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АННОТАЦИЯ

Исследовалась корреляция между скоростью охлаждения, перегревом металлического расплава и получаемой индуцированной магнитной анизотропией в быстроохлажденных аморфных сплавах $Fe_{100-x}B_x$. В образцах с концентрацией бора 15 ат% удалось получить очень малую индуцированную анизотропию, которая практически не зависит от параметров получения. В материалах с большей концентрацией бора на анизотропию влияют как скорость охлаждения, так и перегрев расплава.

KIVONAT

Gyorshütött amorf $Fe_{100-x}B_x$ ötvözetekben vizsgáltuk a korrelációt az előállitáskor alkalmazott hütési sebesség és a fémolvadék tulhevitése, valamint az elérhető indukált mágneses anizotrópia között. 15 at% bórt tartalmazó mintákban csak igen kismértékü indukált anizotrópiát sikerült előállitani és ez az anizotrópia gyakorlatilag függetlennek adódott az előállitás paramétereitől. Nagyobb bór tartalmu anyagokban mind a hütési sebesség, mind az olvadék tulhevités befolyásolja az anizotrópiát.

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ABSTRACT

The correlation between cooling rate or melt superheat and the induced magnetic anisotropy of amorphous rapidly quenched $Fe_{100-x}B_x$ alloys has been investigated. In samples with 15 at% boron concentration only a very small induced anisotropy could be achieved and this was practically independent of the technological parameters. At higher boron concentrations both cooling rate and melt superheats influenced the induced magnetic anisotropy.

INTRODUCTION

Some works have pointed out that in amorphous $Fe_{100-x}B_x$ ribbons /$13<x<23$/ an induced anisotropy can be achieved by heat treatment in a magnetic field. The magnitude of this anisotropy depends on boron content [1,2].

In general the technological parameters of material preparation influence magnetic properties. In view of this, the correlations between cooling rate or melt superheat and induced magnetic anisotropy have been investigated.

EXPERIMENTAL

The amorphous samples were prepared by the spinning wheel method. The materials were quenched from 1670 and 1770 K melt temperature at two cooling rates produced by 6210 and 12420 rev/min of the spinning wheel of 76 mm diameter. All samples were checked by X-ray diffraction. The crystallization temperature was determined from the thermomagnetic curves. The annealing temperature was chosen to be 120 K below the crystallization temperature. The stress-relief annealing was performed and checked by the anisotropy measurements themselves: the annealing was continued until the anisotropy became independent of the annealing time. The magnetic annealing was performed at the same temperature and duration as the stress-relief annealing. The magnetic field was 4000 A/m.

The magnetic anisotropy was determined from the energy required to attain magnetic saturation obtained from M - H curves measured on a set of 20 cm straight ribbons by an astatic magnetometer. The induced anisotropy $/K_u/$ was determined by subtracting the value of anisotropy /K/ obtained after stress-relief annealing from the value measured after the field heat treatment. All measurements were made at room temperature.

RESULTS AND DISCUSSION

In *Fig. 1.* the influence of stress-relief annealing on anisotropy can be seen at two boron concentrations prepared from 1770 K melt temperature using two cooling rates. The measured values of K give the same concentration dependence as our earlier investigations [2]. On the other hand it is evident that the cooling rate influences the anisotropy and its development.

The K curves in *Fig. 2.* show the development of the induced magnetic anisotropy. These depend on melt superheat and cooling rate. In the samples with 15 at% boron only a very small induced anisotropy can be achieved practically independent on

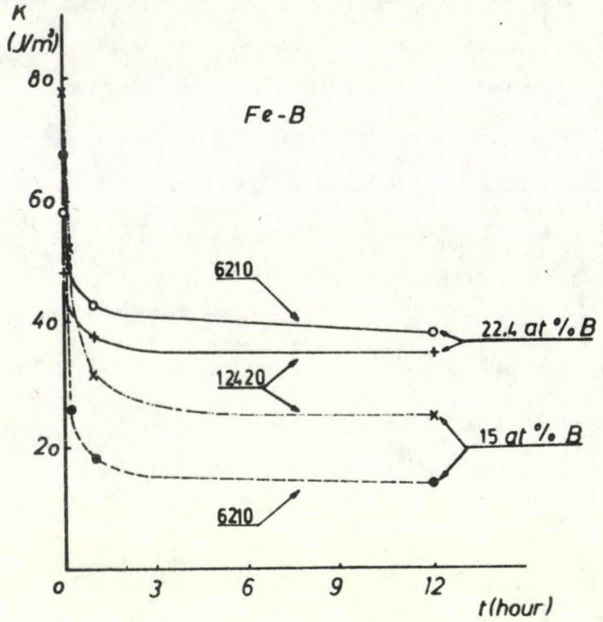

Fig. 1.

Anisotropy measured after stress-relief annealing as a function of annealing time.

-o- 22.4 at% B, 6210 rev/min;
-+- 22.4 at% B,12420 rev/min;
-●- 15 at% B, 6210 rev/min;
-x- 15 at% B,12420 rev/min;

All samples were quenched from 1770 K melt temperature.

