Structural Properties Of Lithium-Lead-Borate Glasses.

H.Anil kumar[1],M.Sathish[2]

[1*]Department of Physics, GOVT first grade College, Magadi-562120
[2] Department of Physics, GOVT first grade College, Doddaballapur-561203

Abstract: $20Li_2O$-$20PbO$-$60B_2O_3$ glass have prepared by conventional melt quenching method. The SEM and X-Ray patterns have confirmed the vitreous state of this glass. The glasses were investigated by using mid transmission infrared spectroscopy technique. In order to obtain the information concerning network structure of the studied glass. Glass transition estimated from DSC measurement.

Keywords: SEM, XRD, FTIR, DSC.
PACS: 78.40.Pg, 61.43.Fs, 62.20, 62.20D.

INTRODUCTION

New glassy materials from alkali borate glasses with high ionic conductivity are receiving considerable attention because of their unique properties and potential applications [1].Alkali borate glasses form good glasses over a wide range of compositions [2]. A variety of anionic borate species, such as penta-, tri-, tetra-, di-, pyro- and orth-borate, besides structural entities like boroxol rings have been identified in glasses containg B_2O_3 and PbO [3] and belongs to unique amorphous solid state materials, which are thermally stable and are formed wide range of PbO concentrations. The large glass forming region is advantageous for manufacture of structurally and optically, different systems, which strongly depends on PbO- B_2O_3 ratio [4].

EXPERIMENTAL

The basic glass with composition $20Li_2O$-$20PbO$-$60B_2O_3$ was prepared by conventional melt quenching method. The X-ray diffraction pattern of the powdered sample was recorded using XPERT PRO diffractometer in which the K_α radiation of wavelength 1.54056A^o were generated at the Cu-anode. The scanning rate was 10^o/min. The IR spectra of the studied glass samples were recorded using a Perkin-Elmer double beam 598 spectrometer in conjunction with the Kbr data technique, over spectral range 4400-400cm^{-1} at room temperature. Surface morphology of the samples was investigated using SEM [model-LEO-440i (U.K)] with Magnification = 5.00KX. DSC measurements were carried out for all prepared samples with the commercial Netzsch Simultaneous Thermal Analyzer STA409C with 32-bit controller. It was performed in range from 0^0C to 550^0C with a heating rate of 1^0 C per minute.

RESULT AND DISCUSSION

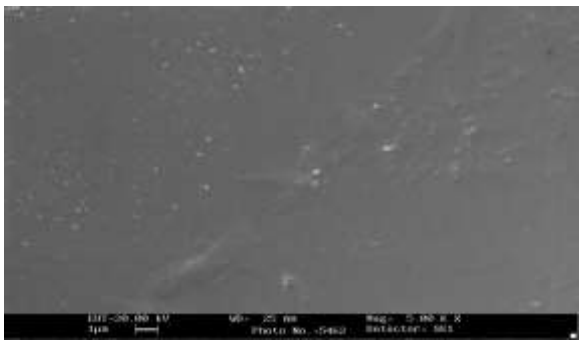

Fig.1 shows the typical SEM micrographs of the sample.

Fig. 1 shows the SEM micrograph of the sample.

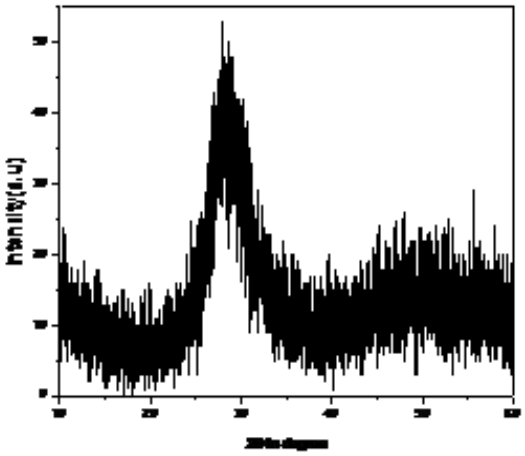

Fig.2 show the XRD spectra of the sample

X-Ray diffraction pattern did not reveal any crystalline phase in the prepared glass sample as shown in fig. 2 and did not show any sharp peaks in the spectra.It is confirmed that they are in amorphous nature.

