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АННОТАЦИЯ

Найдена корреляция между параметрами получения металлических стекол Fe-B /скорость охлаждения и температура расплава/ и магнитным последействием, измеренным в них, которое может быть мерой для оценки подвижности атомов бора. Изучено влияние отжига для снятия внутренних напряжений и отжига в магнитном поле на эффект магнитного последействия.

KIVONAT

Korrelációt találtunk Fe-B fémüvegekben az előállitás paraméterei /hütési sebesség és olvadék hőmérséklet/ valamint a rajtuk mért mágneses utóhatás között, ami mértéke a bór atomok mozgékonyságának. Megvizsgáltuk a lágyitó hőkezelés és a mágnesteres hőkezelés hatását is az effektusra.

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ABSTRACT

Correlations were found between technological parameters such as the cooling rate and melt temperature and the magnetic after-effect, which may be a measure of the mobility of boron atoms in Fe-B amorphous alloys. The influence of stress-relief annealing and magnetic annealing was also investigated.

INTRODUCTION

It has already been shown [1] that magnetic after-effect can be measured in amorphous $Fe_{100-x}B_x$ /13<x<24/ alloys. The relaxation effect depends strongly on the boron content and is the highest at eutectic concentration. In the knowledge that magnetic properties of amorphous alloys depend on the technological parameters of preparation [2,3], investigations were carried out to determine the influence of cooling rate at two melting temperatures on the magnetic after-effect.

EXPERIMENTAL

The amorphous ribbons were prepared by melt spinning. The samples were quenched from 1570 to 1770 K at various cooling rates from 6210 to 12420 rev/min of Ø 76 mm copper-disc. All measurements of time decrease of susceptibility were made on a set of straight samples in as-quenched state, after stress-relief annealing and after annealing in a 4000 A/m magnetic field.

The initial magnetic susceptibility was measured at 0.1 A/m a.c. field with 970 Hz using a mutual induction bridge.

RESULTS AND DISCUSSION

The relatively large influence of cooling rate on the time decrease of susceptibility of the as-quenched samples is shown in *Fig. 1.* The higher the cooling rate the higher the change of susceptibility. It was found that on changing the rotation speed from 8694 rev/min to 10557 rev/min the value of

$$\frac{\Delta\chi}{\chi_o} = \frac{\chi(t=30\,\mathrm{sec}) - \chi(t=1800\,\mathrm{sec})}{\chi(t=30\,\mathrm{sec})}$$

increases by about 10% /*Fig. 2.*/ which is comparable with the change caused by varying the boron content from 13 to 24 at% in $Fe_{100-x}B_x$ [1]. This may be interpreted by saying that at a higher cooling rate more "free volume" is frozen in. At a higher cooling rate the internal stresses quenched-in influence the coercive force in the same manner [2] as the magnetic after-effect.

On investigating those temperature ranges in which the magnetic after-effect can be detected we also found some influence of the cooling rate: a higher cooling rate shifts the upper boundary to a lower temperature. An opposite shift of the lower boundary can be observed in heat treated samples with and without magnetic field. This points also at the role of cooling rate on free volume and internal stress in connection with magnetic after-effect.

When we investigated the concentration dependence of the magnetic after-effect in the as-quenched state at various

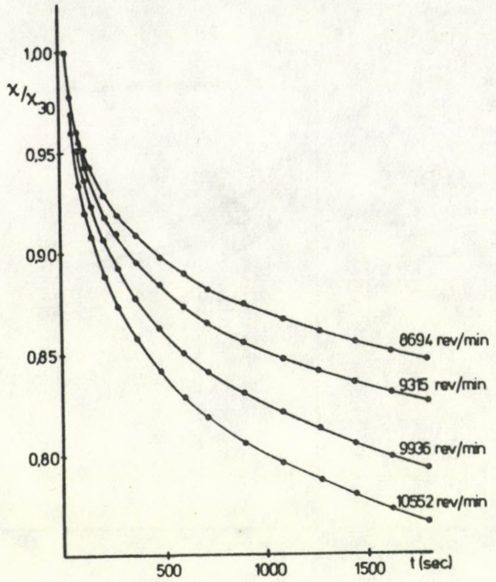

Fig.1. Time dependence of relative susceptibility measured on as-quenched $Fe_{83.6}B_{16.6}$ samples prepared with various cooling rates. T_{melt}=1570 K, T_{meas}=600 K.

