KFKI-1980-95

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BUDAPEST

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To appear in the Proceedings of the Conference on Metallic Glasses: Science and Technology, Budapest, Hungary, June 30 - July 4, 1980; Paper M-19

HU ISSN 0368 5330
ISBN 963 371 741 8

АННОТАЦИЯ

Методом оптомеханики измерялась магнитострикция, что дало возможность проведения измерения под минимальным механическим напряжением. Изучалось влияние различных термоотжигов /отжиг для снятия внутренних напряжений, отжиг в магнитном поле и под механическим напряжением/ на магнитострикцию насыщения аморфных сплавов Fe-B.

KIVONAT

Magnetostrikciót mértünk optomechanikai módszerrel. Ez lehetővé tette, hogy minimális mechanikai feszités alatt végezhessük a mérést. Különböző hőkezelések (megeresztő, mágneses térben és mechanikai feszültség alatt végzett hőkezelés) hatását vizsgáltuk Fe-B amorf ötvözetek telitési magnetostrikciójára.

ABSTRACT

Magnetostriction was measured using the opto-mechanical method which gave the possibility to study the magnetostriction on quasi-free samples. Investigations were carried out to determine the effects of various heat treatments /stress-relieve, magnetic annealing and annealing under tensile stress/ on the saturation magnetostriction of Fe-B amorphous alloys.

INTRODUCTION

The magnetostriction values, particularly those of Fe-B amorphous alloys, are very important [1-3] both from the theoretical and practical points of view. The saturation magnetostriction of these alloys depends strongly on boron content and since this is relatively large it thus provides a good method for studying the magnetomechanical properties. Fe-B amorphous alloys show a typical dependence of magnetic properties on the processing conditions [4]. They also offer possibility of developing induced anisotropy by magnetic or stress-annealing [5].

We studied the saturation magnetostriction in the as-quenched state depending on the cooling rate and the correlation between induced anisotropy and magnetostriction.

EXPERIMENTAL

The samples used were thin /~20 μm/ and narrow /1-2 mm/ ribbons of amorphous alloys prepared by melt spinning. The magnetostriction was measured using the opto-mechanical method which gave us the opportunity of studying the magnetostriction /λ/ under very small external tensile stress /σ/. The saturation magnetostriction /λ_s/ was determined from the λ/H/ curves measured at different tensile stresses and extrapolated to zero stress */see Fig. 1./*. All measurements were carried out at room temperature.

