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Long Wave Length Absorption Edge in CuO-B2O3-Na2O-ZnO

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ABSTRACT

The Investigated glass system is xCuO-(50-X0)B_2O_3-30Na2O-2oZnO,where x=1,3,4,5,7and 10 mol.%. The investigated glass has been prepared by conventional melt Quenching technique. The optical measurements were measured by using JENWAY (6405UV/Visible) spectrophometer covering the wave length range from 190 to 11oo nm. From optical absorption spectrum the energy gap and band tail were measured for all glass samples by using truces equations.

Keywords : Borate Glass, Optical Transition Mechanism, Absorption Edge

I. INTRODUCTION

xCuO-(50-X0)B2O3-30Na2O-2oZnO glass system exhibits special optical properties .It is characterized by broad absorption bands in near UV and near IR regions. So, high transmission regions is observed between them i.e a transmission window is created. The behavior depends on composition. The above arguments indicates the Cu is found in its divalent states [1] .Copper in glass system can take zero valence state i.e atomic Cu^0 or in monovalent state Cu^{1+} and finally in divalent state $Cu^{2+.}$

In the former two cases the d shell is completely filled which in the latter case is partially filled and hence d transition are possible. The selective absorption of d-d transition is responsible for the observed color [2].By measuring optical absorption on can estimates legend field parameters such 10Dq and reach constant [3].

In previous articles analysis of the transmission window has been discussed [4].In the present articles it is interested in the long wave length observed edge .The obtained data were used to estimate the gap energy and band tail width as a function of composition .

II. EXPERIMENTAL TECHNIQUE

The investigated glass has been prepared by conventional melt quenching technique. The oxide components were carefully weighted and well mixed in mortar. The mixture was then heated in an electrical furnace at 950^o c.

For 30 min. with continuous shaking to insure high homogeneity. The molten glass was then poured between two brass plates. Apart of the prepared samples were polished carefully with fine emery paper in order to study their optical measurements using JENWAY (6405UV/Visible) spectrophometer covering the wave length range from 190 to 11oo nm.

III. RESULTS AND DISCUSSION

Mechanism of optical transition, the absence of transition symmetry means that the Hamiltonian does not commute with the translation symmetry. In such case the linear momentum is not conserved i.e it is not good quantum number. So most probable absorption mechanism is the indirect one.

Ultraviolet and visible transmission spectra were obtained for finely polished glass samples. For sake the determination of the absorption mechanism, one should apply the well-known relation [1]:

$$\alpha h\nu = B(h\nu - E_g)^n \quad (1)$$

Where B is constant called band tailing parameter,   is the optical band gap energy and   factor depends on the transition type and material structures. In non-crystalline systems, indirect transitions are more frequent absorption mechanism. This is due to the fact that in the amorphous systems, the absence of translation symmetry means that momentum is not conserved i.e. it is not a good quantum number. Plotting (αhν) 0.5 as a function of photon energy hν , the Eg can be determined by extrapolating the linear segment of the curve to the hν axis where (αhν)0.5 =0 , it is shown in figure 1.

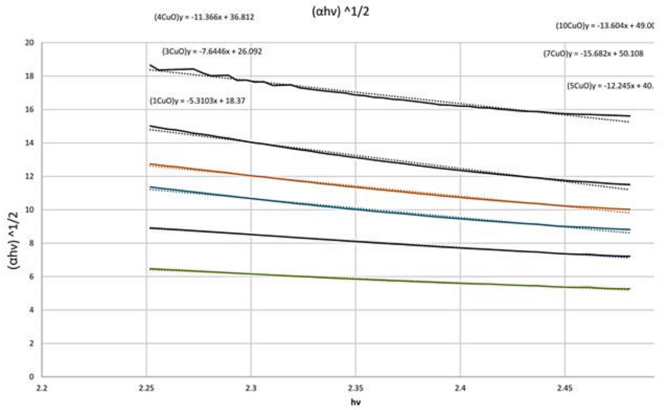

Figure 1. (αhν)^0.5 as a function of hν

To estimate the Urbach energy or band tail width (E_t) one should apply Urbach relation, it is shown in figure 2

$\alpha = \alpha 0 \exp \ (h\nu/Et)$ (2)

$Ln\alpha = Ln.\alpha_0 + (h\nu/E_t)$ (3)

Where α_o is constant and E_t is usually interpreted as the band tail width of the localized states in the band gap. Urbuch plots are dependent on the natural logarithm of the absorption coefficients, ln α, and the photon energy, hν. The obtained values of E_t were estimated by determining the slopes of the linear part of the curves [5].

