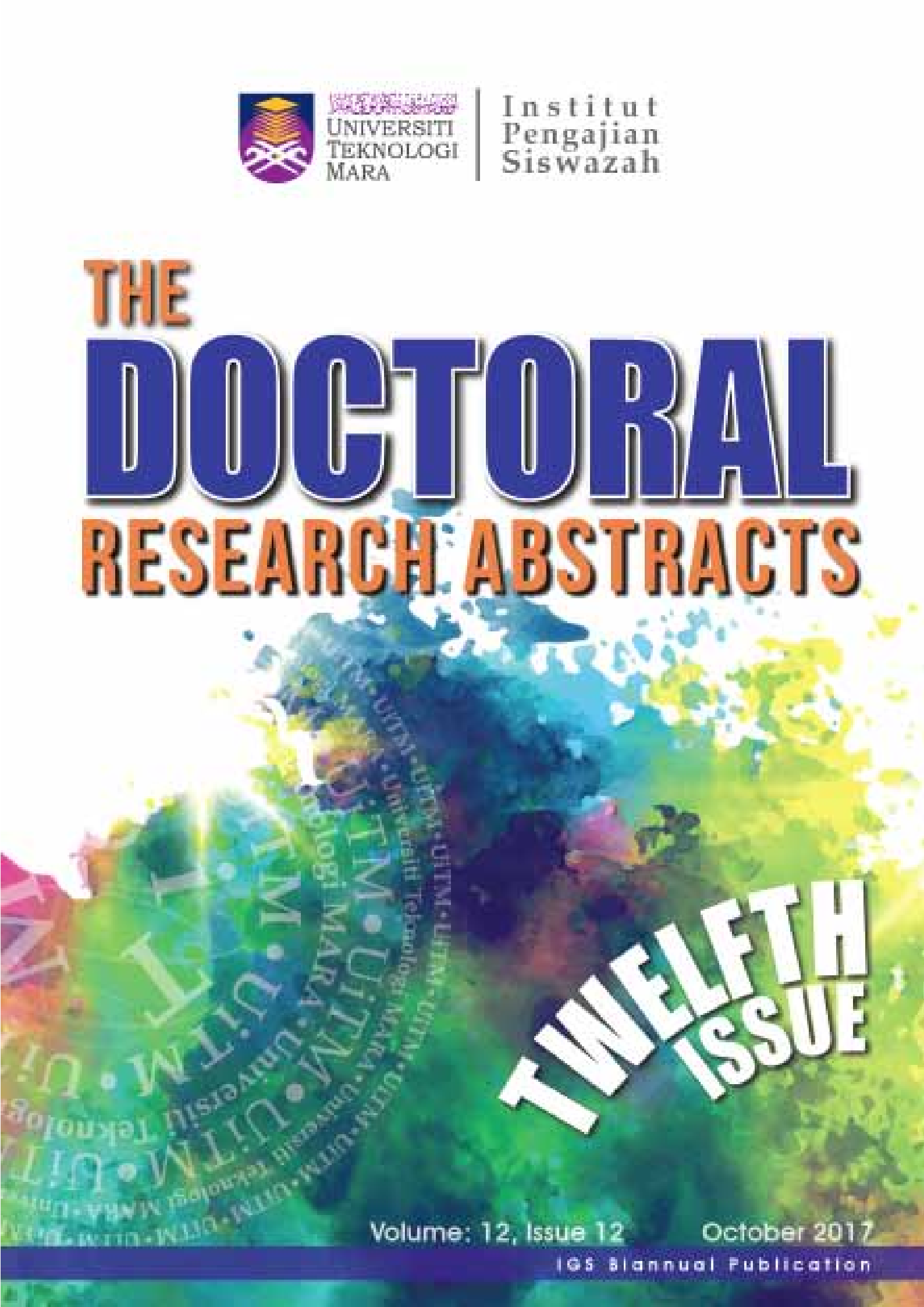
UNIVERSITI TEKNOLOGI MARA
Institut Pengajian Siswazah

