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**PHYSICO-CHEMICAL PROPERTIES
OF THE AMORPHOUS ALLOYS BASED ON FERRUM
AFTER LOW TEMPERATURE TREATMENT**

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Influence of surface modification of the amorphous metallic alloys based on Fe: Fe_{59.0}Ni_{26.0}Cr_{6.3}Mo_{0.9}V_{1.6}W_{0.3}Si_{3.0}B_{2.9}, Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}, Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4} by low temperature (T = 77 K) on the electrochemical properties of aqueous solutions of NaCl, HCl, KOH was investigated.

Chemical activity of the samples of amorphous iron-based alloys in aqueous environments of potassium hydroxide and hydrochloric acid has been estimated for the first time.

It was shown that by selection cooling time physical and chemical properties of the amorphous alloys could be changed.

Ключові слова: amorphous alloys based on Fe, modification, low temperature treatment, corrosion resistance.

Structural modifications in amorphous metallic alloys (AMA) based on iron, due to various external influences with modification aim associated with the relaxation processes and are accompanied by relaxation and reduced excess of free volume. The changes of physico-chemical properties of the AMA were noticed [1–2], which can be used for application of different temperature-time modes with the aim of obtaining predetermined properties.

Considered using alloys Fe₅₉Ni₂₆Cr_{6.3}Mo_{0.9}V_{1.6}W_{0.3}Si₃B_{2.9}, Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}, Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4} in difficult temperature terms, it is important to carry out a complex research of changes of structural, mechanical and electrochemical parameters after low-temperature treatment. To spread the practical application of iron amorphous alloys in medicine, rationally to measure electrochemical parameters not only in standard corrosive medium of 0.5 M aqueous solution of sodium chloride, but also in 0.5 M aqueous solutions of hydrochloric acid and potassium hydroxide.

It was investigated the effect of low-temperature treatment ($T = 77\text{ K}$) on the physico-chemical properties of tape amorphous alloys $\text{Fe}_{59}\text{Ni}_{26}\text{Cr}_{6.3}\text{Mo}_{0.9}\text{V}_{1.6}\text{W}_{0.3}\text{Si}_3\text{B}_{2.9}$ (AMA-1), $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ (AMA-2) and $\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$ (AMA-3). Alloys obtained by melt-spinning method (106 K/s) in the form of a tape, width $\approx 20\text{ mm}$ and thickness $\approx 35\text{ microns}$ in the Institute for metal physics of NAS of Ukraine, Kyiv. For such amorphous metallic ribbons identifying contact (*c*) and external (*e*) sides which are characterized by different physico-chemical properties [3].

Changes of electrochemical parameters of the AMA tapes estimated by methods of chronopotentiometry and cyclic voltammetry in potentiodynamic mode with automatic scanning in time (20 mV/s) fixed potential of metal surface with electrode scheme: AMA-electrode – Ag/AgCl/KCl_{sat} and auxiliary electrode – Pt-plate. The measurements were carried out on Potentiostat type EP 20A.

X-ray analysis of AMA was carried out using diffractometer DRON-3M, CuK α radiation. Microscopic investigation of the elemental composition of the AMA surface and microphotographs of the surface with the increasing in 800 times were obtained using electron microscope-microanalyzer REMMA-102-02. Microhardness of the alloy samples, which previously had been cooling, was measured on the device PMT-3 under weight of 165 g.

Influence of low-temperature treatment on the electrochemical parameters of corrosion of the amorphous alloys based on Fe in 0.5 M aqueous solution of NaCl is mixed (fig. 1). According to the results of chronopotentiometric research of the AMA-1 in 0.5 M aqueous solution of NaCl, previous keeping of samples for (0.5–3.0) hours, 2 and 7 days in the environment of liquid nitrogen ($T = 77\text{ K}$) increases the corrosion resistance of the samples, potentials moves in anodic side, besides the keeping time at $T = 77\text{ K}$ do not affect corrosion characteristics. Chronopotentiometric investigation of changes in chemical activity of the AMA-2 showed moving of the potential values in cathodic side (the activation of the surface).

