PECULIARITY OF MAGNETIC AMORPHOUS ALLOYS MODIFICATIONS

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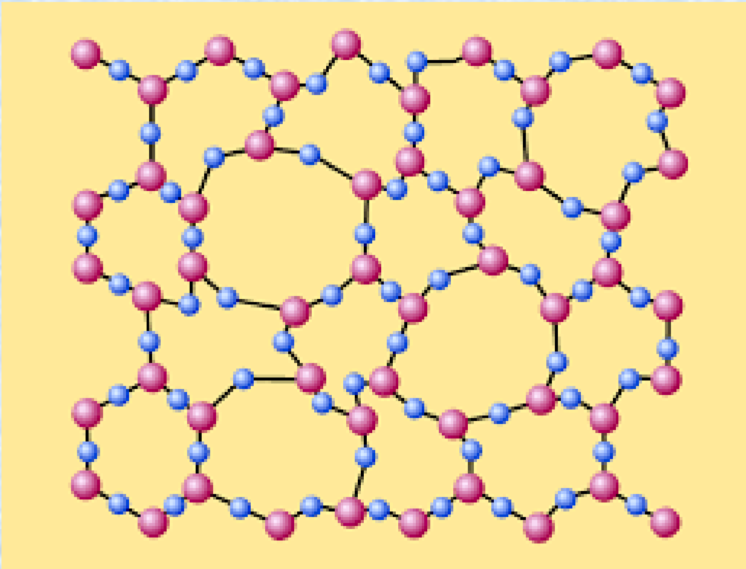
$Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}$ (Fig. 1) and **$Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4}$** alloys, which, along with Fe, contain Ni, Mo or Cu, Nb and are characterized by high values of specific magnetization $\sigma \approx 138 A \cdot m^2/kg$, were studied, considering the high magnetic susceptibility of amorphous metallic alloys (AMA) based on iron and their extensive use in various fields of electric engineering [1-7]. The density of the alloy is decreased by the components with serial numbers higher than that of iron due to a change in the packing of solid spheres of different diameters and the transfer of external electrons from amorphizing boron additives to iron. However, these elements substantially improve the magnetic properties of AMA and control thermal structuration, which is the first stage of modification of the surface and its preparation to the second stage, namely, the application of the polymeric coating [8, 9] .



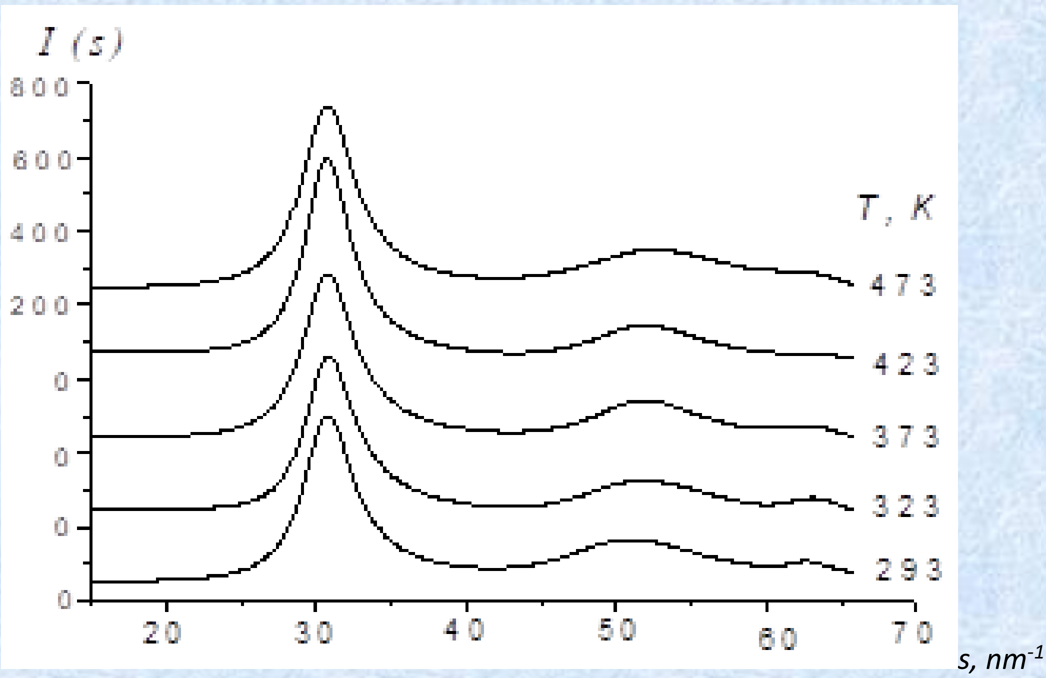


Fig. 1. XRD patterns of AMA $Fe_{78,5}Ni_{1,0}Mo_{0,5}Si_{6,0}B_{14,0}$ annealed at 293 and 473 temperatures.

