

A Research of Transition Metal Ions Doped Using Sodium Borate Glass

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Abstract – Borate glasses are the technologically important class of glasses and play a significant role in various applications. A host of borate rich glasses containing alkali and alkaline earth fluorides as glass modifiers are optimistic materials for their probable applications in the field of optical communications, laser hosts, optical filters, photonic devices, and so forth. For many years, glasses containing transition metal ions have attracted attention because of their potential applications in electrochemical, electronic and electro-optic devices. Optimization of optical properties of glasses is a very important task prior to their application for optical devices. Optical spectroscopy is an important and mandatory tool for understanding the structure and dynamics of glassy amorphous materials.

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INTRODUCTION

Ultrasonic non-damaging characterization of materials is a flexible apparatus for exploring the change in microstructure, disfigurement process and mechanical properties of materials over a wide scope of temperatures (Krauthramer et al., 1993). This is conceivable because of the nearby relationship of the ultrasonic waves with flexible and inelastic properties of the materials. It is additionally because of the accessibility of various recurrence run and numerous methods of vibration of the ultrasonic waves to test into the full scale, smaller scale and submicroscopic levels (Rajendran et al., 2003).

There is an expanding enthusiasm for the measurement of flexible properties of solids utilizing ultrasonic methods, due to their non-ruinous nature. Flexible and acoustical properties of glasses are critical from the perspective of their application in unique gadgets (Truell et al., 1965). The principle explanation behind broad ultrasonic examinations of solids is the requirement for versatile properties of materials like gems, amalgams, plastics, earthenware production, and glasses, etc in an assortment of uses. The more seasoned static and dynamic methods of measuring versatile constants of huge examples have increased wide acknowledgment because of their effortlessness. Among the different more up to date procedures pulse reverberation methods are helpful where measurements of most astounding exactness are required.

The measurement of flexible constants of solids in of impressive intrigue and critical to both science and innovation. This measurement yields significant data in regards to the powers employable between the

particles or particles in a strong, since the flexible properties depict the mechanical conduct of materials, this data is of crucial significance in deciphering and understanding the idea of holding in the strong state, when a material is exposed to a pressure it will get most grounded and inside as far as possible pressure connected on a materials is straightforwardly corresponding to strain (Hookes law). The proportionality consistent relating the anxiety is the modulus of versatility or the flexible steady normally there are three kinds of flexible constants (vijoy et al., 2001). They are (I) Young's modulus (Y) (ii) Bulk modulus (K) and (iii) Rigidity or shear modulus (G).

The consistently expanding enthusiasm for the examination of glasses is propelled by their across the board viable application and the way that they show various abnormal physical properties, which recommend explicit auxiliary singularities that separate the shiny condition of issue from the crystalline just as the normal undefined state up until now, in any case, a bound together hypothesis of lustrous condition of issue has neglected to rise, thus the particular structure of glasses keep on being not exactly completely comprehended. These particular qualities are very articulated, specifically, in the acoustical properties of glasses, basically, in the sythesis and temperature reliance of the speed and assimilation of ultrasonic waves (Hopkins et al., 1965, Kulbitskaya et al., 1976). Hence a large number of productions have been dedicated to the examination of glasses by ultrasonic methods. Flexible properties are exceptionally enlightening about the structures of solids and they are straightforwardly identified with the interatomic possibilities. Glasses being isotropic and have just

two autonomous flexible steady: longitudinal and shear versatile moduli. These two parameters are acquired from the longitudinal and shear sound speeds and thickness of the glass. The remainder of the flexible constants (mass, Young's modulus, and Poisson's ratio) could be found. Versatile moduli values of unadulterated, double progress and back earth and multi segment tellurite glasses including halide and oxyhalides, hydrostatic and uniaxial weight conditions of ultrasonic waves in these glasses at room temperature have been estimated already (El-Mallawany et al., 2002, Lambson et al., 1984, Sidky et al., 2002, El-Mallawany et al., 2006).

Flexible properties of solids are extremely noteworthy, in light of the fact that their measurement gives data with respect to the powers that are acting between the constituent molecules of a strong. This is significant in deciphering and understanding the idea of holding in the solids and non-ruinous nature of the strategy. Along these lines, the decision of fitting strong material for a specific reason requires data about its mechanical properties. Thus, versatile properties are appropriate for portraying the glass structure as a component of creation (Venkata et al., 2009). The most significant piece of the investigation on the soluble base borate glasses demonstrates non-direct conduct, which has applications in strong state gadgets, cathode materials for batteries, gas and substance sensors, electro-compound, electric and electro-optical gadgets (Raghavendra et al., 2011). New shiny materials from salt borate glasses with high ionic conductivity are getting significant consideration as a result of their special properties and their potential applications (Ramadevudu et al., 2000). The job of Na₂O in the B₂O₃ system is to change the host structure through the change of the auxiliary units of the borate arrange from [BO₃] to [BO₄]. Borate glasses containing antacid particles have been contemplated widely due to their innovative applications in strong electrolytes (Angell et al., 1983). Among soluble bases, little size, light weight and very electropositive character of Li⁺ and Na⁺ particles are considered as elements which offer ascent to high voltages and high energy densities (Angell et al., 1990). Soluble base borate glasses are outstanding because of their high straightforwardness, low softening point, high warm soundness, and great uncommon earth particle dissolvability (Soga et al., 1988, Kaczmarek et al., 2002). Be that as it may, enthusiasm for these glasses is restricted as laser has because of their high phonon energy. All things considered, the expansion of some change metal oxide like WO₃ to Na₂O-B₂O₃ glass makes them more dampness safe, and the phonon misfortunes can likewise be limited to an enormous degree. Tungsten-containing glasses have been read for the great properties of tungsten particles, for example, high electro-antagonism, polarizability, enormous particle span, and alterable valance (Sheoran et al., 2011, Pisarska et al., 2011). An audit of writing shows that endeavors have been made to think about the auxiliary and physical properties of xLi₂O-(30-x)Na₂O-10WO₃-

