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Study of physical, structural and optical properties of MnO containing lithium borosilicate glasses

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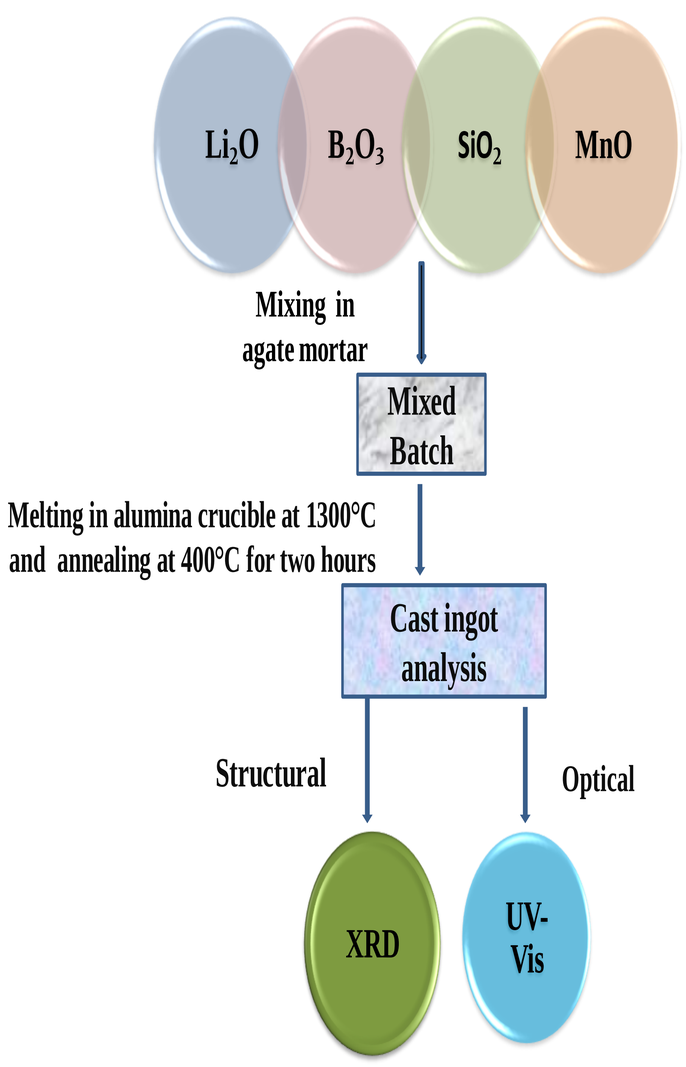
ABSTRACT

The glasses with composition xMnO-(20-x)Li_2O-50B_2O_3-30SiO_2 (where x = 4, 6, 8 and 10 mol %) were prepared via melt and quench technique. Structural and optical properties of the samples were investigated using X-ray diffraction (XRD) and UV- visible spectroscopy. Various physical parameters viz. density, molar volume, ionic concentration and inter-nuclear distance have been calculated. The density of the samples increases with increasing MnO content due to higher molar mass of MnO as compared to Li_2O whereas the molar volume decreases. The ionic concentration increases with the increasing content of MnO while the inter-nuclear distance decreases, which results in more compact boron network in borosilicate glasses. The XRD patterns confirm the amorphous nature of the glasses. The optical band gap of the glass samples decrease with increasing content of MnO whereas the Urbach energy increases. Urbach energy is highest for maximum concentration of MnO, which indicates the maximum disorder in that glass.

INTRODUCTION

Transition metal oxides (TMOs) are gaining attention due to their diverse physical, structural, and optical properties and can be used in dosimetery, thermoelectronics, magnetic materials, memory and optical switching etc. Among these systems, manganese oxides are widely studied and used in many applications like radiation dosimetry, paramagnetic probes, catalytic processes etc due to its occurrence in different valence states viz. Mn^{2+}, Mn^{3+} and partially filled d shell. The aim of present paper is to study the effect of MnO on physical, structural, and optical properties of Li_2O containing borosilicate glasses .

