SPECTROSCOPIC STUDIES OF Cr_2O_3 DOPED CALCIUM STRONTIUM SODIUM BORATE GLASSES

Dr. J. Lakshmi Kumari

Department of Physics, GVSM Govt Degree College,
Vulavapadu. Prakasam Dist., A.P., India
Email: drluckky@gmail.com

Received: Jul. 2019 Accepted: Aug. 2019 Published: Sep. 2019

Abstract: The **Cr_2O_3** borate (20-x)CaO-xSrO-(20-y)Na_2O-60B_2O_3-y(CSNB) (5≤x≤15) glasses doped with 0.1mol% of **Cr_2O_3** ions were prepared by the melt quench technique. The structural and optical analysis of glasses is carried out by X - ray diffraction (XRD), Electron Spin Resonance (ESR) Optical absorption Spectra and FTIR(Fourier transform Infrared Spectroscopy) techniques. ESR spectra of all the three glasses exhibit an intense absorption centered at g = 1.961, 1.979 and 2.014 respectively.

Keywords: XRD, ESR Spectrum, Chromium Ions, Borate Glasses.

Introduction: Glasses of the (20-x)CaO-xSrO-(20-y)Na_2O-60B_2O_3-y (CSNB) system with (5 <x <15) mol% and y = 0.1mol% of Cr_2O_3 were characterized by X-ray diffraction (XRD), ESR (Electron Spin Resonance), Optical absorption Spectra and FT-IR Studies. The ESR results indicate trigonal (C_{3v}) distorted octahedral symmetry. The Optical band energy (Eopt) and Urbach energy (ΔE) were calculated from their ultra violet edges. The IR studies shows that the glassy system contains BO_3 and BO_4 units in the disordered manner.

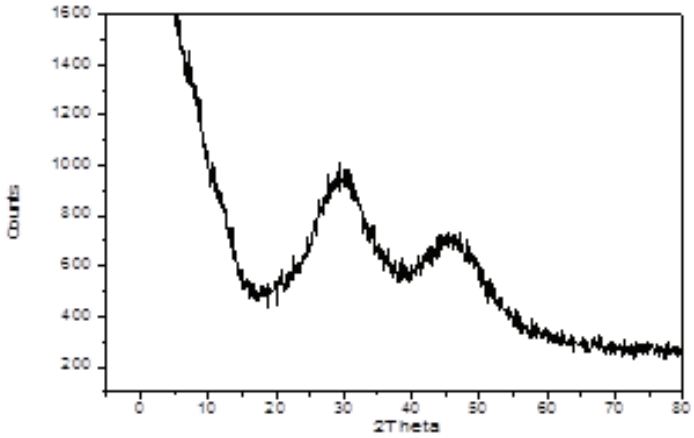

Fig. 1: XRD Pattern of Undoped (Cr_0) CSNB Glass

Experimental: The glasses used for the present study are prepared by the melting and quenching techniques [1, 3]. The starting materials used for the preparation of the present glasses were Analytical grade reagents (99.9 % pure) of CaO, B_2O_3, SrO, Na_2O, and Cr_2O_3. The compounds of required compositions were thoroughly mixed in an agate mortar and melted in a porcelain crucible. The furnace used was a PID temperature controlled furnace. The glasses were melted at about 940 - 980 ^oC for an hour till a bubble free liquid was formed. The resultant melt was poured on a rectangular brass mould (containing smooth polished inner surface) held at room temperature. The samples were subsequently annealed at 300^oC in another furnace. The glasses were then ground and optically polished. The approximate final dimensions of the glasses used for studying the electrical and optical properties are 1 cm x 1 cm x 0.2 cm of the glasses.

Results and Discussion:

X-Ray Powder Diffraction: The XRD pattern of the present glass system did not reveal any discrete or sharp peaks, but the characteristic humps of the amorphous materials. The amorphous nature of these glasses is confirmed by the X-ray diffraction technique.