60B₂O₃ through IR (Edukondalu et al., 2013) notwithstanding, as far as we could possibly know, no ultrasonic investigation has been made on this sort of sodium borate glasses at room temperature. Consequently the target of the present ultrasonic based examination is to have a deliberate report on the characterization of the sodium borate glasses doped with lithium oxide and tungsten trioxide for various sythesis . The auxiliary formula for boron trioxide, sodium oxide, lithium oxide and tungsten trioxide are given as Fixed temperature. The versatile properties, longitudinal modulus, shear modulus, Young's modulus, mass modulus and Poisson's ratio together with the microhardness, mellowing temperature, and Debye temperature were observed to be fairly touchy to the glass sythesis (Hesham et al., 2007)

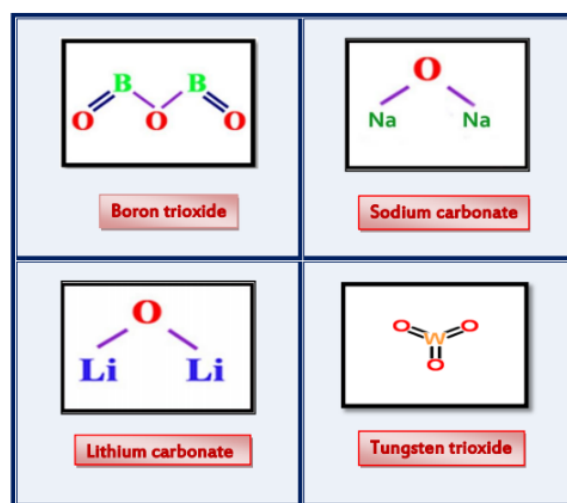


Figure 1 Flexible properties

EXPERIMENTAL

Sample Preparation and XRD Measurement-

The glass tests of the formula 20Na₂O-(80-x)B₂O₃-xLi₂O and 20Na₂O-(80-x) B₂O₃-xWO₃ (where x = 0 to 10 in ventures of 2 mol%) have been set up by the regular dissolve extinguishing system. Required amounts of investigative evaluation of Na₂CO₃, B₂O₃, Li₂CO₃ and WO₃ were acquired from E-merck, Germany and Sd-fine synthetic compounds, India. The correct organizations were combined by crushing the blend over and again to get a fine powder. The blend is dissolved in alumina cauldron at about 1053K for 45 minutes to homogenize the liquefy. The liquefy was immediately extinguished by pouring on to a copper plate and covering with another plate and the irregular bits of tests subsequently framed were gathered. At that point the glass tests were tempered at 573K for two hours to maintain a strategic distance from the mechanical strains created during the extinguishing procedure. The examples arranged were artificially steady and non-hygroscopic. The readied glass tests were cleaned and the surfaces are made

impeccably plane and smoothened by precious stone

Table 1 Nomenclature of prepared glass samples.

SAMPLE NO.	NOMENCLATURE	COMPOSITION IN MOL %	REMARKS
Plate I 1	Na ₂ O - B ₂ O ₃ NB	Na ₂ O - B ₂ O ₃ 20 - 80	Mol % of Na ₂ O is constant
Plate II	Na ₂ O-B ₂ O ₃ - Li ₂ O	Na ₂ O-B ₂ O ₃ - Li ₂ O	
1	NBL 1	20 - 78 - 02	
2	NBL 2	20 - 76 - 04	
3	NBL 3	20 - 74 - 06	
4	NBL 4	20 - 72 - 08	
5	NBL 5	20 - 70 - 10	
Plate III	Na ₂ O-B ₂ O ₃ -WO ₃	Na ₂ O-B ₂ O ₃ -WO ₃	
1	NBW 1	20 - 78 - 02	
2	NBW 2	20 - 76 - 04	
3	NBW 3	20 - 74 - 06	
4	NBW 4	20 - 72 - 08	
5	NBW 5	20 - 70 - 10	

disc and diamond powder. Nomenclature of prepared glass samples and shown in the Table 1. Thickness of the glass samples are measured using digital vernier caliper (MITUTOYO DIGIMATIC CALIPER) with an accuracy of 0.0001 mm.

X-ray Diffraction-

The undefined idea of glass tests was affirmed by X-beam diffraction system utilizing a x-beam diffractometer (MODE: PW3040/60 X'PERT PRO).

Measurement of Density-

The density of the glass tests at room temperature was estimated utilizing Archimedes rule. The xylene was utilized as a drenching liquid. The density was determined utilizing the formula

$$\rho = a / (a - b) \times \rho_x$$

where **a** and **b** are the weight of the samples in air and in xylene. ρ_x is the density of xylene at 308.15 K.