METHODOLOGY



RESULTS

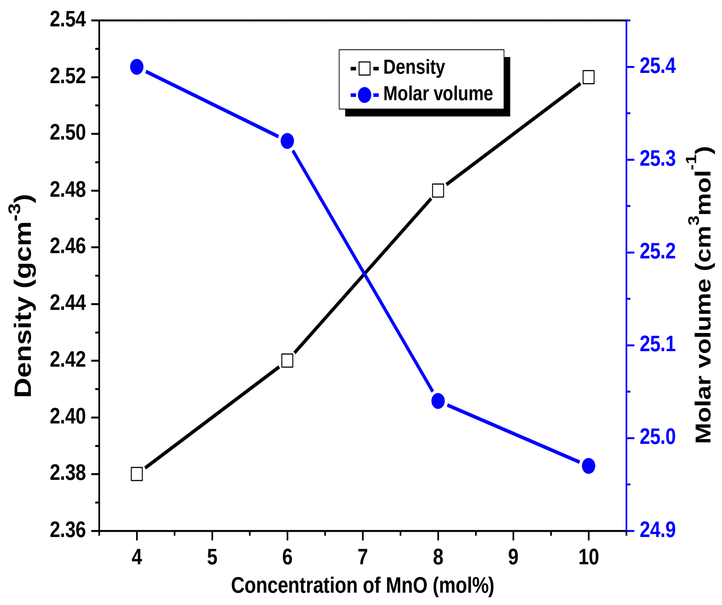


Fig. 1: Change in Density and Molar volume with MnO content

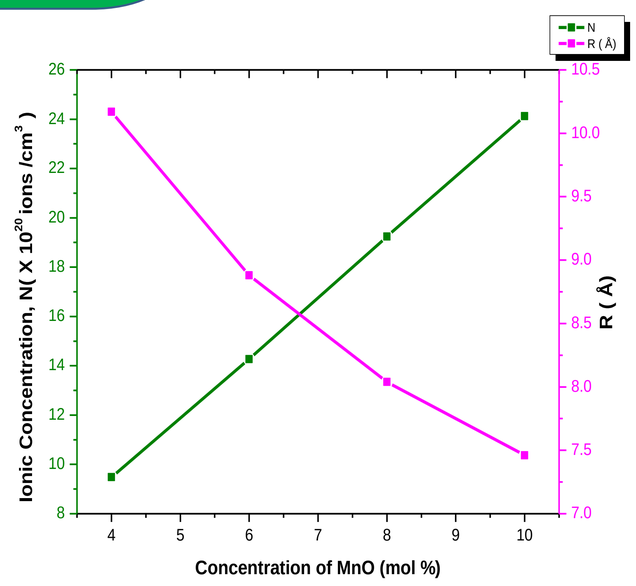


Fig. 2: Change in ionic concentration and interionic distance with MnO content

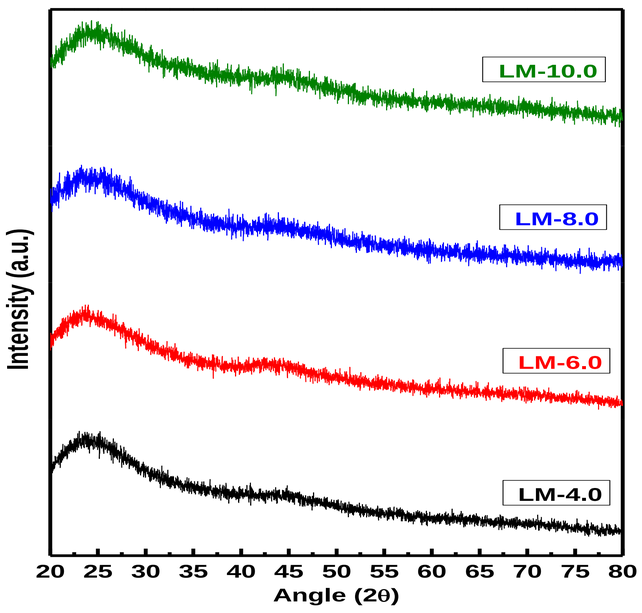


Fig. 3: XRD patterns of as - quenched samples

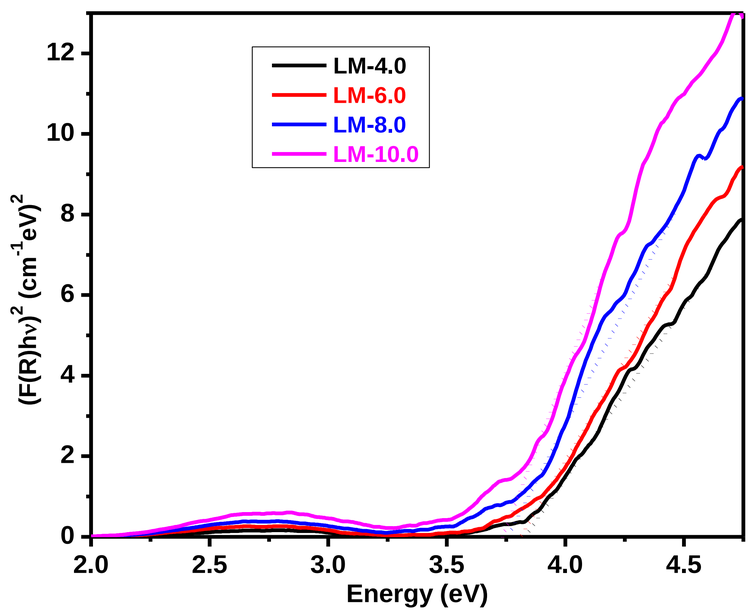


Fig. 4: Tauc's plots of as-quenched samples for optical band gap.

CONCLUSIONS

- ✓ **Density increases with increasing content of MnO where as the molar volume decreases, which can be due to higher molar mass of MnO (70.9374 g/mol) as compared to Li_2O (29.88 g/mol).**
- ✓ **Ionic concentration increases due to increase in NBOs whereas decrease in interionic separation supports decrease in molar volume.**
- ✓ **XRD patterns confirms the amorphous nature of the samples as sharp peaks are not observed.**
- ✓ **Optical band gap decreases with increasing MnO content which can be due to the increasing amount of non-bridging oxygens (NBOs).**
- ✓ **Urbach energy increases with increase in MnO content which indicates the increase in disorder of the as - quenched samples.**

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