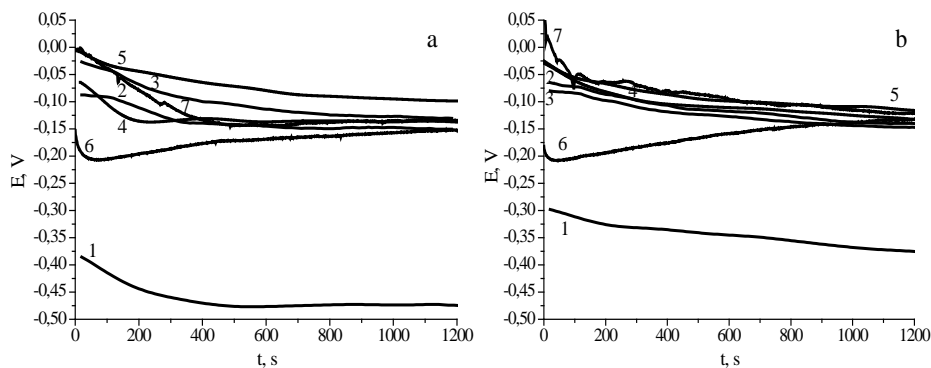


Fig. 1. Change of potential of contact (a) and external (b) sides of the AMA-1 in 0.5 M aqueous solution of NaCl: initial (1) and previously kept for 0,5 hour (2), 1 hour (3), 2 hours (4), 3 hours (5) and 2 (6) and 7 days (7) in the environment of liquid nitrogen ($T = 77\text{ K}$).

According to the research of influence of low-temperature treatment on the corrosion of the amorphous alloy $\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$ by cyclic voltammetry method (fig. 2)

previous exposition for 1 and 3 hours of samples of the AMA in liquid nitrogen decreases their corrosion resistance, which is reflected in increasing of corrosion currents and moving of corrosion potentials in cathodic side. Almost similar results are observed after two and seven days of low temperature treatment. After long exposition of the AMA-2, 3 samples in liquid nitrogen influence of time of low-temperature treatment smoothed, which was confirmed by practically the same corrosion parameters after 2 and 7 days of cooling.

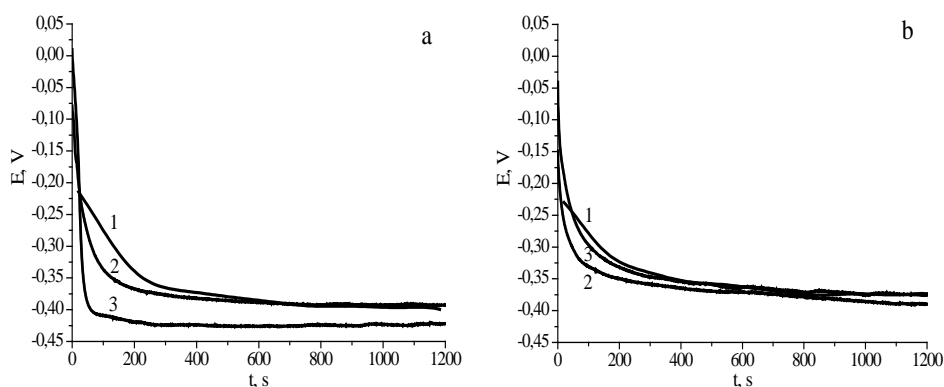


Fig. 2. Change of potential of contact (a) and external (b) sides of the AMA-3 in 0.5 M aqueous solution of NaCl: initial (1) and previously kept for 0,5 hour (2) and 7 days (3) at the environment of liquid nitrogen ($T = 77$ K).

Despite the specifics of each alloy, the fluctuations of free potential $\sim(0.05 \div 0.15)$ V confirms the high stability of the amorphous alloys $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ and $\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$ to a low-temperature treatment.

To estimate passing of redox processes in amorphous metallic alloys and investigate their resistance in aggressive environments, we used cyclic voltammetry (table 1, fig. 3). As a result of measuring of the AMA $\text{Fe}_{59}\text{Ni}_{26}\text{Cr}_{6.3}\text{Mo}_{0.9}\text{V}_{1.6}\text{W}_{0.3}\text{Si}_3\text{B}_{2.9}$ resistance in 0.5 M aqueous solution of NaCl we observed decreasing of corrosion resistance of samples, which implies moving of corrosion potentials in cathodic side, and increasing of corrosion currents.