The potentiometric investigations showed that the potentials that arise at the first moment of contact of the electrode with the corrosive medium and reach constant values after a certain time are substantially different for both alloys (see Fig. 2).

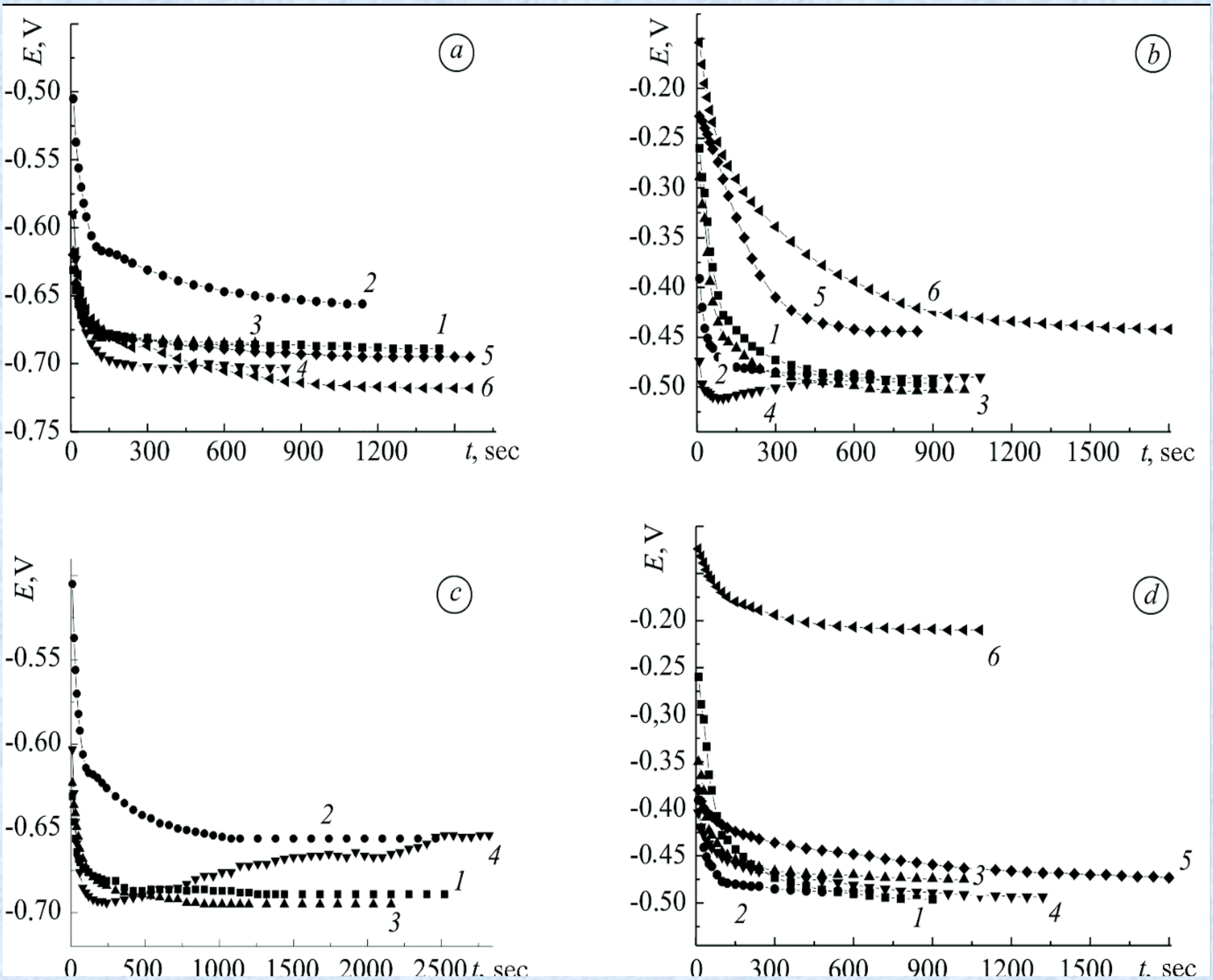


Fig. 2. Rate of reaching a stationary potential in 0,5 M NaCl for the contact side (1, 3, 5) and the outer side (2, 4, 6) of the $Fe_{78.5}Ni_{1.0}Mo_{0.5}B_{6.0}Si_{14.0}$ AMA (a, c) and $Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4}$ AMA (b, d) coated by an OP film (1, 2), coated by the same film after preliminary 1 h heat treatment (HT, OP) (a, b) at 373 K (3, 4) and 473 K (5, 6), and coated by an OP film (1, 2) with subsequent 1 h heat treatment (c, d) at 373 (3, 4) and 473 K (5, 6).