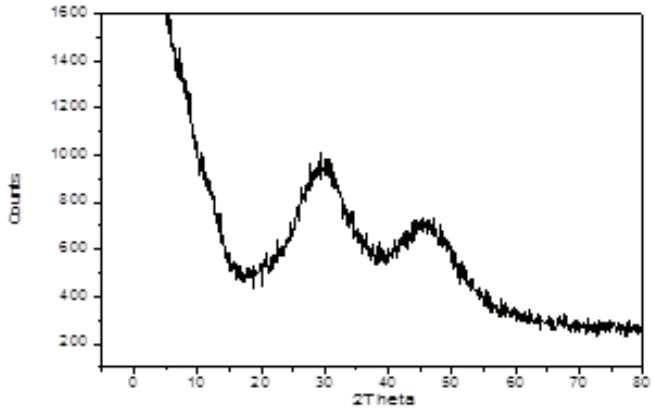

Fig. 1: XRD Pattern of Undoped (Cr_0) CSNB Glass

ESR Spectrum: ESR spectra of all the three glasses exhibit an intense absorption centered at g = 1.961, 1.979 and 2.014 respectively. The spectrum is attributed to the isolated Cr^{3+} ions and the high field portion (g ~ 2) mainly belongs to the exchange coupled pairs Cr^{3+} - Cr^{3+} ions.

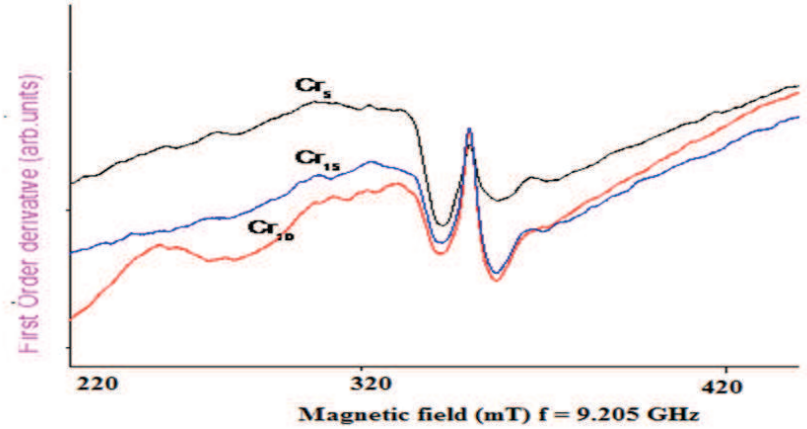

Fig. 2: ESR Spectrum of Cr_2O_3 Glass Systems

The Spectrum indicates the concentration of isolated Cr^{3+} ions increases from Cr_5 to Cr_{15} glasses. When X = 5CaO mol% and X = 15 SrO mol% the g value is high compared to Cr_5 and Cr_{10} glasses. Cr_{15} glass sample attribute to the isolated Cr^{3+} ions.

Conclusion:

1. From powder XRD pattern prepared glasses are in amorphous nature.
2. Optical absorption spectra exhibited different bands which are characteristic for Cr^{3+} ions in the host glasses.
3. The ESR spectra exhibit two resonance signals. They ascribed to Cr^{3+} (d^3) in trigonal (C_{3v}) distorted octahedral symmetry.

References:

1. D. K. Durga, N. Veeraiah, Phys. B 324 (2002) 127.
2. T. R. N. Kutty, Mat. Res. Bull. 25 (1990) 485.
3. V. R. Kumar, J. L. RaO, N. O. Gopal, J. Mater, Sci. 41 (2006) 2045.
4. A. Majchrowski, I. V. Kityk, J. Ebothe, Phy. Stat. Solidi (b), 241 (2004) 3047.
5. C. Laxmikanth, B. V. Raghvaiah, B. Appa Rao, N. Veeraiah, J. Lumin 109 (2004) 3047.
6. K. A. Murphy, J. E. Shelby, Phys. Chem. Glasses 44 (2003) 325.
7. S. V. G. V. A. Prasad, N. Veeraiah, Phys. Stat. Solidi 202 (2005) 812.
8. A. Ramesh Kumar, J. L. RaO, N. O. Gopal, J. Mater. Sci. 41 (2006) 2045.
9. M. F. Hazenkamp, A. C. Stickl, E. Cavalli, H.U. Gudel, Inorg. Chem. 39 (2000) 251.
10. G. Herzberg. Molecular spectra and Molecular structure, III (Van Nostrand Reinhold, New York, Cincinnati, Toronto, London, Melbourne (1966).

***

Dr. J. Lakshmi Kumari
Department of Physics, GVSM Govt Degree College,
Vulavapadu. Prakasam Dist., A.P., India
Email: drluckky@gmail.com