Previous cooling of the AMA $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ for 1 and 3 hours, obviously, leads to the surface passivation, which leads to increasing of corrosion stability, corrosion potentials move in anodic side (table 1). However, the surface layers are not stable after long contact with aggressive environment and corrosion potentials move to cathodic side. Variable changes of external potential in aggressive environment are destructive for protective oxide-hydroxide surface layers [4]. After increasing of cooling time of samples electrochemical corrosion parameters change nonlinear.

So far as amorphous alloys can be used in medicine: to stitch bone, in blood clots capture filters and for cancer treatment [5], it was reasonable to investigate their electrochemical activity in acidic solutions after low-temperature treatment. In the initial state final values of sample potential in the environment of hydrochloric acid set in time, however, the form of the kinetic curve is determined by the elemental composition of

the alloy [6]. If AMA-1 potential moves in anodic side, passivating layers of insoluble compounds of alloy components are forming, which promote corrosion stability of this alloy, for AMA-2 – potentials move in cathodic side (table 2, fig. 4). Chronopotentiometric investigation of chemical activity of initial AMA-3 and previously kept in liquid nitrogen showed moving of potentials in anodic side (the passivation of the surface) (table 2).

Table 1

Electrochemical corrosion parameters of AMA in 0.5 M aqueous solution of NaCl: initial and previously cooled at $T = 77$ K depending on the number of scanning cycles

Cycle	Side	Cooling time									
		–		0.5 hour		1 hour		2 hours		3 hours	
		$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²
Fe₅₉Ni₂₆Cr_{6.3}Mo_{0.9}V_{1.6}W_{0.3}Si₃B_{2.9}											
1	c	0.25	1.58	0.60	3.98	0.59	3.89	0.56	3.63	0.45	3.67
	e	0.23	1.69	0.75	5.62	0.56	3.63	0.47	3.31	0.52	4.48
5	c	0.59	1.27	0.76	5.75	0.63	4.27	0.57	3.72	0.32	4.37
	e	0.61	4.07	0.73	5.37	0.63	4.27	0.53	4.78	0.54	8.23
10	c	0.47	2.28	0.60	3.98	0.6	3.98	0.68	4.78	0.64	3.78
	e	0.51	1.28	0.75	5.62	0.71	5.13	0.64	5.14	0.62	3.96
Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}											
1	c	0.92	1.04	0.76	1.87	0.75	3.27	1.06	1.55	1.03	1.97
	e	0.94	0.38	0.89	1.21	0.91	3.63	1.07	1.10	1.08	2.21
5	c	0.90	4.32	0.70	4.18	0.73	9.74	1.04	1.93	1.03	6.54
	e	0.91	1.24	0.86	3.80	0.86	10.23	1.05	0.78	1.04	1.88
10	c	0.87	2.86	0.64	5.44	0.71	7.98	1.02	1.04	0.85	1.45
	e	0.82	1.04	0.79	1.87	0.75	3.27	1.06	1.55	1.03	1.97
Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4}											
1	c	0.81	0.93	0.48	0.15	0.99	1.88	0.63	3.20	0.89	2.39
	e	0.63	1.23	0.87	0.04	0.68	1.56	0.49	3.59	0.21	2.55
5	c	1.02	1.92	0.84	0.12	1.06	1.74	1.00	2.11	0.96	3.38
	e	0.97	1.91	1.01	1.32	0.98	3.18	0.94	2.92	0.90	2.16
10	c	1.07	2.68	0.98	0.89	1.01	1.53	0.96	4.30	0.94	3.54
	e	1.11	3.16	0.99	1.24	0.99	2.31	0.94	3.86	0.90	1.38

Previously low-temperature treatment of the AMA-1 promotes increasing of samples stability in acidic solutions, initial potential values move in anodic side. The increasing of cooling time is an effective way of modification. Almost a similar results was observed for AMA-2 and 3.