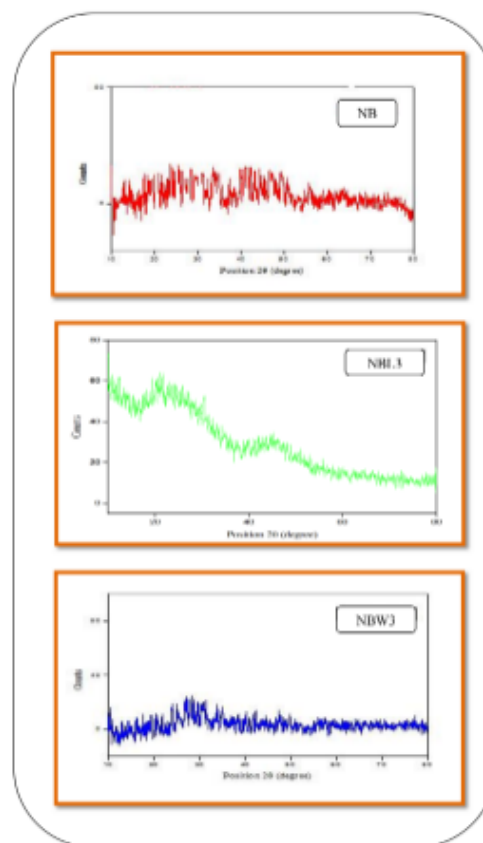


FIG. 2. XRD Profile of glass sample of NB, NBL3 and NBW3.

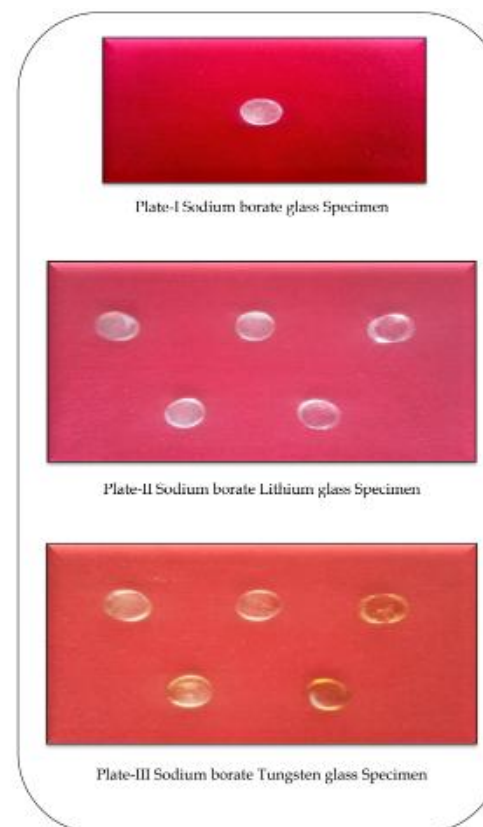


Figure 3 Measurement of Density

Measurement of velocity-

The ultrasonic longitudinal and shear speeds of the examples were dictated by utilizing the customary pulse-reverberation methods at room temperature by utilizing 5MHz X-cut and Y-cut transducers. These transducers went about as the two transmitters and receivers of the ultrasonic pulse. The transducers were carried into contact with every one of the thirteen examples by methods for a couplant, so as to guarantee that there was no air void between the transducer and the example. Couplant ultrasonic sound gel was utilized for longitudinal waves while nectar was utilized for shear waves. By applying consistent weight on the test the reverberation wave structures were acquired on the presentation unit and put away in the memory. Figs. 2&3 show one such reverberation wave structure acquired for longitudinal and shear waves.

The PC controlled pulse reverberation framework utilized for the measurements had two software's, one for putting away the information as observed on the screen and the second for breaking down the equivalent. These products were modified so that by simply bolstering the thickness of the example and the recurrence of the ultrasonic waves, the presentation unit will demonstrates the sufficiency, weakening and speed of the

Longitudinal and shear waves

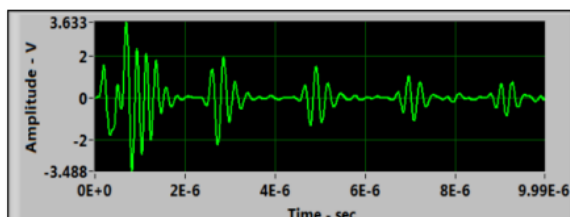


Fig. 4. Longitudinal wave form

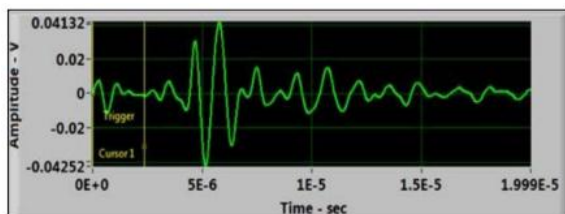


Fig. 5. Shear wave form

Ultrasonic wave having the particular frequency and thickness. Ultrasonic velocity was also calculated using the relation

$$U = \frac{2d}{t}$$

Where, U is the ultrasonic velocity of the specimen (ms-1), d, thickness of the specimen (mm) and t, transit time in micro seconds.

Measurement of Attenuation-

A method dependent on the possibility of pulser-receiver framework is utilized to ascertain the lessening of the ultrasonic waves engendered in the tried glasses. The ultrasonic weakening is acquired from the measurement of adequacy rot of progressive echoes saw on the screen.

