STRUCTURE CHARACTERIZATION OF MULTICOMPONENT AMORPHOUS ALLOYS BASED ON ZIRCONIUM

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For the last years multicomponent amorphous and nanocrystalline systems attract a special attention of new materials developers. In particular, intensive investigations in search of enhanced radiation resistance materials are carrying out. Such materials are the amorphous alloys based on zirconium.

In the present work using X-Ray diffraction patterns we have studied structure characteristics of $Zr_{57}Cu_{15.4}Ni_{12.6}Al_{10}Nb_5$ amorphous bulk alloys before and after irradiation by low energy deuterium plasma ions. We applied the method of construction of radial distribution function (RDF) by means of Fourier transformation of interference function i(S), where S is wave vector. Using this method for multicomponent systems it is possible to determine radii of coordination spheres and total number of nearest neighbors in first coordination sphere (coordination number N_G) [1]. X-Ray diffraction measurements were carried out with reflection technique using DRON-2 diffractometer with Cu K_α radiation in θ-2θ geometry and with crystal-monochromator. Algorithm of RDF calculation was realized in special program in MatLab environment.

Diffraction patterns of the samples before and after irradiation revealed broad halo that was evidence of amorphous state of alloy. Interference function and RDF are shown in Fig1a,b. Position of the first RDF peak r_1 = 3,20 Å practically coincides with doubled radius of zirconium atom (R_{Zr} = 1,59 Å) which is the largest in size and in number among other atoms of system. The coordination number before irradiation N_G = 13,4.

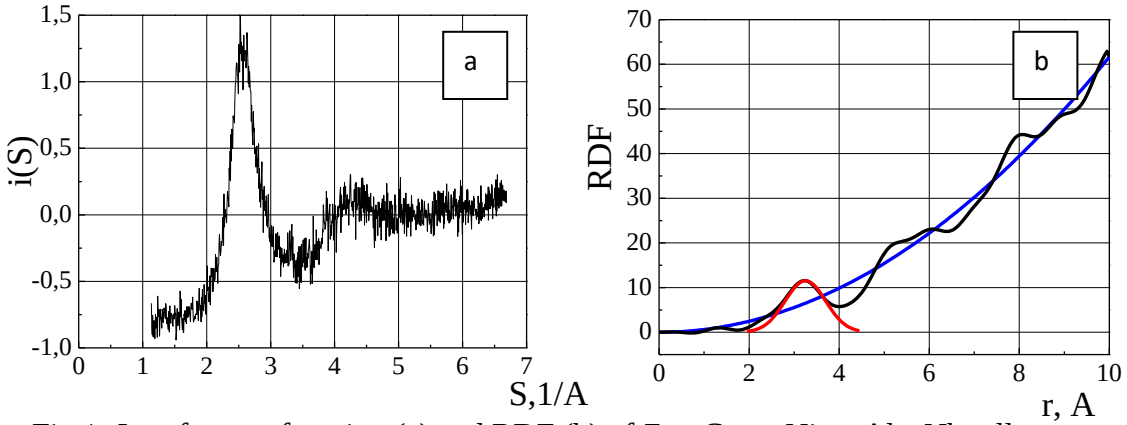

Fig.1- Interference function (a) and RDF (b) of Zr_{57} $Cu_{15.4}$ $Ni_{12.6}$ Al_{10} Nb_5 alloy

Calculations for irradiated samples show that the first peak position shifts to lower values r_1 = 3,15 Å (0,05 Å lesser). To explain this effect we used a mechanism of exchange of dissimilar atoms between the first and the second coordination shells as result of impact under irradiation.

Література:

[1] Glassy Metals II: Atomic Structure and Dynamics, Electronic Structure, Magnetic Properties: Edited by H.Beck and H.-J.Güntherodt. – Springer-Verlag, Berlin, 1983.