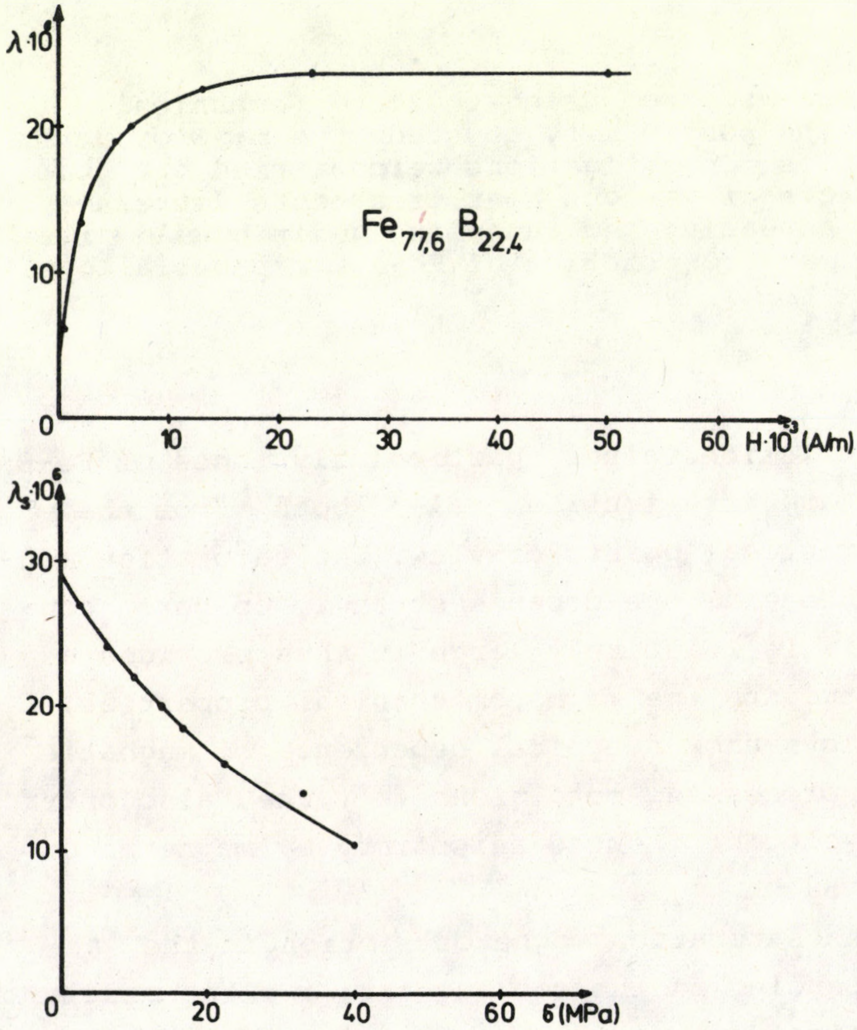

Fig. 1. Magnetostriction curves measured on as-received $Fe_{77.6}B_{22.4}$ samples quenched from 1770 K melt temperature at 6210 rev/min. a/ magnetostriction /λ/ as a function of applied magnetic field /H/; b/ saturation magnetostriction /λ_s/ as a function of applied tensile stress /σ/.

RESULTS AND DISCUSSION

The concentration dependence of λ_s in Fe-B has been published in the literature, e.g. ref. [3]. In *Fig. 2.* we have plotted our results and two points from [3]. O'Handley et al. say nothing about the preparation conditions. From our results it is evident that, for example, the cooling rate can strongly influence the saturation magnetostriction. If the revolution of the disc is increased from 6210 to 12420 rev/min the megnetostriction falls by about 5o%. Also for lower boron concentration we obtained a lower value for λ_s than in [3]. The reason for this may be the difference in the conditions of preparation.

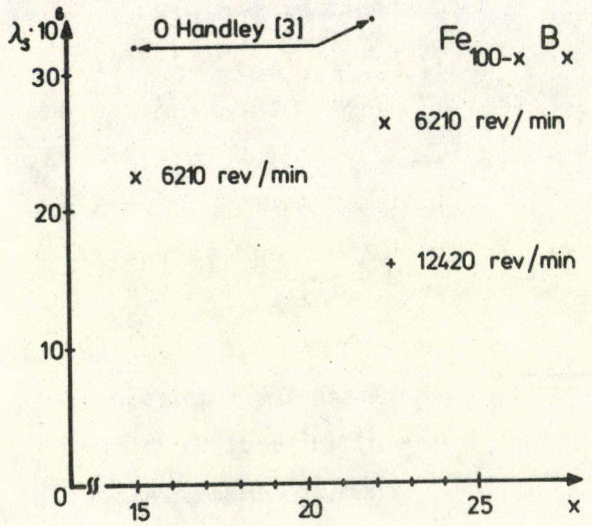

Fig. 2. Effect of cooling rate on saturation magnetostriction /λ_s/ of $Fe_{1oo-x}B_x$.
-.- values taken from [3].
-x- 6210 rev/min
-+- 12420 rev/min
T_{melt} = 1770 K.

In all samples we found the same tendency in $\lambda_s/\sigma/$ as in *Fig. 1b.* /λ_s falls with rising tensile stress/. In an earlier work we studied the influence of cooling rate on the coercive force /H_c/ in $Fe_{83.4}B_{16.6}$ and found an increase of H_c on increasing the cooling rate in the same range [4]. This is in connection with stresses quenched in. If this is compared with our measurements of magnetostriction it can support the idea that tensile stresses are quenched-in into the ribbons.

With respect to the above it is obviously necessary to use the same preparation parameters when one wishes to compare certain properties of various alloys. We were careful to make sure that we complied with this prerequisite in our investigations of magnetostriction in magnetic- and stress-annealed Fe-B amorphous alloys.