The constriction coefficient of the example in neper per unit length is acquired from the relation

$$I = I_0 e^{-\alpha d}$$

Where d is the thickness of the example, I_0 and I are the ratios of abundance of the two progressive echoes. The evaluated precision in the speed measurement is about 0.05% and that of the constriction measurements is about 5%.

THEORY AND CALCULATION

The versatile and warm properties of the glass examples were determined at room temperature by utilizing the deliberate values of density (ρ), longitudinal speed (U_l), shear speed (U_s) and weakening (α).

Longitudinal modulus (L)-

The ratio between longitudinally applied stress and the longitudinal strain (Bhattia *et al.*, 1973, Mason 1965) is obtained for longitudinal wave propagation as\

$$L = \rho U_l^2$$

Shear modulus (G)-

The shear modulus can be found from shear speed, which is found in materials that continue shearing powers (generally solids and thick liquids)as

$$G = \rho U_s^2$$

Bulk modulus (K)-

The ratio between bulk stress and bulk strain is obtained from the ultrasonic velocities as

$$K = L - \left(\frac{4}{3}\right) G$$

Poisson's ratio (σ) -

It is aphoristic that the flexible constants are altogether interrelated. In this manner, when the isotropic moduli are built up, Poisson's ratio (σ) may be calculated, as this is also a function of the ratio of the longitudinal and shear velocities. It is given by the relation

$$\sigma = \left(\frac{L - 2G}{2(L - G)} \right)$$

Young's modulus (E) -

This is defined as the ratio between unidirectional stress and the resultant strain and is given in terms of the ultrasonic velocities U_l and U_s as

$$E = (1 + \sigma) 2G$$

Acoustic impedance (z)-

The transmission and reflection of sound energy in the glass specimens was determined using the acoustical impedance

$$Z = U_l \rho$$

Internal friction (Q^{-1}).

The attenuation co-efficient and U_l are related to internal friction (Maynell *et al.*, 1972) in a material for a given frequency by the relation

$$Q^{-1} = \frac{\alpha}{8.66 \pi f U_l}$$

where, α - attenuation coefficient and f -frequency of the quartz crystal

Micro hardness (H_v)-

Micro hardness is given by

$$H_v = (1 - 2\sigma) \frac{E}{6(1 + \sigma)}$$

Debye temperature (θ_D) -

The Debye temperature (θ_D) of the sample is calculated from the Relation

$$\theta_D = \frac{h}{K_B} \left(\frac{9N}{4\pi V_m} \right)^{1/3} U_m$$

where, h , K_B , N , V_m and U_m are the Planck's constant (6.626×10^{-34} Js), the Boltzmann's constant (1.38×10^{-23} JK⁻¹), the Avogadro's number (6.023×10^{23} mol⁻¹), the molar volume and mean sound velocity of the sample respectively where

$$U_m = \left[\frac{1}{3} \left(\frac{2}{U_s^3} + \frac{1}{U_l^3} \right) \right]^{-1/3}$$

Thermal expansion coefficient (α_p)-

Thermal expansion coefficient can be obtained (Padakis *et al.*, 1976) as

RESULTS AND DISCUSSION

The experimental values of density (ρ), longitudinal ultrasonic velocity (U_l), shear ultrasonic velocity (U_s), and attenuation (α) of the sodium borate glasses with respect to the change in mol percentage of Li₂O and WO₃ used as network modifier (NWM) are listed in the

Table 2. The calculated values of longitudinal modulus (L), shear modulus (G), bulk modulus (K), Young's modulus (E), Poisson's ratio (σ), acoustic impedance (Z), internal friction (Q^{-1}), microhardness (H), Debye temperature (θ_D) and thermal expansion coefficient (α_p) are presented.

The X-beam diffraction designs (Fig. 1) of the contemplated glass frameworks uncovers the nonappearance of any discrete or ceaseless sharp crystalline pinnacles, yet show homogenous shiny characters.

The density is an amazing asset fit for investigating the adjustments in the structure of glasses. The density is influenced by the auxiliary mellowing/smallness, change in geometrical configuration, coordination number, cross-connect density and measurement of interstitial spaces of the glass (Yasser *et al.*, 2009). The density values (Fig. 4) were found to diminish with direct substitution of Li₂O and WO₃ by B₂O₃, Na₂O. This abatement in density values was proposed, because of the slight diminishing in the B₂O₃ mol% content and the slight increment of WO₃ and Li₂O as appeared in table 2,

which means the expansion in the measure of modifiers' substance related with boron ions and thusly the lessening in dimensionality of borate system structure (Gaafar et al., 2013). The density values of NBL glass framework are a lot higher than that of NBW glasses. Further, it is seen from the Figs. 5&6, the values of longitudinal speed (U) and shear speed (Us) are expanding with expanding of Li₂O substance, and the equivalent has diminished with expanding of WO₃ substance, however the pace of increment of U is more prominent than that of Us. The speed increments straightly with expanding Li₂O content, and credited this expansion to an expansion in the three-dimensional linkage and unbending nature of the glass organize (Yasser et al., 2004). The expansion of ultrasonic speeds is identified with the reduction in the quantity of non-spanning oxygens and thus the expansion in availability of the glass organize (Samir et al., 2009). All in all, the lessening of ultrasonic speed is identified with the expansion in the quantity of non-crossing over oxygen's and therefore the reduction in availability of the glass organize (Marzouk et al., 2007). Further, the flexible moduli and lessening investigates more data about the auxiliary changes and steadiness of the glass organize (Nishara Begam et al., 2007). The lessening coefficient portrays the all-out decrease in the power due to

Table 2 Measured values of density (ρ), longitudinal velocity (U), shear velocity (U_s) and attenuation (α) of NB, NBL, and NBW glasses at room temperature.