The preliminary heat treatment of the AMA before the application of an oligomeric film and also the 1 h annealing (at 373–473 K) of samples coated by a film cause the fixation and consolidation of the protective cover. Regardless of the duration of application and sequence of heat treatment of samples, the contact side of the $Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}$ AMA oxidizes easier than the external side. The opposite regularity is shown for the $Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4}$ AMA.

The results of the measurement of the resistance to charge transfer through the "polymeric layer–metal surface"interface (R_2) and the capacitance of the double electric layer (Q_{dl}) by the EIS method and the roughness of the surfaces (R_f) of $Fe_{78.5}Ni_{1.0}Mo_{0.5}B_{6.0}Si_{14.0}$ and $Fe_{73.1}Cu_{1.0}Nb_{3.0}Si_{15.5}B_{7.4}$ in 0.5 and 0.05 M aqueous solutions of NaCl (Fig. 3, Tables) confirm that the outer side of the $Fe_{78.5}Ni_{1.0}Mo_{0.5}B_{6.0}Si_{14.0}$ strip has a larger affinity to the polymer. The resistance R_2 on the polymer–metal interface is higher than the contact resistance (R_1).

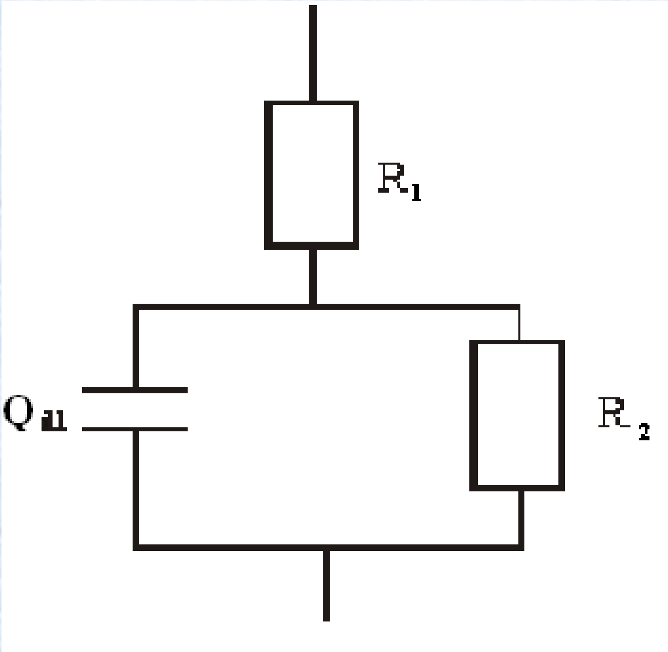


Table. Results of Electrochemical Impedance Spectroscopy of Specimens of an $Fe_{78.5}Ni_{1.0}Mo_{0.5}B_{6.0}Si_{14.0}$ Alloy Coated by an OP Film and Heat Treated in a 0.5 M Aqueous Solution of NaCl

Modification	Side	R_1, Ом	E, В	R_2, Ом	$Q_{dl}\cdot10^4$, Ф·см$^{-2}$	α	R_f
373 К + OP	con.	51,54	-0,68	916	7,40	0,59	3,70
	out.	52,31	-0,61	476	6,64	0,67	3,32
473 К + OP	con.	60,38	-0,70	1803	7,96	0,70	3,98
	out.	53,54	-0,64	756	3,65	0,72	1,83
OP + 373 К	con.	56,30	-0,69	1849	13,64	0,63	6,82
	out.	59,34	-0,61	396	28,52	0,82	14,26
OP + 473 К	con.	58,24	-0,63	766	16,45	0,91	8,23
	out.	56,05	-0,57	271	24,63	0,73	12,32