THE DOCTORAL RESEARCH ABSTRACTS



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Title : DIELECTRIC, ELASTIC AND OPTICAL PROPERTIES OF $80TeO_2$-$(20-x)MnO_2$-xFe_2O_3 AND $30Li_2O$-$4MoO_3$-$(66-x)TeO_2$-xV_2O_5 MIXED OXIDE TELLURITE GLASSES IN THE CONDUCTIVITY ANOMALY REGION

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In this study, two series of mixed oxide tellurite based glasses with composition $80TeO_2$-$(20-x)MnO_2$-xFe_2O_3 (x = 5 mol% to 20 mol%) and $30Li_2O$-$4MoO_3$-$(66-x)TeO_2$-xV_2O_5 (x = 0.2–1.2 mol%) were prepared using melt-quenching method to investigate their dielectric, AC conductivity, elastic and optical properties. For the $80TeO_2$-$(20-x)MnO_2$-xFe_2O_3 glass samples, the dielectric constant showed strong variation with Fe_2O_3 at a frequency ≥ 10 kHz, where ε′ decreased to a minimum value at x = 10 mol% before increasing for x >10%. The decrease in ε′ may be attributed to some form of hindrance effect on heavy dipoles caused by the mixed transition-ion effect (MTE). Meanwhile, variation of AC conductivity with Fe_2O_3 showed non-linear increase for $x \leq 10$ mol% before dropping to a minimum at 15 mol% Fe_2O_3. This result is attributed to Anderson localization because of the disorder in the glass system. On the other hand, DC conductivity for the same glass system showed a strong increase for $x \leq 10$ mol% Fe_2O_3 before reaching a saddle-like behavior between 10 mol % ≤ x ≤ 15 mol%, followed by a large increase for x > 15 mol%. Independent longitudinal modulus (CL), shear modulus (μ) and bulk modulus (Ke) showed increased values for $x \leq 10$ mol% with an anomalous drop at x = 15 mol% Fe_2O_3, followed by a large increase at x > 15 mol%. The anomalous region between 10 mol% ≤ x ≤ 15 mol% coincided with DC conductivity saddle-like region and is suggested to be related to the MTE. Meanwhile, in the same region, optical band gap (E_{opt}) exhibited a maxima, whereas refractive index showed a minima, thereby indicating a variation in polarizability due to changes in concentration of bridging and non-bridging oxygens. For the $30Li_2O$-$4MoO_3$-$(66-x)TeO_2$-xV_2O_5 glasses, the variation of AC conductivity with V_2O_5 showed a non-linear increase for $x \leq 0.6$ mol% before decreasing to a minimum at 0.8 mol% V_2O_5. The decrease in σAC is attributed to some forms of blocking effect on Li+ ions caused by the mixed ionic-electronic (MIE) effect. Meanwhile, dielectric constant showed a general increase for $x \leq 0.6$ before an anomalous decrease at x = 0.8 mol% V_2O_5, which was followed by a large increase at x > 0.8 mol%. The decrease at x = 0.8 mol% coincided with the σAC drop at the same location. This decrease was also suggested to be related to the MIE that induced a blocking effect, which caused the restricted dipole movement. Meanwhile, DC conductivity showed initial weak increase for $x \leq 0.6$ mol% V_2O_5 before decreasing sharply at x = 0.8 mol% followed by a large increase for x > 0.8 mol%. Independent longitudinal modulus (CL), shear modulus (μ) and related elastic modulus also exhibited non-linear behavior where their values decreased to a minimum at x = 0.8 mol% before increasing beyond x = 0.8 mol% with the addition of V_2O_5. The decrease in elastic modulus for $x \leq 0.8$ mol% indicated a decrease in stiffness and rigidity of the glasses due to increase in non-bridging oxygen (NBO) contributed by TeO_3 and MoO_3 which weakened the glass network. Subsequently, a large increase at x > 0.8 mol% is suggested to be due the increase in BO contributed by VO_5 together with the formation of strong covalent V-O bond. The anomalous region at x = 0.8 mol% which coincided with the DC conductivity minimum region is suggested to be related to the (MIE) effect. Meanwhile, in the same region, optical band gap (E_{opt}) and refractive index (n) exhibited an off-trend behavior indicating variation in polarizability due to changes in concentration of bridging and non-bridging oxygen.