DIFFERENTIAL THERMAL ANALYSIS OF THE GLASSY SYSTEM AsSe-AsTe

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Abstract:

Thermal induced phase transformation for the system AsSe-AsTe have been studied using DTA. The dependence of the characteristic temperatures Tg, Tc and Tm on the ratio of Se/Te have been determined. The increase of Te content leads to the decrease of both Tg and Tc which means thetellurium inhances the crystallization process in these glasses exactly as in the case of $AsSe_{3/2-x}\ Te_x$ *and* $AsSe_{5/2-x}\ Te_x$. *The kinetic calculations have been tried also. Reseanable results have been obtained for two compositions only* $AsSe_{0.5}\ Te_{0.5}$ *and* $AsSe_{0.1}\ Te_{0.9}$ *with* $E_{cryst.}$ *equal 31.0 K.cal/mole for the first and 45 and 65 K.cal/mole for the second. The other compositions either do not crystallize completely or have complicated and overlaped peaks.*

Introduction

The binary system As-Se and the ternary system As-Se-Te have interesting properties as well as technological applications specially because they form wide range of glassy regions. In the binary system As-Se the stiochemical compound As_2Se_3 can be easily obtained in glassy state and can be easily transformed to crystalline state. Also AsSe can be obtained in both amorphous and crystalline states as indicated by their phase diagram (1). The other concentrations have eutitic character and it is difficult to crystallize. In the sytem As-Te there is only one stiochemical compound As_2Te_3. All the other concentrations give mixed crystalles around eutitic points (1). Previously the crystallization kinetic have been studied for both systems As_2Se_5-As_2Te_5 and As_2Se_3-As_2Se_3-As_2Te_3. (2,3). While the system As_2Se_3-As_2Te_3 can give limited solid solutions of both $Asse_{3/2}$ & $AsTe_{3/2}$ and crystallization tendency depending on the ratio Se/Te. The system AsSe-AsTe upon crystallization must give salid solutions with phase separation according to the phase diagram (4).

The present work deals with the same study applied to AsSe-AsTe in a trial to study the crystallization kinetics using DTA. The X-ray study (5) indicates the presence at least two phases. Their concentrations depends on the ratio of Se to Te. These phases may be AsSe with Te replacing Se and AsTe with Se replacing Te. The kinetic calculation, may help in understanding the physicel phenomena associated with the crystallization process.

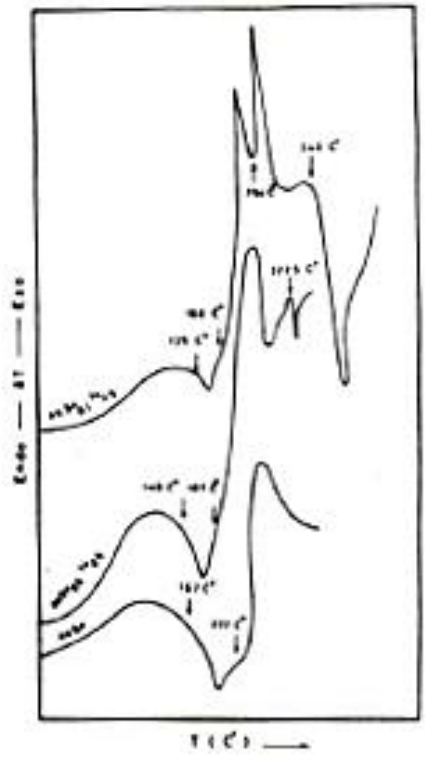

Fig.1: DTA Thermograms for the compositions AsSe, $AsSe_{0.5}Te_{0.5}$ and $AsSe_{0.1}Te_{0.9}$

Table(1): Characteristic temperature (ϕ = 10 deg/min) of $AsSe_{1-x}Te_x$ glasses. The temperature are given in °C

Composition	T_g °C	Crystallization Exotherm T_c °C		T_m °C
		First peak	Second peak	
As Se	162	222	-	-
As $Se_{0.6}$ $Te_{0.4}$	150	220	-	-
As $Se_{0.5}$ $Te_{0.5}$	140	187	-	322.5
As $Se_{0.3}$ $Te_{0.7}$	142	180	-	310
As $Se_{0.1}$ $Te_{0.9}$	135	160	254	340

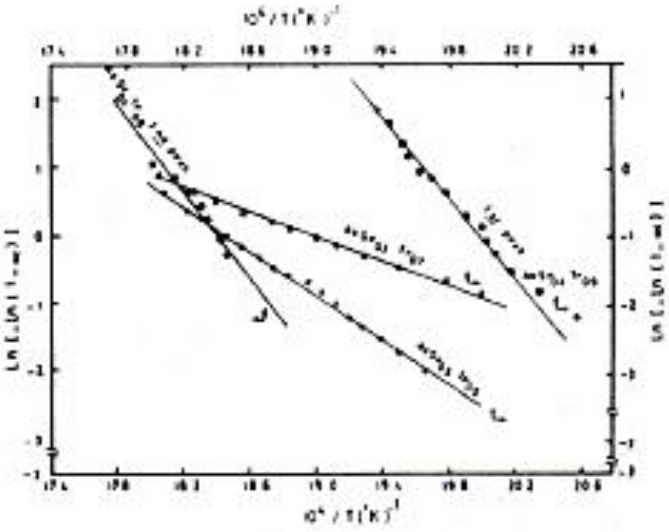

Fig.2: Plots of ln [-ln (1-)] versus 1/T for the first and second peak for the compositions $AsSe_{0.5}Te_{0.5}$, $AsSe_{0.3}Te_{0.7}$ and $AsSe_{0.1}Te_{0.9}$

Table(2): Crystallization kinetic parameters of $AsSe_{1-x}Te_x$ glasses.

Composition	First Peak		Second Peak	
	n	E,Kcal/mol	n	E,Kcal/mol
As Se	2.0	27.0	-	-
$As\ Se_{0.6}\ Te_{0.4}$	2.4	28.0	-	-
$As\ Se_{0.5}\ Te_{0.5}$	2.8	31.0	-	-
$As\ Se_{0.3}\ Te_{0.7}$	2.4	17.0	-	-
$As\ Se_{0.1}\ Te_{0.9}$	2.8	45.0	3.8	65.0

values of "n" (2.0-2.8) which defined the details of nucleation and crystal growth according to equation (4) indicates two or three dimensional growth of crystalline phase.

Conclusions

1. The DTA thermograms for the system $AsSe_{1-x}Te_x$ with $0 < x < 0.5$ do not show crystallization for the rate 10 deg./min.
2. Under the same conditions for the range of concentrations $0.5 \leq x \leq 1$ there is one or two crystallization peaks indicating the possibility of the presence of two crystalline phases.
3. The composition $AsSe_{0.5}Te_{0.5}$ corresponds to the minimum microheterogenity with the least activation energy of crystallization.
4. Within these systems the crystallization process takes place in two or three dimension with $2 < n < 28$.

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