Sample	Density ρ	Ultrasonic Velocity U/(m.s ⁻¹)		Attenuation
Label	/(×kg. m ⁻³)	Longitudinal (U)	Shear (U _s)	α . /(nepers.unit length ⁻¹)
Na ₂ O-B ₂ O ₃ (NB)				
	1353.6	5209.30	2786.06	44.88
System 1 : Na ₂ O-B ₂ O ₃ -Li ₂ O (NBL)				
1	1323.0	5485.44	2942.70	50.88
2	1309.9	5756.10	2994.92	51.58
3	1302.5	6020.94	3026.16	52.56
4	1204.7	6084.66	3074.87	71.00
5	1184.9	6250.00	3108.10	72.85
System 2 : Na ₂ O-B ₂ O ₃ -WO ₃ (NBW)				
1	1322.2	4919.15	2947.37	65.99
2	1261.0	4869.57	2879.58	57.91
3	1252.4	4695.65	2833.33	50.82
4	1224.9	4675.21	2813.57	38.39
5	1155.2	4641.35	2790.87	35.20

Table 3. Values of elastic moduli and Poisson's ratio of NB, NBL and NBW glasses at room temperature

Sample	Longitudinal Modulus L/(×N. m ⁻²)	Shear Modulus G/(×N. m ⁻²)	Bulk Modulus K/(×N. m ⁻²)	Young's Modulus E/(×N. m ⁻²)	Poisson's Ratio (σ)
Na ₂ O-B ₂ O ₃ (NB)					
	3.6732	1.0507	2.2723	2.7311	0.2997
System 1 : Na ₂ O-B ₂ O ₃ -Li ₂ O (NBL)					
1	3.9808	1.1457	2.4534	2.9740	0.29880
2	4.3401	1.1749	2.7735	3.0886	0.3144
3	4.7218	1.1928	3.1314	3.1752	0.3310
4	4.4602	1.1390	2.9415	3.0264	0.3285
5	4.6285	1.1447	3.1023	3.0579	0.3357
System 2 : Na ₂ O-B ₂ O ₃ -WO ₃ (NBW)					
1	3.1990	1.1486	1.6675	2.8023	0.2199
2	2.9902	1.0456	1.5960	2.5746	0.2311
3	2.7614	1.0054	1.4209	2.4528	0.2198
4	2.6773	0.9697	1.3844	2.3584	0.2161
5	2.4886	0.8998	1.2888	2.1898	0.2168

Table 4 Values of acoustic impedance (Z), internal friction (Q⁻¹), microhardness (H_v), Debye temperature (θ_D) and thermal expansion coefficient (α_p) of NB, NBL and NBW glasses at room temperature.

Sample	Acoustic Impedance	Internal Friction	Micro Hardness	Debye Temperature	Thermal Expansion Coefficient
Label	Z/(×kg. m ⁻² s ⁻¹)	(Q ⁻¹) / (×dB.s ⁻²)	Hv / (×N.m ⁻²)	θ_D / (K)	α_p / (×m. m ⁻¹)
Na ₂ O-B ₂ O ₃ (NB)					
	0.7051	2.1683	1.4032	296.60	1208.42
System 1 : Na ₂ O-B ₂ O ₃ -Li ₂ O (NBL)					
1	0.7257	3.4110	1.5431	298.62	1273.49
2	0.7540	3.2954	1.4538	303.44	1335.28
3	0.7843	3.2103	1.3439	306.67	1396.73
4	0.7330	4.2912	1.3021	309.00	1411.51
5	0.7406	4.2865	1.2536	322.92	1449.87
System 2 : Na ₂ O-B ₂ O ₃ -WO ₃ (NBW)					
1	0.6504	4.9333	2.1448	292.34	1141.11
2	0.6141	4.3734	1.8742	227.90	1129.61
3	0.5881	3.9801	1.8780	268.85	1089.26
4	0.5727	3.0197	1.8353	261.86	1084.52
5	0.5362	2.7890	1.6986	260.75	1076.66

Assimilation of energy by the medium and the diversion of energy from the way of the pillar by reflection, refraction and dispersing. The measurement of weakening of ultrasonic waves in the glass framework is the loss of energy during the propagation in the medium (Palani et al., 2014). Paper demonstrates the values of lessening are expanding with expanding of Li₂O concentrations, and it diminishes with expanding of WO₃ concentrations which affirms the fortifying idea of these glasses as recommended from the arrangement reliance ultrasonic speeds (El. Abd et al., 2006). The lessening in the ultrasonic constriction α might be ascribed to the abatement of the W-O ionic bonds. This is presumably ascribed to the increments in the cross-interface density in glasses because of presentation of tungsten particles with a coordination number six.

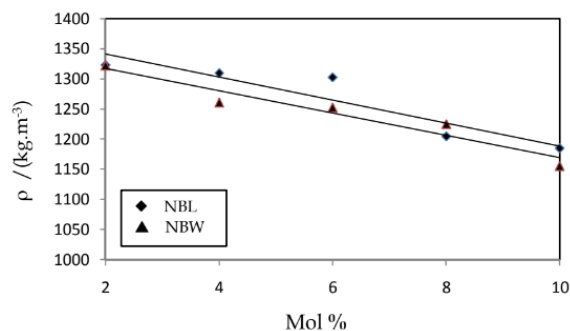


Fig. 6. Variation of density with mole percentage of Li₂O/WO₃ in sodium borate glass.