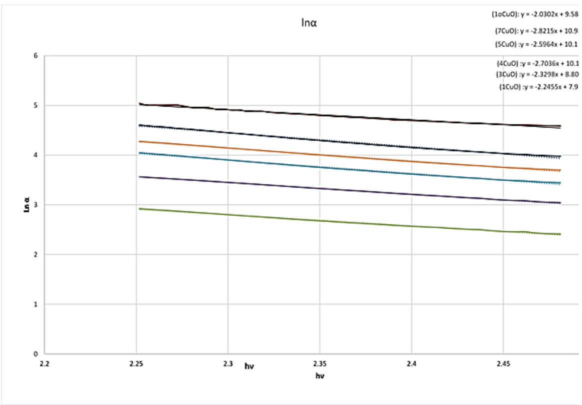

Figure 2. (lnα) as a function of hν

The dependence of band gap Eg on copper concentration is shown in Figure 3 , the dependence is not linear it show tendency to decrease between 1,3 mol.% then it sharply decrease by going from 3,4 mol.% .then it increase by going from 4,5 mol. % and slowly decrease again up to 7 mol.%. This is most likely due to the role of copper in the glass.

The dependence of band tail width Et Urbach energy was calculated as a function of the copper content as shown in Figure 4 It is clear that it follow the behaviour of the band gap. The electron transitions take place across the band gap as shown in Figure 5

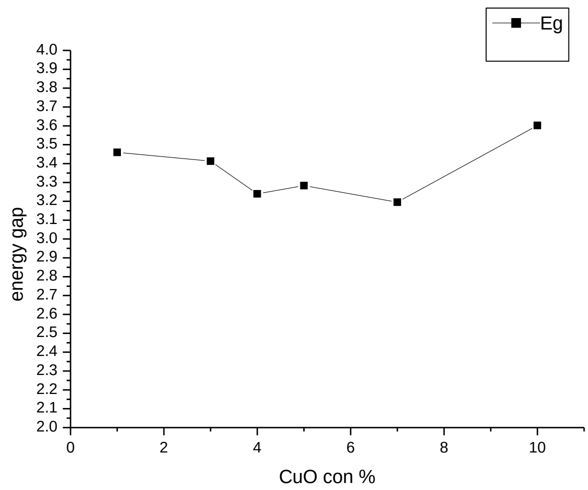

Figure 3. Energy gap composition dependence

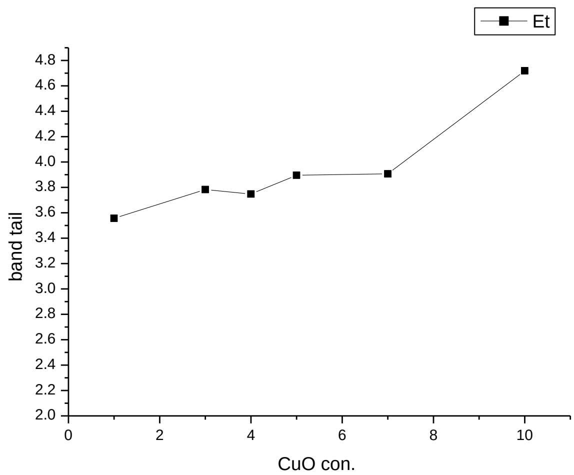

Figure 4. Band tail as a function of the CuO content of the glass system.

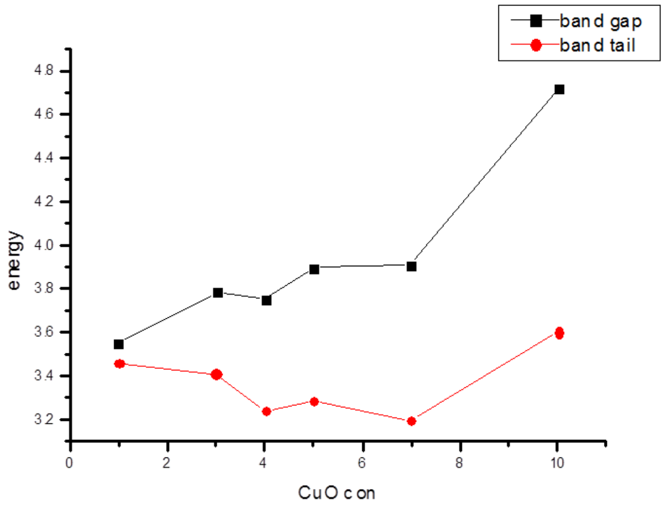

Figure 5. Energy gap and band tail composition Dependence for the glass system.

TABLE I
OPTICAL BAND GAP ENERGY (EG) AND URBACH (ET)

CuO con.	Et	E.g.
1	3.55625	3.45951
3	3.782739	3.41269
4	3.747778	3.23944
5	3.895994	3.28297
7	3.907143	3.19566
10	4.719212	3.60218

IV. CONCLUSION

The glass system is xCuO-(50-X0) B2O3-30Na2O-2oZnO, where x=1, 3, 4, 5,7and 10 mol. %. The glass has been prepared by conventional melt Quenching technique. From optical absorption spectrum the energy gap and band tail were measured for all glass samples by using truces equations.

V. REFERENCES

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