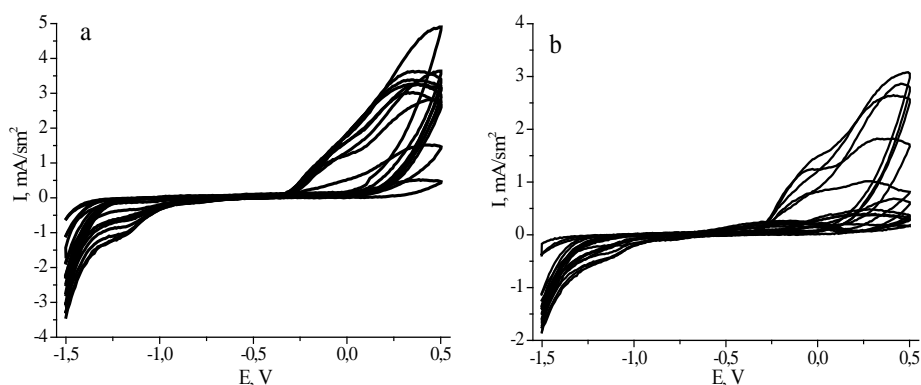


Fig. 3. Cyclic voltamperometry (10 cycles) of contact side of the AMA-3 in 0.5 M aqueous solution of NaCl: initial (a) and cooled for 3 hours at $T = 77$ K.

Table 2

Results of chronopotentiometric research of the AMA in 0.5 M aqueous solution of HCl previously cooled at $T = 77$ K

Cooling time	Side	$-E_0$, V	$-E_c$, V	ΔE , V	$v_{60} \cdot 10^4$, V/s
$\text{Fe}_{78,5}\text{Ni}_{1,0}\text{Mo}_{0,5}\text{Si}_{6,0}\text{B}_{14,0}$					
-	C	0.36	0.40	0.04	1.0
	E	0.37	0.39	0.02	0.7
1.0 hour	C	0.34	0.38	0.04	2.5
	E	0.38	0.38	0.00	1.2
3.0 hour	C	0.33	0.38	0.05	3.0
	E	0.41	0.38	0.03	5.5
7 days	C	0.32	0.36	0.04	3.4
	E	0.36	0.35	0.01	1.7
$\text{Fe}_{73,1}\text{Cu}_{1,0}\text{Nb}_{3,0}\text{Si}_{15,5}\text{B}_{7,4}$					
-	C	0.40	0.34	0.06	3.7
	E	0.39	0.33	0.06	2.8
1.0 hour	C	0.35	0.32	0.03	3.3
	E	0.36	0.33	0.03	2.5
3.0 hour	C	0.37	0.33	0.04	2.6
	E	0.35	0.33	0.02	2.2
7 days	C	0.36	0.33	0.03	2.9
	E	0.35	0.32	0.03	3.3

To investigate the stability of the samples in aggressive environment under the action of external loads were used voltammetry method of measuring chemical activity of the AMA-2 and AMA-3 with cyclic scanning of potential within $(-0.8 \div 0.00)$ V (table 3). The influence of aggressive environment, together with the additional imposition of

potential destroys the surface [6] of the AMA-3, with growing cycles number corrosion potentials (E_{corr}) move in cathodic side, while for AMA-2 more positive corrosion potentials may indicate formation of passivating layers.