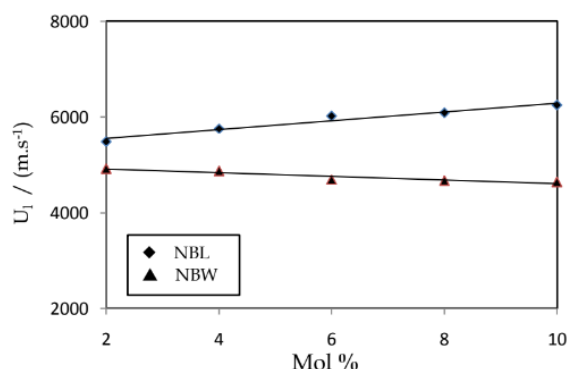


Fig. 7. Variation of longitudinal velocity with mole percentage of Li₂O/WO₃ in sodium borate glass.

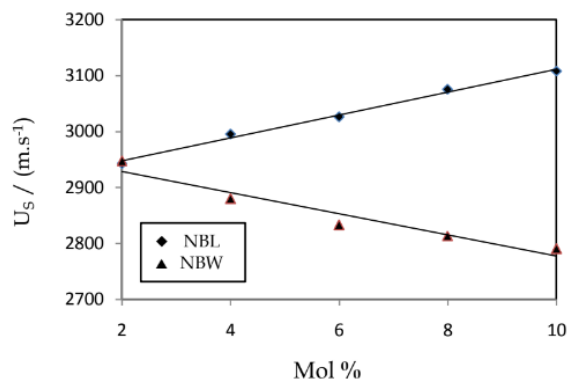


Fig. 8. Variation of shear velocity mole percentage of with Li₂O/WO₃ in sodium borate glass.

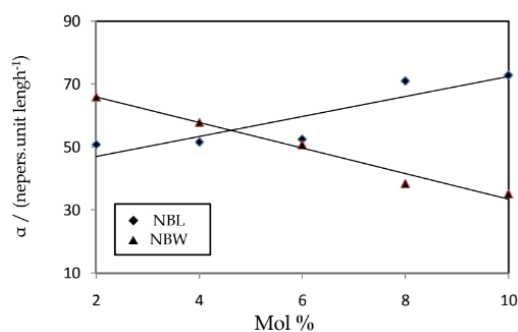


Fig. 9. Variation of attenuation mole percentage of with Li₂O/WO₃ in sodium borate glass.

The adjustments in the idea of the synthetic security and the security quality in the glass structure are typically joined in youthful's modulus which can decide the break conduct associated with the glasses. Then again, the mass modulus is progressively touchy in investigating the adjustments in the cross-interface density and bond extending power consistent (Yasser et al., 2005). Likewise, having the most elevated electro cynicism (Pauling), the Li-O compound bond displays the most unmistakable covalent character. Every one of these information affirm the way that of all antacid particles Li⁺ presents the best limit of associating with oxygen particles (Radu et al., 2004). The variety of longitudinal, shear, mass and Young's moduli (Figs. 9-12) increments with increment in concentration of Li₂O and, it diminishes with expanding of WO₃ concentrations. The conspicuous declines in versatile moduli are because of the constant decrease in the unbending nature of glass tests (El-Mallawany et al., 2006). The flexible properties of covalent systems are extremely delicate to average coordination number; for example high-coordination-bond systems structure moderately hard glasses, and their flexible moduli are dictated by covalent powers, while low-coordination security systems structure generally delicate glasses, and their versatile moduli are controlled by longer-go powers. The ring development of WO₃ with boron is diminished sodium particles conceivably attempt to change the ring-like structure into littler ring development, causing a reduction in flexible moduli (Pakade et al., 1995).

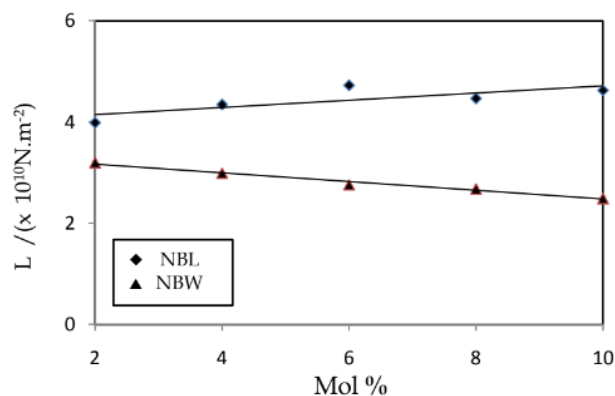


Fig. 10. Variation of longitudinal modulus mole percentage of with Li₂O/WO₃ in sodium borate glass.

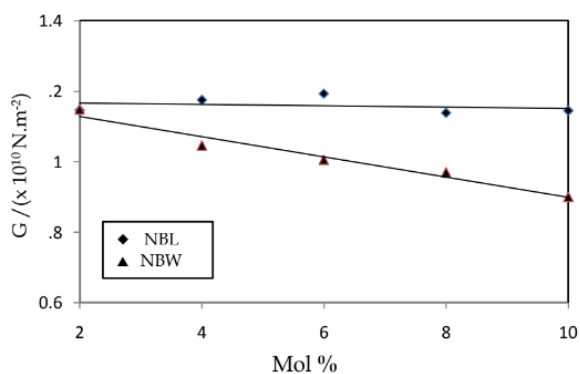


Fig. 11. Variation of shear modulus mole percentage of with $\text{Li}_2\text{O}/\text{WO}_3$ in sodium borate glass.

