Thermal stability and crystallization kinetics of Ge–Se–Cd glasses

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(Received 6 April 2009; final version received 7 October 2009)

The effect is reported of varying cadmium concentration on the glass transition, thermal stability and crystallization kinetics of Ge\textsubscript{20}Se\textsubscript{80-}\textsubscript{x}Cd\textsubscript{x} (x = 2.5, 5, 7.5 and 10 at. \%) glasses. Differential scanning calorimetry results under non-isothermal conditions for the studied glasses are reported and discussed. The values of the glass transition temperature (\(T_g\)) and the peak temperature of crystallization (\(T_p\)) were found to be dependent on heating rate and Cd content. From the heating rate dependence of \(T_g\) and \(T_p\), the values of the activation energy for glass transition (\(E_g\)) and the activation energy for crystallization (\(E_c\)) were evaluated and their composition dependence discussed. The thermal stability of the glasses was evaluated using various thermal stability criteria such as \(\Delta T\), \(H_s\) and \(S\). The stability calculations emphasize that the thermal stability decreases with increasing Cd content.

Keywords: chalcogenide glasses; thermal stability; crystallization kinetics

1. Introduction

Glassy alloys containing chalcogen elements were initially subjects of study because of their interesting semiconducting properties \cite{1} and more recently on account of their importance in optical recording \cite{2}. Recording materials must be stable in the amorphous state at low temperature and have a short crystallization time. Promising materials with these characteristics have been recently studied \cite{3,4}.

The last decades have seen a strong theoretical and practical interest in the application of non-isothermal experimental analysis techniques to consider the trend of many crystallization processes that occur too rapidly to be measured under isothermal conditions. The non-isothermal techniques have become particularly prevalent for determination of the thermal stability of amorphous alloys and in the investigation of the processes of nucleation and growth that occur during transformation of the metastable phases in a glassy alloy as it is heated during differential scanning calorimetry (DSC). Studies of crystallization kinetics and thermal stability in amorphous semiconductors under non-isothermal conditions have been discussed in the literatures \cite{5-7}.

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