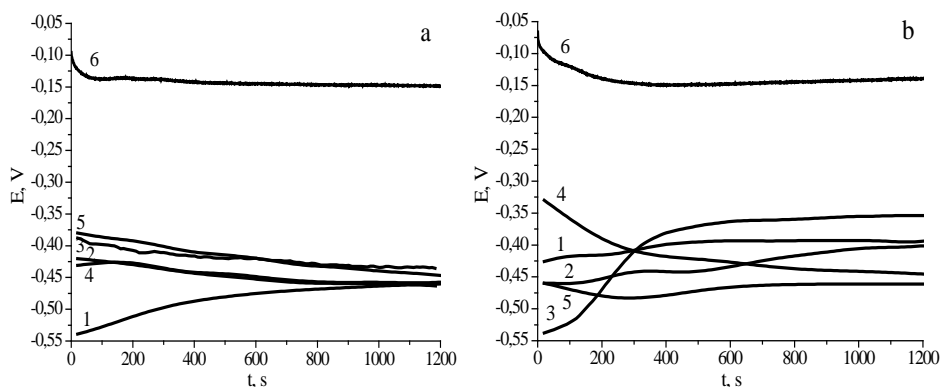


Fig. 4. Change of potential of contact (a) and external (b) sides of the AMA-1 in 0.5 M aqueous solution of HCl: initial (1) and previously kept for 0.5 h (2), 1 h (3), 2 h (4), 3 h (5) and 7 days (6) in the environment of liquid nitrogen at $T = 77$ K.

Alkaline environment (a solution of KOH) limits the products of corrosion of the iron subgroup to oxides Me_nO_m , hydroxides $\text{Me}(\text{OH})_m$ and oxidehydroxide MOOH . It is known [7–10], alloys based on iron passivate in alkaline medium at pH 10–14, at the first place forming oxides Fe_2O_3 and Fe_3O_4 . However, hydroxides $\text{Fe}(\text{OH})_2$ and $\text{Fe}(\text{OH})_3$ are characterized by the best isolating properties, they form a solid protective layer directly on juvenile surface of the amorphous metallic alloy. In the process of formation solid oxide-hydroxide layers an important role playing alloying components: Mo, Ni, and Si and B, which have good corrosion resistance in aggressive environment and high catalytic activity in many electrochemical processes.

The most stable was the investigated alloys AMA $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ and $\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$ in 0.5 M aqueous solution of potassium hydroxide, which determine their perspective using in alkaline solutions. After increasing of time of low-temperature treatment of the AMA $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ the final values of free potential move in anodic side (fig. 5, a), the corrosion resistance of both external and contact surfaces is improving.

It should be noted that for amorphous alloy AMA-3 doped by copper, values of anode potential are increasing, surface is passivated (table 4). This means that the surface of the alloy with Cu already actively oxidized in air and at the first moment protected by inert oxide film (CuO). Potential move in cathodic side after long contact with aggressive environment associated with transpassing dissolution of Fe through surface oxide layer [11].

Analysis of the electrochemical researches results indicates the increasing of stability of the AMA samples in alkaline solution after low-temperature treatment.

Electrochemical corrosion parameters of the AMA in 0.5 M aqueous solution of HCl: initial and previously cooled at $T = 77$ K depending on the number of scanning cycles

Cycle	Side	Cooling time									
		–		1 hour		3 hour		2 days		7 days	
		$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²
Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}											
1	c	0.44	2.87	0.41	2.95	0.39	4.09	0.37	4.24	0.40	2.56
	e	0.40	3.01	0.43	2.86	0.39	1.21	0.38	5.90	0.39	1.58
5	c	0.40	4.26	0.36	5.94	0.35	1.24	0.35	9.09	0.36	5.57
	e	0.37	2.85	0.36	3.41	0.36	5.88	0.35	6.40	0.35	7.11
10	c	0.38	4.46	0.35	5.91	0.35	2.84	0.34	13.75	0.35	5.46
	e	0.36	3.66	0.36	3.41	0.34	1.26	0.34	2.50	0.34	11.34
Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4}											
1	c	0.44	1.25	0.46	2.48	0.50	3.68	0.48	0.93	0.48	3.31
	e	0.56	8.02	0.48	1.73	0.49	3.38	0.46	2.02	0.45	3.49
5	c	0.46	3.22	0.49	0.97	0.48	1.12	0.48	1.29	0.41	1.15
	e	0.58	5.63	0.46	2.47	0.47	1.46	0.45	1.46	0.41	0.16
10	c	0.52	2.42	0.50	1.98	0.51	1.19	0.45	0.60	0.42	1.34
	e	0.54	6.16	0.49	1.79	0.50	1.64	0.43	0.68	0.43	0.16