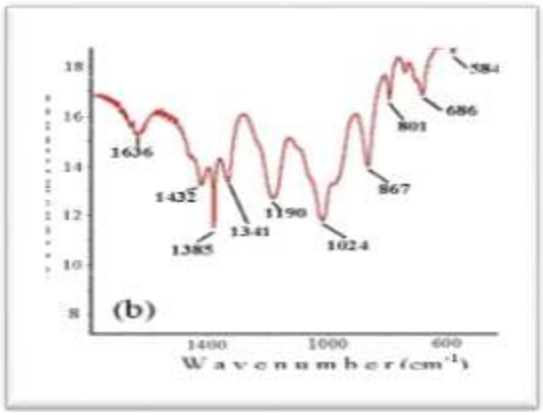

Fig.3 FT-IR spectra of the glass sample.

Fig.3 shows the FTIR spectra of glass recorded in the range 4400-400cm^{-1} along with the band assignments.

The quantum-chemical calculations of the IR spectra reveals that the proposed model for lead – borate glass network is an good agreement with the experimental IR data as shown in table.1.The evaluation of vibrational spectrum of the proposed model is important for understanding the broadening of-effect of the glass from the experimental FTIR spectrum.

In brief lead oxide may disrupt the bond connecting neighboring [BO_3] and [BO_4] groups and can be incorporated into the glass as network forming Pb-O groups([PbO_4] and / or[PbO_3]).Additional oxygen for the coordination requirement of lead oxide to form network–formers by a further molecule of lead oxide itself.

TABLE 1. FTIR wave numbers and assignments of the prepared glass**.**

Wavenumber (cm^{-1})	**Assignments**
708	**B-O-B** bending vibrations
1020	**B-O** stretching vibration of **BO_4** units in tri-, tetra- and penta- borate groups
1190	**B-O** stretching vibration of trigonal **BO_3** units in boroxol rings
1385	**B-O** stretching vibrations of **BO_3** units in meta- pyro- and ortho-borate groups

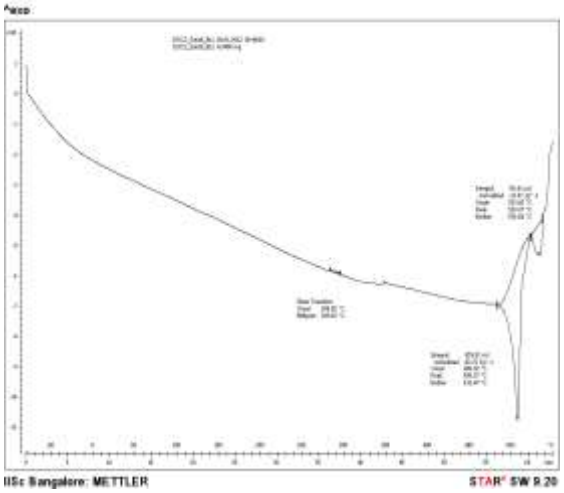

Fig. 4 show DSC spectra of glass

Fig.4 shows the DSC spectra of the prepared glass sample. The figure gives the information that the sample contains one exothermic hump corresponding to glass transition temperature (T_g) is order of 289.65^0 c and two endothermic humps corresponding to melting temperature(T_m).

CONCLUSIONS

XRD and SEM confine the amorphous phase of the prepared glass system. Our result show that the B-O and Pb-O stretching vibration region of the proposed model is similar to the same region of the glass. Then the vibrational modes corresponding to the [PbO_4], [BO_3] and [BO_4] geometries are significantly broadened in the disordered phase. We also suggest that the proposed model is the basic building block of the B_2O_3-PbO glass.

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