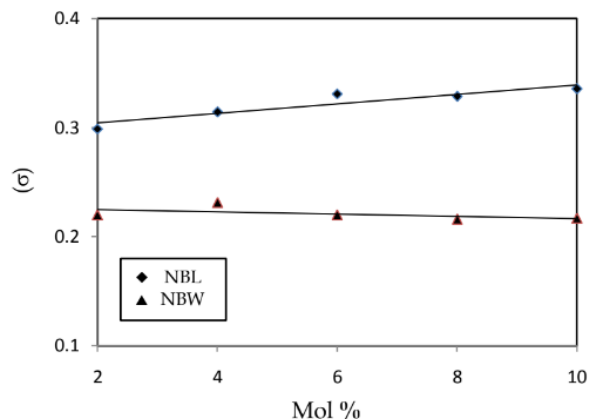


Fig. 14. Variation of Poisson's ratio mole percentage of with $\text{Li}_2\text{O}/\text{WO}_3$ in sodium borate glass.

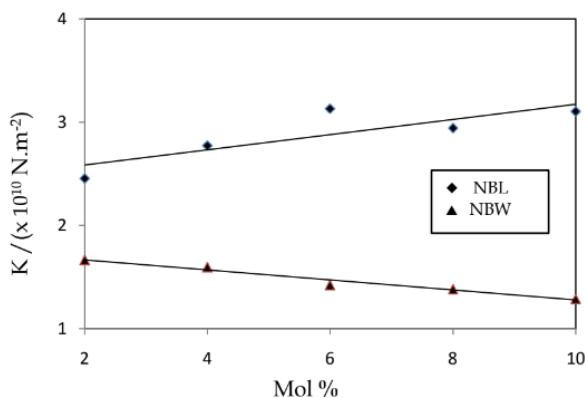


Fig. 12. Variation of bulk modulus mole percentage of with $\text{Li}_2\text{O}/\text{WO}_3$ in sodium borate glass.

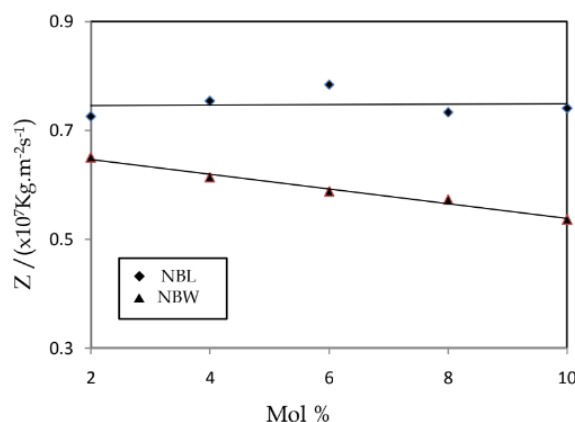


Fig. 15. Variation of acoustic impedance mole percentage of with $\text{Li}_2\text{O}/\text{WO}_3$ in sodium borate glass.

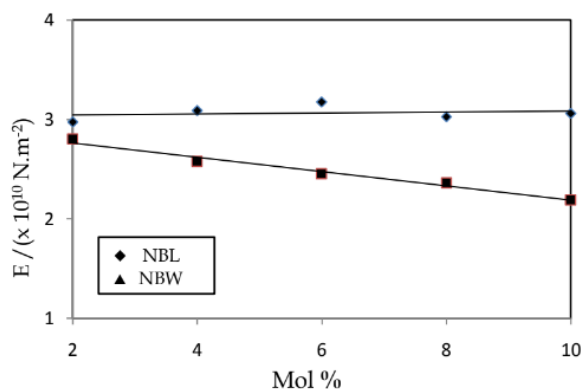


Fig. 13. Variation of young's modulus mole percentage of with $\text{Li}_2\text{O}/\text{WO}_3$ in sodium borate glass.

Boron particles structure in borate glasses auxiliary units BO_3 with three-composed boron iota and BO_4 with four-facilitated boron molecule (Kouldeka et al., 2000). It is notable that the impact of presentation of soluble base metal oxides in B_2O_3 glass is the conversion of SP^2 planer BO_3 units into increasingly stable SP^3 tetrahedral BO_4 units. Each BO_4 unit is connected to two such different units and one oxygen from every unit with a metal particle and the structure prompts the arrangement of long tetrahedron chains. WO_3 is modifier oxide and enters the glass arrange by separating the irregular system. Regularly the oxygens of these oxides break the nearby symmetry while the cations (W^{6+} particles) take the interstitial positions. The monotonic diminishing in versatile moduli derives the nonattendance of basic stage changes (Rajendran et al., 2001) and more manifestations of NBO. Poisson's ratio can be clarified based on the impact of tractable weight on an arranged chain of iotas or particles. On the off chance that strain is horizontal to the chain, its impact is maximum for most reduced cross-joins. (Rajendran et al., 2003) detailed that Poisson's ratio is influenced by the adjustments in the cross-interface density of the