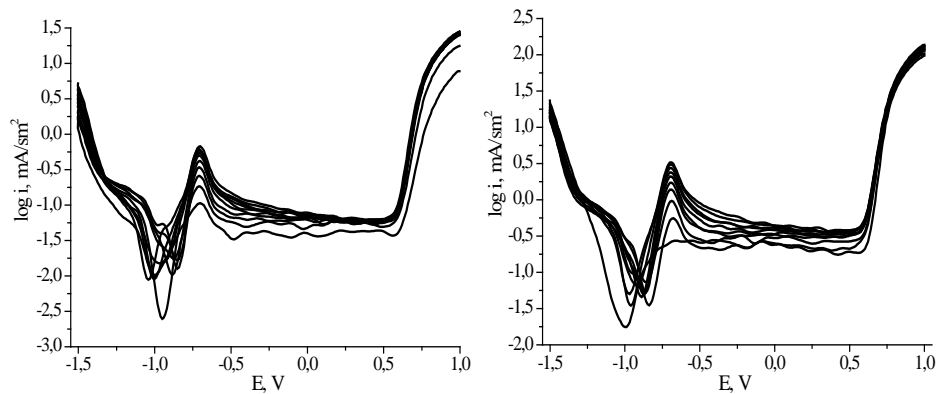


Fig. 5. Voltamperometric curves (10 cycles) of the contact (a) and external (b) sides of the AMA-2 in 0.5 M aqueous solution of KOH.

Investigation of the samples microhardness, which were under the influence of low temperatures showed that cooling of the AMA Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0} at $T = 77$ K leads to increasing of samples microhardness, and the change of microhardness of Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4} has nonlinear character (table 5). The obtained values of

microhardness of the AMA $\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$ confirm the high mechanical resistance of alloy, which is not amenable to the influence of low-temperature treatment and also there are no significant changes in the structure (table 5).

Table 4

Electrochemical corrosion parameters of the AMA in 0.5 M aqueous solution of KOH: initial and previously cooled at $T = 77$ K depending on the number of scanning cycles

Cycle	Side	Cooling time									
		–		1 hour		3 hour		2 days		7 days	
		$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²	$-E_{\text{corr}}$, V	$i_{\text{corr}} \cdot 10^4$, A/sm ²
$\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$											
1	c	1.00	1.03	1.06	2.62	1.04	2.26	0.94	1.44	0.93	2.37
	e	0.99	1.76	0.87	1.78	0.88	1.67	0.82	0.61	0.80	2.30
5	c	0.88	1.04	0.92	1.72	0.89	4.78	0.82	0.76	0.78	8.94
	e	0.86	5.28	0.90	4.77	0.90	3.74	0.82	1.24	0.81	6.34
10	c	0.84	0.88	0.91	6.10	0.86	2.24	0.80	1.87	0.76	10.05
	e	0.82	3.48	0.90	2.91	1.03	3.27	0.84	2.16	0.82	8.32
$\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$											
1	c	0.78	2.20	0.65	1.21	0.69	1.72	0.63	1.98	0.59	2.54
	e	0.76	1.16	0.67	0.71	0.67	1.15	0.65	1.46	0.68	0.71
5	c	0.72	2.51	0.58	1.53	0.69	0.97	0.60	3.88	0.53	2.95
	e	0.76	1.94	0.62	1.18	0.62	0.87	0.63	4.48	0.53	2.65
10	c	0.69	1.85	0.53	1.68	0.65	2.81	0.60	3.32	0.46	3.77
	e	0.71	1.25	0.59	1.73	0.56	0.22	0.58	5.69	0.52	2.24

Table 5

Microhardness ($H_b \times 10^9$, Pa) of samples of the amorphous alloys based on Fe cooled at $T = 77$ K

AMA	Cooling time, hour				
	–	0.5	1.0	2.0	3.0
$\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$	10.03	11.70	11.47	11.65	11.30
$\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$	12.96	14.87	17.39	14.36	12.83
$\text{Fe}_{59.0}\text{Ni}_{26.0}\text{Cr}_{6.3}\text{Mo}_{0.9}\text{V}_{1.6}\text{W}_{0.3}\text{Si}_{3.0}\text{B}_{2.9}$	8.78	10.25	8.40	10.53	8.18

By x-ray microanalysis measured elemental composition of the AMA before and after low-temperature treatment (table 6). After 2 and 3 cooling hours contact surface of the AMA-2 became more electrochemically active than external, because of the obtaining

technology of the AMA tape solidifying for a parts of second later, and already containing nanocrystalline phase with oxide layer, which increases its stability.

