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INDUCED ANISOTROPY IN Fe-B AMORPHOUS ALLOYS[1]

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In the presented paper the dependence of the induced magnetic anisotropy of the $Fe_{100-x}B_x$ $(15 \leq x \leq 24)$ alloys on the technological parameters of preparation (the melt cooling rate and the melt overheating) was investigated. The results indicate the important role of the boron atoms in the development of this anisotropy. The quantitative manifestation of anisotropy seems to be dependent on the microstructural state of the as-quenched alloy.

НАВЕДЕННАЯ АНИЗОТРОПИЯ В АМОРФНЫХ СПЛАВАХ Fe-B

В работе исследована зависимость наведенной магнитной анизотропии сплавов $Fe_{100-x}B_x$ $(15 \leq x \leq 24)$ от технологических параметров приготовления (скорость охлаждения расплава и перегрев расплава). Результаты указывают на важную роль атомов бора при развитии этой анизотропии. Количественное проявление анизотропии, очевидно, зависит от микроструктуры охлажденного сплава.

I. INTRODUCTION

In Fe-B amorphous alloys, produced by a rapid quenching of the melt, the annealing in the magnetic field may produce the induced magnetic anisotropy. This anisotropy depends on the boron content [1, 2]. On the other hand, there is a well-known influence of the technological parameters of the alloy preparation on some magnetic properties [3]. Therefore the dependence of the induced anisotropy of $Fe_{100-x}B_x$ $(15 \leq x \leq 24)$ alloys on the melt cooling rate and on the overheating was investigated.

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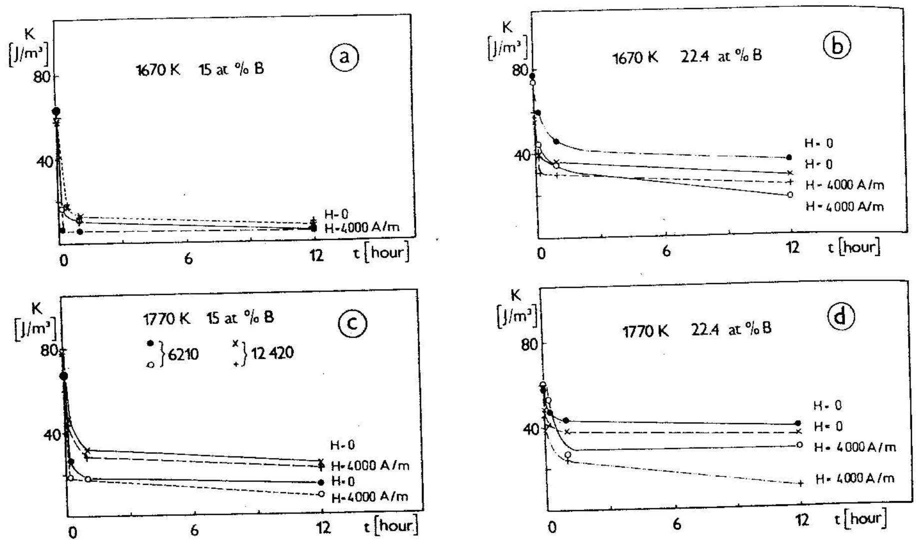

Fig. 1. Development of the induced magnetic anisotropy by annealing in the magnetic field of 4000 A/m in samples with various boron contents and prepared at different technological parameters.

II. EXPERIMENTAL

The used amorphous samples were prepared by the wheel spinning method. The material were quenched at two different melt temperatures (1670 and 1770 K) and at two cooling rates corresponding to 6210 rev/min and 12 420 rev/min of the cooling wheel. All samples were subjected to stress-relief annealing. The annealing temperature was chosen 120 K below the crystallization temperature. The magnetic annealing was performed in the field of 4000 A/m and at the same temperature and duration as the stress-relief annealing. The magnetic anisotropy was determined from the energy required to attain magnetic saturation obtained from the $M-H$ curve. 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 annealing. The measurements were made by an astatic magnetometer at room temperature.

III. RESULTS AND DISCUSSION

Investigating the anisotropy after stress-relief annealing we found that the melt cooling rate and melt overheating influence the anisotropy. Fig. 1 shows the influence of the cooling rate and the melt overheating on the development of the induced uniaxial magnetic anisotropy. In the samples with 15 at. % boron only

a very small anisotropy can be achieved, which is practically independent from technological parameters. In the hypereutectic range the influence of the used technological parameters is more marked.

Investigating the magnetic anneal anisotropy in amorphous Fe—Ni—B alloys [1] in terms of the directional order theory [4] the role of boron atoms in the directional ordering was shown in Fe-B alloys. The boron may here act similarly as the interstitials do in developing directional ordering in crystalline materials. Our results support the assumption that in the development of the induced anisotropy in the investigated alloys the ordering of the boron atoms plays an important role [1].

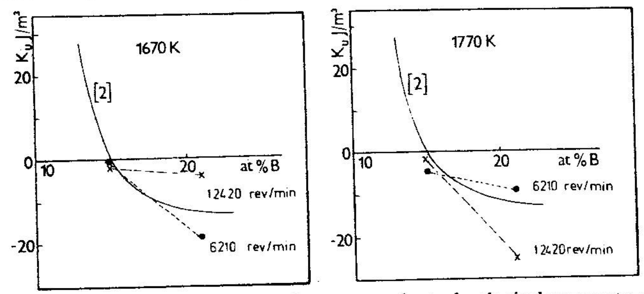

Fig. 2. Dependence of the induced magnetic anisotropy on the technological parameters of the sample preparation.

In Fig. 2 the concentration dependences of K_u for all investigated samples are given, together with our earlier results [2]. In the hypereutectic range the sample quenched at 1670 K with a lower cooling rate gives a higher induced anisotropy and in the case of the 1770 K melt temperature the situation is opposite. It seems that the ordering process depends in this concentration range on the parameters of the alloy preparation. The results for the melt temperature of 1770 K suggest the conclusions of the magnetic after-effect investigation that a lower cooling rate leads to a higher mobility of boron atoms [5]; this mobility is considered to be indirectly proportional to the value of the induced anisotropy. Our results show that the decrease of the melt temperature influences the boron atoms mobility and hence the induced anisotropy also in dependence on the cooling rate.

REFERENCES

[1] Luborsky, F. E., Walter, J. L.: IEEE Trans. Magn. MAG-*13* (1977), 953.
[2] Kisdi-Koszó, É., Potocký, L., Novák, L.: J. Magn. Magn. Mater. *15—18* (1980), 1383.
[3] Novák, L., Potocký, L., Lovas, A., Kisdi-Koszó, É., Takács, J.: J. Mag. Magn. Mater. *19* (1980), 149.
[4] Slonczewski, J. C.: in *Magnetism*, Vol. I, Ed. by G. Rado and H. Shul. Academic Press. New York 1963.
[5] Vojtaník, P., Kisdi-Koszó, É., Lovas, A., Potocký, L., Boškovičová, M.: Acta Phys. Slov. (*to be published*).

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