P-Tu-36

Martensite γ→α transformation in deformable stainless steels irradiated with ions and pulse electron flows

A.V. Russakova, D.T. Berdaliev, O.P. Maksimkin, K.V. Tsay

Institute of Nuclear Physics NNC RK, Almaty
http://www.enu.kz .

It was revealed earlier that intensive influence of high energy particles can lead to formation of thin ferromagnetic layers on surface of austenitic stainless steels/1/. Along with that it is noticed that occurrence of a ferromagnetic layer took place at evaporation of easy volatile components (Cr, Mn) from paramagnetic material /2/.

It is not excluded that the favorable conditions (temperature, an irradiation) for this effect can develop on surfaces of constructional materials of the first wall of thermonuclear facilities in the conditions of their operation. Thus formation of magnetic layers can be promoted by the blistering phenomenon, and also by the martensite γ→α transformation.

Thereupon in the present work the influence of irradiation with light (C, N, Ti) and heavy (WC, ^{84}Kr) particles, and also with pulse electron flow (E=200-500 keV, g=10^7-10^{10} W/cm^2) on characteristics of durability and plasticity at stretching and fatigue tests, and also regularities of non-diffusive γ→α transition in a corrosion-proof industrial steel 12Cr18Ni10Ti and austenitic nickel less steels Cr15Mn14 were investigated.

By means of transmission electronic microscopy and magnetometry methods the dislocation structure and phase structure of the near-surface layers modified by an irradiation was investigated.

In particular, it was established that as a result of influence on materials of pulse electronic beams in deep layers of 12Cr18Ni10Ti steel the dislocation structure, typical for strongly deformed material with low energy of packing defect is formed. The increase of power density over $5\cdot10^8$ W/cm^2 has led to the formation of developed cellular dislocation structure which evolution comes to the end with origin and development of martensite α - phase.

For 12Cr18Ni10Ti steel, implanted by C and N ions, durability at low-cycled fatigue tests was defined, vicissitude of destruction process was revealed and the important role of γ→α transformation kinetics in formation of fatigue properties of the metastable steel was shown. As a result of the steel irradiation with heavy ^{84}Kr ions with energy E=1.56 MeV /nucleon and fluence 1x10^{15} particles/cm^2 in the near-surface layer according to electronic- microscope researches so-called α – «irradiation martensite» is formed.

Bombardment of the deformed samples of Cr15Mn14 steel by WC ions with energy of 50 KeV has led to the appreciable change of their magnetization which is connected with formation of so-called «elastic α - martensite» which content changed as a result of loading removal and repeated loading of plastically deformed steel.

References

[1] V.K.Shamardin, Z.E.Ostrovsky, A.M. Pecherin, V.M.Kosnkov, V.V. Jakovlev, F.V.Risovannaja. Research of screen assemblage e-26 cover after 22-year-old exploitation in BOR-60 reactor. In the

book “Collection of reports of the fifth interbranch conference on reactor material science”. Vol.2.part2., Dmitrovgrad 1998.,p.25-40;
[2] G.S.Krinchik, L.V.Nikitin, L.I.Ivanov, G.G.Bondarenko, G.M.Fedichkin “Magnet-optical method of the first wall of thermonuclear reactor material research”, given by academician B.B.Kadomtsev 20 V II 1987, p. 839-841.