Table 6

Element composition of the AMA surface (atomic %) before and after cooling at T = 77 K for 3 hours

AMA	Element							
	Fe	Ni	Mo	Cr	V	W	Cu	Nb
AMA-1	56.40	29.60	0.57	7.15	1.94	1.69	–	–
AMA-1 (T = 77 K)	58.30	29.70	0.26	7.53	2.12	0.14	–	–
AMA-2	92.95	1.30	1.49	–	–	–	–	–
AMA-2 (T = 77 K)	92.87	1.10	1.20	–	–	–	–	–
AMA-3	84.41	–	–	–	–	–	1.47	7.03
AMA-3 (T = 77 K)	86.45	–	–	–	–	–	1.74	7.11

For multi-component alloy AMA-1 after cooling down to the temperature of liquid nitrogen and warming up to the room temperature, we observed increasing of iron content on the alloy surface, as well as increasing content of elements such as Ni, Cr, W. As for molybdenum, a small amount of it after 3 cooling hours obviously shielded on the surface by other chemical elements, such as Ni, Fe, Cr, V. Cooling of alloy, obviously, accompanied dissociation adsorption of water from residual atmosphere with formation of surface hydroxides [12]. The content of metallic elements on the alloy surface which contains Cu and Nb (AMA-3) is also increasing, while the alloy surface with Ni and Mo (AMA-2) depleted on metal elements.

Conclusions

By chronopotentiometric method it was shown that cooling of the AMA $\text{Fe}_{59.0}\text{Ni}_{26.0}\text{Cr}_{6.3}\text{Mo}_{0.9}\text{V}_{1.6}\text{W}_{0.3}\text{Si}_{3.0}\text{B}_{2.9}$ at T = 77 K increases its corrosion resistance in 0.5 M aqueous solution of NaCl, and for $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ and $\text{Fe}_{73.1}\text{Cu}_{1.0}\text{Nb}_{3.0}\text{Si}_{15.5}\text{B}_{7.4}$ the low-temperature treatment activates the alloys surface, corrosion potentials (E_{corr}) move in cathodic side. After voltamperometric investigation corrosion stability of the alloys AMA-1,3 in 0.5 M NaCl decreased, and for $\text{Fe}_{78.5}\text{Ni}_{1.0}\text{Mo}_{0.5}\text{Si}_{6.0}\text{B}_{14.0}$ increased. Low-temperature treatment is changing the elemental composition of the surface layer, that clearly registered by electrochemical methods in the process of interaction with an aggressive environment. The previous low-temperature treatment of samples increases the system stability in aqueous solutions of HCl and KOH.

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РЕЗЮМЕ

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**ФІЗИКО-ХІМІЧНІ ВЛАСТИВОСТІ АМОРФНИХ МЕТАЛЕВИХ СПЛАВІВ НА ОСНОВІ
ФЕРУМУ ПІСЛЯ НИЗЬКОТЕМПЕРАТУРНОЇ ОБРОБКИ**

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Досліджено вплив модифікації поверхні аморфних металевих сплавів (АМС) на основі Fe: Fe_{59,0}Ni_{26,0}Cr_{6,3}Mo_{0,9}V_{1,6}W_{0,3}Si_{3,0}B_{2,9}, Fe_{78,5}Ni_{1,0}Mo_{0,5}Si_{6,0}B_{14,0}, Fe_{73,1}Cu_{1,0}Nb_{3,0}Si_{15,5}B_{7,4} шляхом низькотемпературної обробки (T = 77 K) на електрохімічні характеристики у водних розчинах NaCl, HCl, KOH.

Вперше оцінено хімічну активність зразків аморфних сплавів на основі заліза у водних середовищах калій гідроксиду та хлоридної кислоти.

Показано, що підбором тривалості низькотемпературної обробки можна змінювати фізико-хімічні властивості аморфних сплавів.

Ключові слова: аморфні сплави на основі Fe, модифікація, низькотемпературна обробка, корозійна стійкість.

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