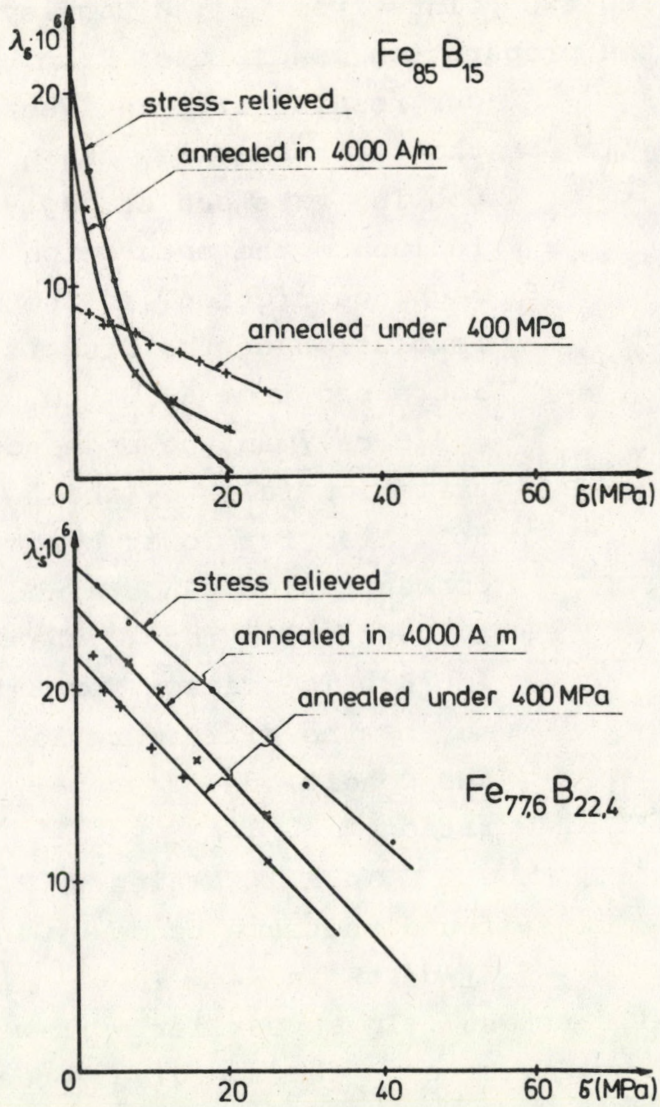

Fig. 3.

Effect of annealing on $\lambda_s/\sigma/$ curves: a/ measured in $Fe_{85}B_{15}$, T_{melt}= 1770 K, 6210 rev/min; b/ measured in $Fe_{77.6}B_{22.4}$, T_{melt}= 1770 K, 6210 rev/min

-.- after stress-relief annealing

-x- after heat treatment in 4000 A/m magnetic field

-+- after heat treatment under tensile stress of 400 MPa

In *Fig. 3.* we have plotted the measured $\lambda_s/\sigma/$ curves in stress-relief-annealed samples and in samples annealed in a magnetic field of 4000 A/m or under a tensile stress of 400 MPa. In $Fe_{85}B_{15}$ the saturation magnetostriction is the same in the samples annealed with and without magnetic field It is interesting that the $\lambda_s/\sigma/$ curves are also very close together. With this heat treatment we could get only small induced anisotropy [5]. On the other hand in $Fe_{77.6}B_{22.4}$ the induced anisotropy is much greater and the curves for annealing with and without magnetic field are different. The influence of tensile stress annealing on both alloys is greater and reduces the value of saturation magnetostriction. This proves that ordering processes influence the magnetostriction of Fe-B alloys.

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63.071

Kiadja a Központi Fizikai·Kutató Intézet
Felelős kiadó: Tompa Kálmán
Szakmai lektor: Hargitai Csaba
Nyelvi lektor: Hargitai Csaba
Példányszám: 220 Törzsszám: 80-635
Készült a KFKI sokszorosító üzemében
Felelős vezető: Nagy Károly
Budapest, 1980. október hó