO-B2O3 samples, NBO formation resulted in decrease of elastic properties. Meanwhile, decrease in elastic moduli for SrO-B2O3-CeO2-Al2O3 samples related to the formation of NBO and grain/phase boundaries due to mixed crystalline/amorphous phases. The fraction of the four coordinated boron atoms (N4) values, calculated from FTIR spectra have same trend with elastic properties results. Quantitative analysis of ultrasonic data using the bulk compression and ring deformation models showed reduction in the ratio of calculated bulk modulus to the experimental bulk modulus, Kbc/Ke indicating decreased ring deformation in borate anomaly region. Observed mismatch in maximum value of optical band gap (Eopt) and minimum values of electronic polarizability ($\alpha O2-$), optical basicity (Λ) and refractive index (n) when compared to maximum values of N4 and elastic behavior was attributed to the formation of weak coordinated covalent bonds during structural transformation and addition of cation with high polarizability to the xSrO-10PbO-(90-x)B2O3 glass. Presence of crystalline phases along with the glass matrix in the SrO-B2O3-CeO2-Al2O3 glass at x > 35 mol% resulted in higher of Eopt and lower of n values. Formation of BO4 and partial crystallization have resulted in enhancement and quenching of emission spectra in the SrO-B2O3-CeO2-Al2O3 glasses, respectively. Meanwhile, by varying PbO content in xPbO-30SrO-(70-x)B2O3 samples, elastic moduli, FTIR and optical absorption analysis revealed that PbO acts differently i.e glass former and glass modifier, depending on the PbO concentration. PbO can act as a conditional glass former and its incorporation into glass in the form of PbO4, which causes considerable change in the structure of glass. In this work, it can be suggested that at x ≤ 10 mol% of PbO content, Pb2+ is incorporated as network modifier, while it acts as network former for the higher PbO content (x > 10 mol%).