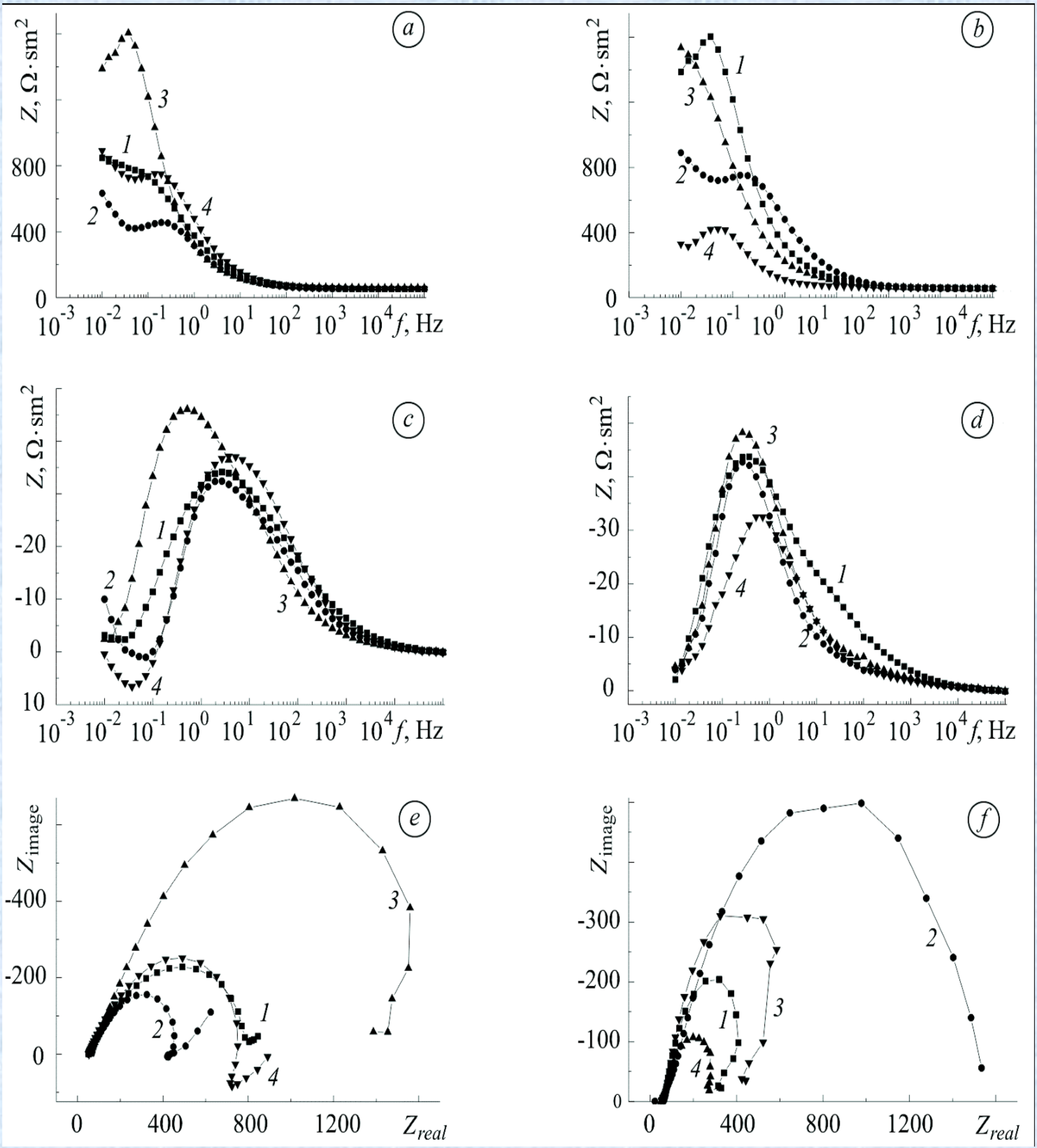


Fig. 3. Dependence of the impedance modulus and phase angle on the frequency of current and Nyquist curves for the contact (1, 3)and outer (2, 4) sides of the $Fe_{78.5}Ni_{1.0}Mo_{0.5}Si_{6.0}B_{14.0}$ AMA after 1 h heat treatment at 373 K (1, 2) and 473 K (3, 4) and the subsequent (a, c, e) and preliminary (b, d, f) coating by an OP film in a 0.5 M NaCl solution.

CONCLUSIONS

The results of the electrochemical investigations indicate that, in 0.5 and 0.05 M aqueous solutions of NaCl, not only the alloys of different composition but also the contact and outer sides of each AMA strip differ in reactivity.

To optimize the modification of the surfaces of strip amorphous metallic materials, one must take into account not only the differences in the elemental compositions of the alloys, but also the contact and outer sides of AMA strips, which substantially affect the formation of protective polymeric layers.

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