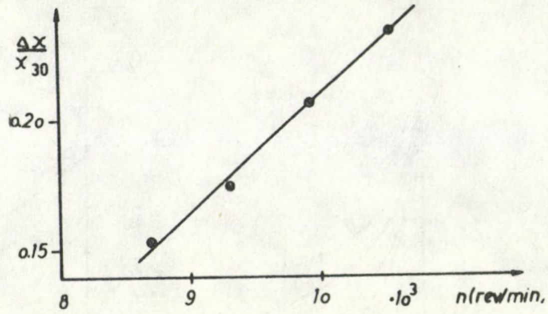

Fig.2. Relative change of susceptibility as a function of rotating speed /n/ of the disc /Ø=76 mm/ measured on as-quenched $Fe_{83.4}B_{16.6}$ samples at 600 K. T_{melt}= 1570 K.

cooling rates we detected the same tendency as in [1]. This maximum near the eutectic concentration may be the consequence of the lowest viscosity found at this concentration [4]. This can be seen also in *Fig. 3*. Going from lower to higher cooling rate the magnetic after-effect rises too. This fact and the previous one both indicate that the mobility of boron atoms is also influenced by the cooling rate whether due to changes of free volume or to the binding state of boron atoms. The role of internal stress at various cooling rates can be checked by comparing *Fig. 3a and 3b*. After stress-relieve annealing the same tendency can be found in the dependence of after-effect on cooling rate as well as on boron content but the change in both cases is smaller.

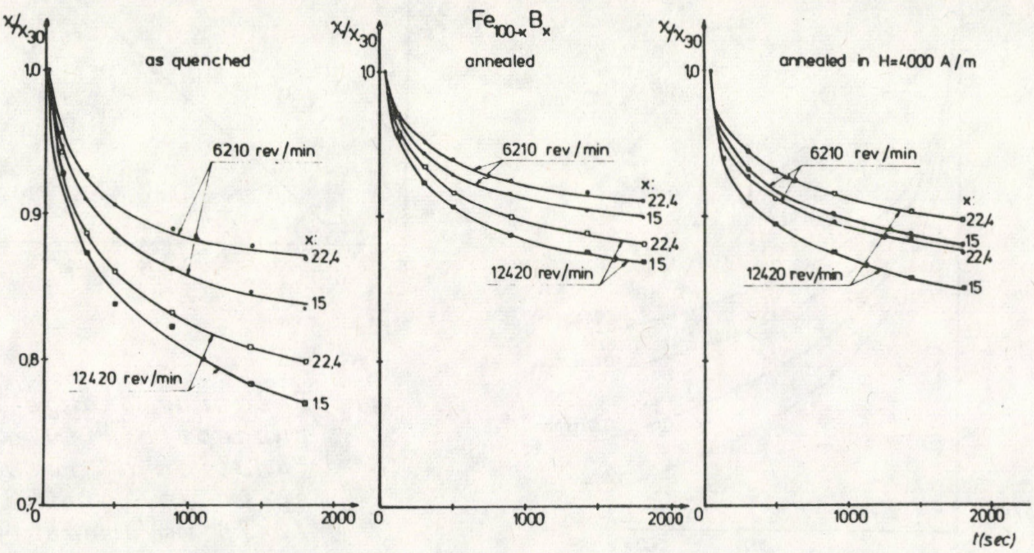

Fig. 3. Time dependence of relative susceptibility on samples containing 15 and 22.4 at% B prepared by two cooling rates /using 6210 -.-, and 12420 - - rev/min/ quenched from 1770 K. T_{meas} *= 330 K.*
a/ in as-quenched state,
b/ after stress-relieve annealing,
c/ after annealing in 4000 A/m magnetic field.

It is interesting to compare *Fig. 3b and 3c.* Figure 3c shows the time dependence of susceptibility on samples heat treated in a 4000 A/m magnetic field at the same temperature and time duration as for the stress-relief annealing. Near the eutectic composition the same increase of magnetic after-effect can be observed for both cooling rates. At hyper-eutectic concentration an opposite tendency can be seen: at a lower cooling rate the after-effect increases; for a higher cooling rate it decreases. This is in strong correlation with induced anisotropy measured on the same samples [3].

A relatively high degree of magnetic anisotropy was found for the higher cooling rate which is supposedly connected with an atomic ordering which may hinder the motion of boron atoms.

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