The Glassy state activation enthalpy of the Johari-Goldstien relaxation for the $Ge_{30-x}Se_{70}Ag_x$ (x= 0, 5, 10, 15, 20) glassy systems

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Abstract: For glassy substances, the secondary relaxation can be predicted quantitatively from the coupling model. Here $E_β$ is defined as the glassy state activation enthalpy of the Johari-Goldstein β relaxation, T_g is the glass transition temperature of the α – relaxation and R is the gas constant. The calculated values of $E_β$ are in good agreement for the glass formers. The calculated results locate the origin of this cross co-relation between T_g and $E_β$.
Keywords: Glassy state activation enthalpy and glass transition temperature.

I.   Introduction

Underlying the glass transition and its related dynamics is one of the most important features in condensed matter physics [1, 2]. The glass transition related relaxation scenario encompasses the drastic viscous slowdown of the super-cooled liquids, which is ultimately bringing the liquids in the glassy state. A glass forming liquid generally shows a non –Arrhenius temperature dependence of viscosity and the related a-relaxation time. In addition to the primary a- relaxation process, a secondary so called Johari-Goldstein (J-G) β-relaxation often exists at high frequencies [3].

Naturally, the J-G relaxation is defined is not intermolecular but intermolecular in origin. Science the primary a- relaxation also involves motion of the entire molecules; there is a reason to except that the dynamic properties of J-G β-relaxation defined here may bear some co-relation with that of the a-relaxation [4-6].

In the present work we have to correlate $E_β$ with T_g and calculate the different value of $E_β$ for different T_g's

II.   Relation between $E_β$ and T_g

Since the independent relaxation of the coupling model involve the local motion of the entire molecules, one such criterion is the correspondence between the most probable JG β –relaxation time $τ_{JG}$ and the independent relaxation time $τ_0$ [7-10], as-

$$τ_{JG} = τ_0 \qquad ------------------(1)$$

The correspondence has been shows to hold for genuine JG-β relaxation in a number of glass former sat temperatures above the glass transition temperature T_g. This is an indication of the possible fundamental role played by the JG-β relaxation I glass transition.

The possible connection of the JG β-relaxation to the glass transition is suggested by the empirical relation between T_g and the activation enthalpy $E_β$ of $τ_{JG}$ is given by-

$$E_β = 24RTg \qquad ------------------(2)$$

where R is the gas constant, which is found by Kudlik et.al. [11-13].
The calculated values of $E_β$ and T_g [14] are listed in Table-1, as

Table-1, the values of $E_β$, T_g and the $E_β/RT_g$

In%	Tg(K)	Eβ (KJ/mol)	Eβ/RTg
0	505.64	100.7705	24.0125
5	492.82	98.1764	24.0126
10	485.40	96.8594	24.0127
15	484.50	96.6789	24.0127
20	482.60	96.3007	24.0127

III.   Conclusion

The correlation of E$_\beta$ with RT$_g$ found by Kudlik *et.al.*, has drawn attention to workers [15-19] in glass transition, including us. We confirm the findings of Kudlik *et. al*. that   the ratio (E$_\beta$/RT$_g$)$_{expt.}$ For the JG β-relaxation in the given glassy system straddles the values of 24. Finally the values of (E$_\beta$/RT$_g$)$_{expt.}$ For non-JG secondary relaxations examined in this work are significantly greater than 24.

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