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DSC Measurements of Amorphous Metal Film

1. Introduction

The excellent hardness, corrosion resistance and other properties of amorphous metals has drawn the attention of industry and accelerated commercialization of these new materials. Conversely, these metals have the disadvantage of being thermally unstable, i.e., an amorphous metal's characteristics change when heat treated. In order to improve these metal's heat stability, various research methods are being applied.

DSC measurement is a useful means for study of crystallization of materials, making it easily applicable to the study of amorphous substances. However, because there is an interaction between the film and the substrates, measurements of amorphous metal films must be carried out without separating the film from the substrate. This requires a high sensitivity DSC that can handle micro-sample measurements.

This brief describes crystallization data from the DSC100 high sensitivity Differential Scanning Calorimeter for a 1000Å Tb-Fe-Co amorphous alloy film deposited on the surface of a glass plate.

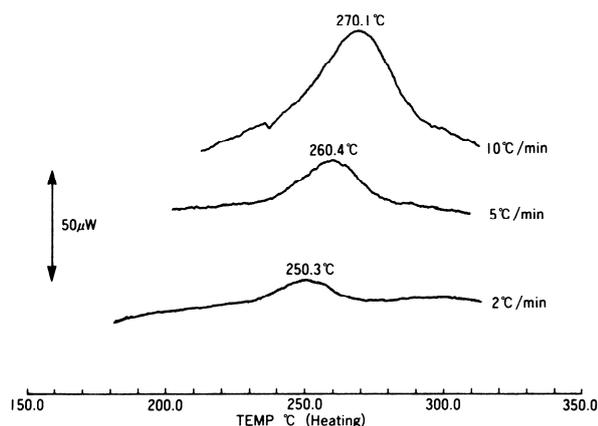


Figure 1 DSC Results of amorphous alloy film
Heating rates : 2°C/min, 5°C/min, 10°C/min
Atmosphere : Ar 40ml/min

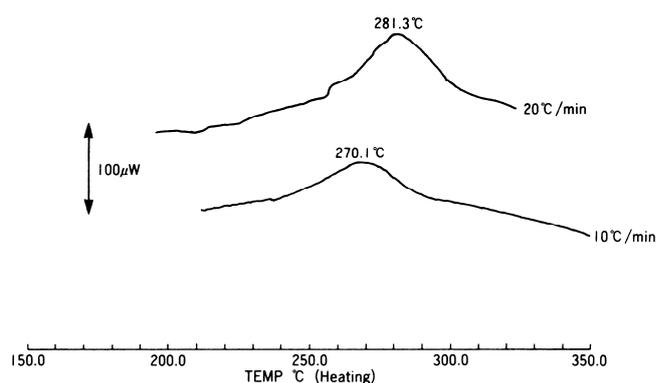


Figure 2 DSC Results of amorphous alloy film
Heating rates : 10°C/min, 20°C/min
Atmosphere : Ar 40ml/min

2. Experiment and Results

Figures 1 and 2 show several DSC data curves obtained using various heating rates. In these curves, crystallization exothermic peaks are observed in the 240°C to 300°C range. Notice that as the heating rate increases, the peaks become larger and shift to higher temperature regions.

Figure 3 shows a Kissinger plot of this data for reference. The slope of this plotted line allows us to estimate that the activation energy for crystallization of this alloy is 169.6kJ/mol.

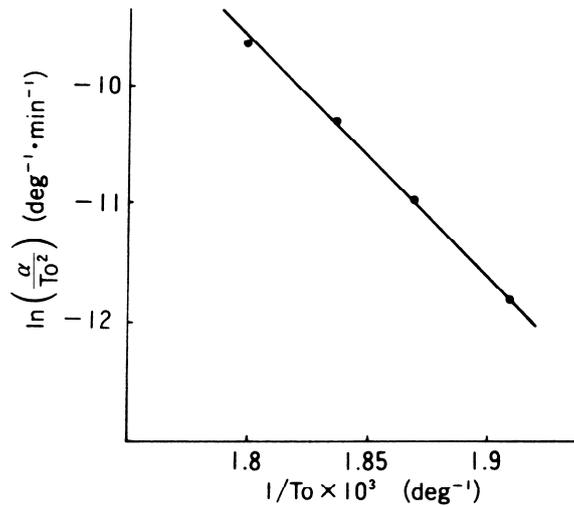


Figure 3 Kissinger plot

3. Summary

It is known that the physical properties of an amorphous metal film are affected by the film's thickness. If the DSC100 module is capable of analyzing the crystallization process of a 1000Å thin film deposited on glass, it should be useful for any amorphous substance heat stability evaluation.