glass organize, and the structure with high cross-connect density have Poisson's ratio in the request of 0.1-0.2, while structures with low cross-connect density have Poisson's ratio in the request of 0.3-0.5. In the examined glass framework, the values of Poisson's ratio (Fig. 13) are increments with expanding of Li₂O and it turns around in WO₃ glasses. Further, these values are changing from 0.2 to 0.3. The reduction in Poisson's ratio is because of creation of system linkages and arrangement of littler auxiliary units in the glass tests (Pakade et al., 1995). Further, an expansion in cross-connect density prompts a decline in Poisson's ratio and strives versa. Further, the expansion in acoustic impedance and inside grating (Fig. 14&15) is because of the expansion in minimization and inflexibility of the structure of the Li₂O contrasted with WO₃ glass. The conduct of inside erosion is a proportion of warmth delivered with in a material by change of mechanical strain energy, when it is exposed to fluctuating pressure. The littler values of inward erosion demonstrate the more slow nuclear or sub-atomic developments. The nonstop reduction in microhardness, Debye temperature and warm extension coefficient saw in WO₃ glasses (Figs. 16&17) uncovers the nearness of Non-connecting oxygen particle (NBO) and this causes the development of delicate lustrous system (Yasser et al., 2005, Sidkey causes the arrangement of delicate smooth system (Yasser et al., 2005, Sidkey et al., 1990).

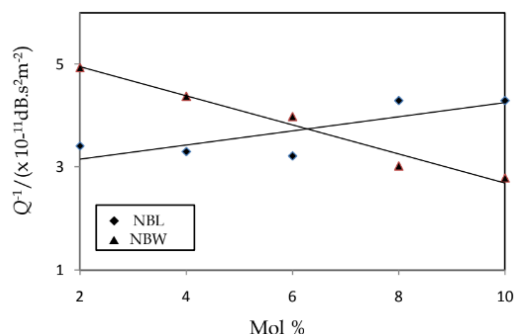


Fig. 16. Variation of internal friction mole percentage of with Li₂O/WO₃ in sodium borate glass.

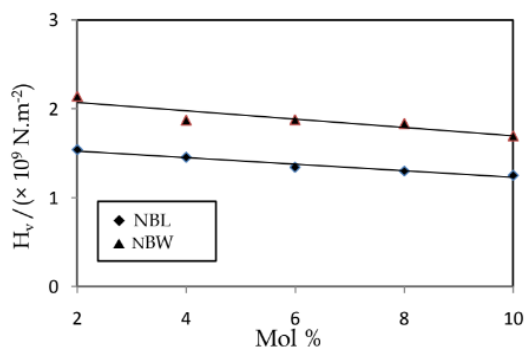


Fig. 17. Variation of microhardness mole percentage of with Li₂O/WO₃ in sodium borate glass.

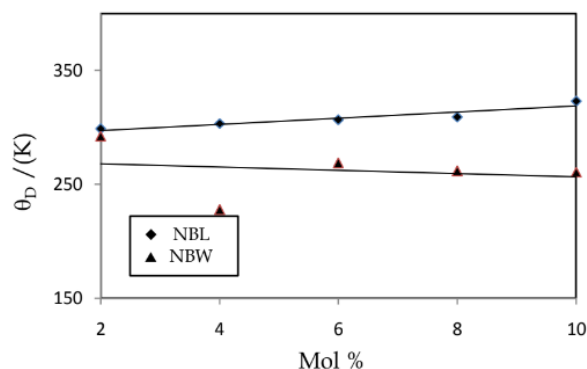


Fig. 18. Variation of Debye temperature mole percentage of with Li₂O/WO₃ in sodium borate glass.

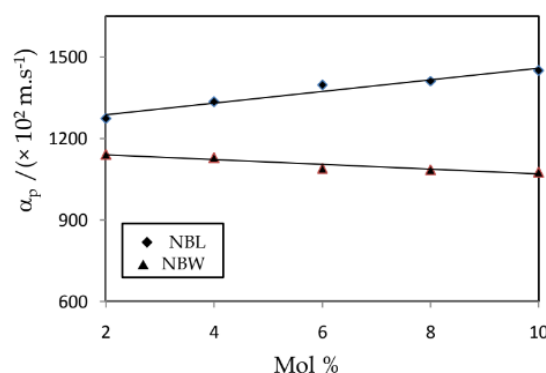


Fig. 19. Variation of micro hardness mole percentage of with Li₂O/WO₃ in sodium borate glass.

CONCLUSION

The versatile module of the 20Na₂O-(80-x)B₂O₃-xLi₂O and 20Na₂O-(80-x)B₂O₃-xWO₃ glass frameworks show numerous improvements with the dynamic expansion of Li₂O and WO₃. The improvements are ascribed to the expansion in the cross connection density, and the unbending nature of the glass organize. The diminishing in density of the glass examples demonstrates that it relies upon the nuclear load of the metal particle in the system modifier (NWM). The diminishing flexible moduli show a decrease in system unbending nature of the glass tests. It is commonly acknowledged that lithium and tungsten particle enter the glass structure initially in one valance state viz., Li⁺ and W⁶⁺. The assessed acoustical, versatile and mechanical properties of the lithium and tungsten doped with sodium borate glasses illuminate the unbending nature and smallness in basic system. In any case, the NBL arrangements of glass have higher unbending nature, quality and conservativeness of the glass organize over the NBW glasses.

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