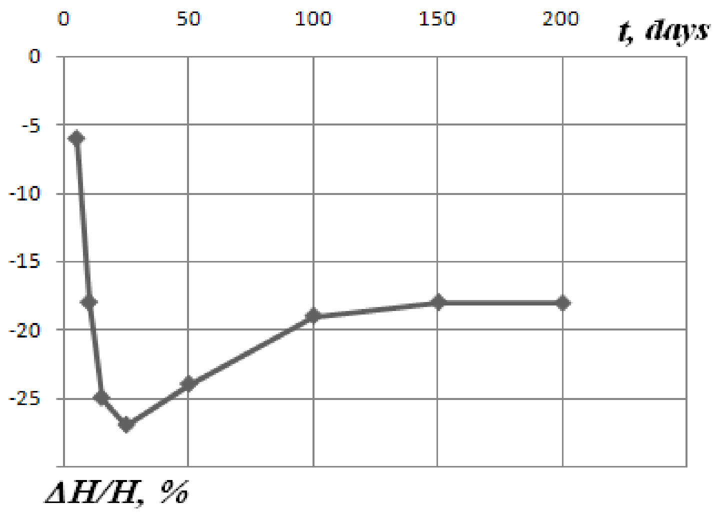
Effect of Constant Magnetic Field on the Properties of Amorphous Alloys based on Transition Metal

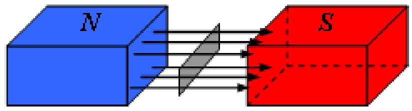
Tsaregradskaya T.L., Ovsiienko I.V., Kozachenko V.V, Kurilyik A.M., Saenko G.V., Kalenyk O.O., Turkov O.V.

Taras Shevchenko National University of Kyiv, Department of Physics
01601, Volodymyrska st. 64/13, Kyiv, Ukraine, E-mail: tsar_grd@ukr.net

The magnetic field is one of the thermodynamic factors that effect the kinetics and mechanisms of structural-phase changes in various materials and create an effective opportunity to influence the structure and, consequently, the functional properties of materials.



It is shown that the thermal stability of amorphous alloys after treatment in a magnetic field increases: for $Co_{67}Fe_3Cr_3Si_{15}B_{12}$ alloy the increase in thermal stability is maximum after treatment for **15 days** and is **70 K**, with further increase in processing time the effect decreases and after treatment for 50 days stabilizes at **40 K**; for $Ni_{40}Fe_{40}B_{20}$ alloy, the increase in thermal stability is maximum after treatment for **25 days** and is **50 K**, with a further increase in exposure time, the effect decreases and after treatment for **50 days** stabilizes and is **30 K**.



It is established that the micromechanical properties of amorphous alloys $Co_{67}Fe_3Cr_3Si_{15}B_{12}$ and $Ni_{40}Fe_{40}B_{20}$, the indicator of which is microhardness, under the influence of a magnetic field of **0.64 T** undergo the following changes: at the initial stages of the experiment up to **(15-25) days** there is a decrease in microhardness **(22-27%)** i.e. increasing the ductility) of alloys, and with increasing the time of exposure to the magnetic field to **(50-100) days** there is a gradual strengthening and reduction of microhardness is **(13-18)%.**

The value of the parameters in the thermal stability of the initial amorphous alloys and after the processing by the magnetic field

Amorphous alloys processing time in magnetic field, days	The onset temperature of intense crystallization, ^0C $\pm5\,^0C$	Temperature of complete crystallization, ^0C $\pm5\,^0C$	Crystallization interval, ^0C $\pm5\,^0C$
Initial alloy $Co_{67}Fe_3Cr_3Si_{15}B_{12}$	500	600	100
Processing by constant magnetic field 0,64 T			
5	505	600	95
10	525	640	115
15	570	700	130
25	550	690	140
50	540	705	165
100	540	700	160
Processing by constant magnetic field 0,64 T			
Initial alloy $Ni_{40}Fe_{40}B_{20}$	440	540	100
5	445	540	95
10	460	565	105
15	480	590	110
25	490	620	130
50	475	610	135
100	470	610	140

The nonmonotonic dependence of the relative change in microhardness and thermal stability of amorphous alloys on the time of exposure to the magnetic field is explained by the fact that magnetic treatment causes two competing processes that cause changes in these parameters: **fast acting - decay of clusters** (borides and silicides) and **long-term - the growth of frozen crystallization centers**, which leads to the strengthening of the structure, which causes a decrease in the magnetoplastic effect and the effect of increasing thermal stability.