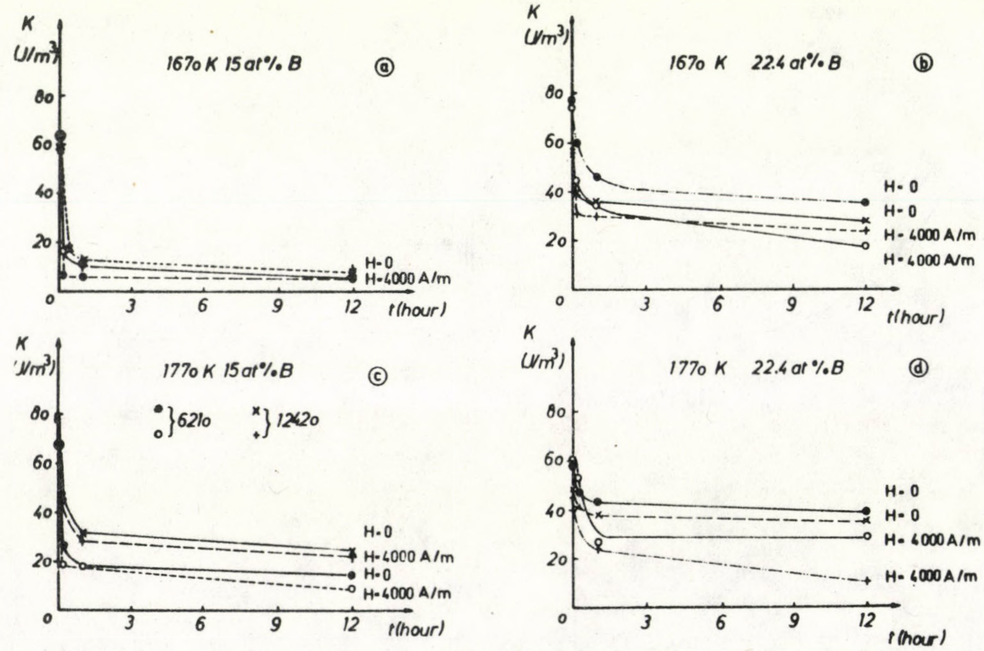

Fig.2. Anisotropy measured after magnetic heat treatment and after stress-relief annealing as a function of annealing time. $-\genfrac{}{}{0pt}{}{\bullet}{o}-$ *6210 rev/min;* $-\genfrac{}{}{0pt}{}{+}{x}-$ *12420 rev/min.*

a/ T_{melt} *= 1670 K, 15 at% B;* *b/* T_{melt} *= 1670 K, 22.4 at% B;*

c/ T_{melt} *= 1770 K, 15 at% B;* *d/* T_{melt} *= 1770 K, 22.4 at% B.*

the technological parameters /*Fig. 2a and c*/. These results suggest the idea that in the development of induced anisotropy in Fe-B alloys the ordering of boron atoms has a considerable role [1]. Near the eutectic concentration this ordering process is perturbed by the mobility of boron atoms. In the hypereutectic range the influence of melt superheat and cooling rate can be seen /*Fig. 2b and c*/.

The measured induced magnetic anisotropy for investigated alloys, in general, proves the K_u - at% B concentration curve given in [2]; however, at that time the technological parameters of alloys preparation were neglected. In *Fig. 3.* we repeat this curve and give our results which are related to the technological parameters. In the hypereutectic range

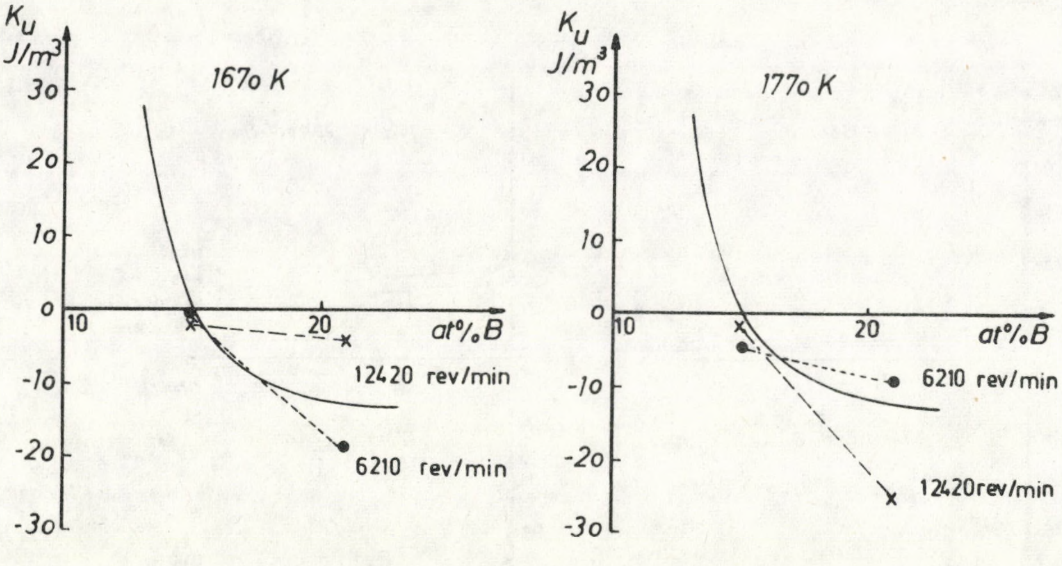

Fig. 3. Induced magnetic anisotropy as a function of boron concentration. The full line is taken from [2], the various points refer to the present work.

in the sample quenched from 1670 K the slower cooling rate gives the higher induced anisotropy and in the case of 1770 K melt temperature the situation is the opposite. This shows that ordering process depends in this concentration range on the technological parameters. Measurements of magnetic after-effect in the same samples have shown that on the samples prepared from 1770 K melt temperature at a higher cooling rate the after-effect is smaller than at the lower cooling rate [3]. From this, we can conclude that higher mobility lowers the induced anisotropy.

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