

ANALYSIS OF THE ISOTHERMAL DILATOMETRIC BEHAVIOUR OF THE NiZr METALIC GLASS DOPED WITH HYDROGEN AS A FUNCTION OF HYDROGEN CONCENTRATION

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Abstract

Metalic glass Zr_{63,5}Ni_{36,5} was doped with hydrogen in concentration of 0,5; 1; 1,5; 3,6; 5,8; and 6,9%. The samples were subjected to isothermal dilatometric measurements at the tension of 2,8 MPa. The curves obtained are presented as a function of hydrogen concentration. In all the cases, (at any of the constant time of isothermal treatment) a linear dependence of the length change with the hydrogen concentration is obtained. It is very interesting that all the obtained straight lines cross in a point corresponding to the hydrogen concentration of 1,72%. The explanation of such a behaviour is given in this paper by means of filling the excess free volume.

INTRODUCTION

Amorphous systems are prone to hydrogen absorption. This process is interesting from the standpoint of the investigation of the structure of the system, as well as from the standpoint of the application in terms of the hydrogen storage.

This paper deals with the system Zr_{64,5}Ni_{36,5} doped with six different hydrogen concentration. The samples are subjected to the isothermal dilatometric treatment [1]. The investigation is primarily aiming to answer the very significant question of the relationship between absorbed hydrogen and the excess free volume in the system.

EXPERIMENTAL

The ribbons of the amorphous system $Zr_{63,5}Ni_{36,5}$ obtained by ultra-rapid quenching on one roller were electrolytely doped with hydrogen. The hydrogen concentrations were verified using a previously established relationship between the gain in resistance and volumetrically determined hydrogen absorption. The ribbons were subjected to the isothermal dilatometric treatment at the temperature of 473K and a small tension of 0,5 MPa. The masured samples were 17mm long, 2.3mm wide and from 30 to 32 μ m thick. The measurement was done in a helium atmosphere.

RESULTS AND CONCLUSION

The results of the direct measurement are graphically presented in figure 1. One can clearly see that the absorbed hydrogen affects the free volume in the system. Actually, the free volume is decreased with increasing hydrogen concentration. This is visible from the curves for the hydrogen concentrations of 0,5 and 1%, where ever smaller shrinking appears. That is, the greater hydrogen concentration the smaller shrinking of the sample.

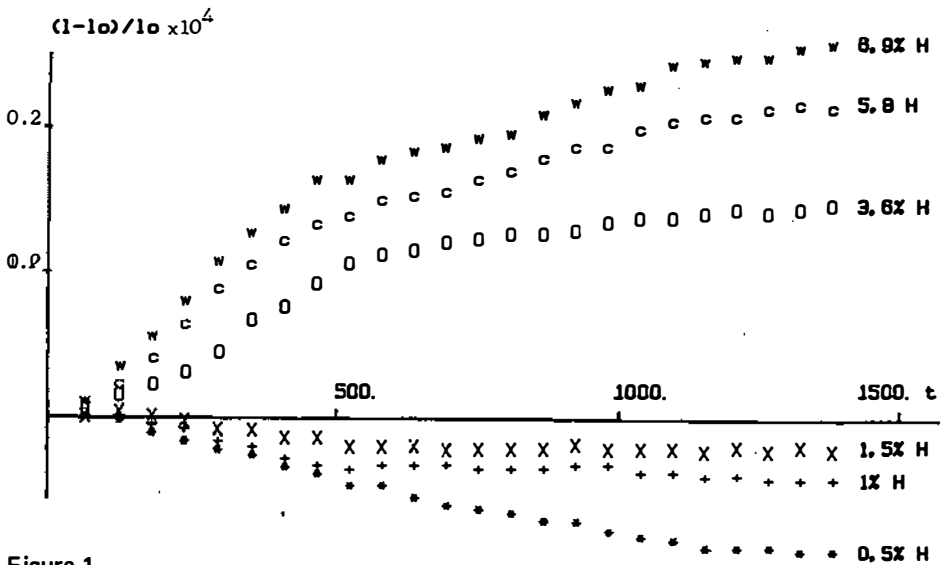


Figure 1.

Since the shrinking of the sample is proportional to the quantity of the excess free volume, the hydrogen appears to decrease the excess free volume inserting itself into the spaces of the grid that become smaller during the temperature relaxation.

For the hydrogen concentrations greater than 1% according to the results presented. The flow is improved so that, the spaces of the grid being filled, hydrogen contributes to ever greater flow by its presence 2.

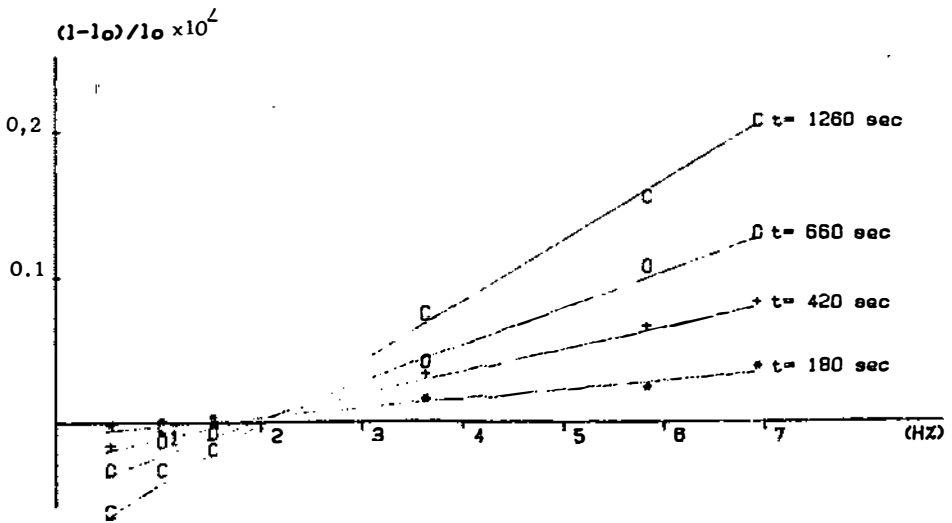


Figure 2.

In figure 2. dilatometric results are shown as a function of concentration. A very interesting dependence is observed, namely, change in length is linearly dependent on the concentration. Besides, it is observed that the straight lines cross at a point corresponding to the hydrogen concentration of 1,72%. The explanation of this phenomena is very hard to give at present. That is why the investigation is continuing in this direction 3. However, the results undoubtedly show that the increase of the hydrogen concentration decreases the excess free volume and quite likely influences the cluster formation of the amorphous system, that is into higher concentrations weakens their bonds and greatly improves the flow within the system.

REFERNECES

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