Nanocomposites and nanomaterials

The effect of cyclic martensitic transformations on diffusion of cobalt atoms in Fe-18wt.%Mn-2wt.%Si alloy

V.E. Danilchenko, A.V. Filatov, V.F. Mazanko, V.E. Iakovlev

Induced Martensitic Transformations Department, G.V. Kurdyumov Institute for Metal Physics, NAS of Ukraine, Vernadsky Blvd. 36, Kyiv 03142, Ukraine.
E-mail: zvik83@mail.ru

Diffusion characteristics of cobalt in Fe-18wt.%Mn-2wt.%Si alloy after cyclic γ–ε–γ martensitic transformations were studied using the radioactive isotopes method. The observed significant increase of diffusion mobility of cobalt atoms under the cyclic γ-ε-γ martensitic transformations was due to the action of two independent mechanisms - an athermal one and a thermally activated one. The first one arose from the direct γ-ε and the reverse ε-γ transformations with corresponding direct and reverse lattice shears during alternating stresses and simultaneous lattice restructuring. The another mechanism arose under the diffusion annealing of the phase-hardened alloy. As a result of thermal cycling, defects of the crystal structure accumulated in the lattice: dislocations, low-angle subboundaries, the chaotic packaging defects, all of them being the ways of the diffusion acceleration. With increasing the degree of the phase-hardening (to 100 γ-ε-γ cycles), the penetration depth of atoms of the isotope increased twice and the diffusion coefficients after the first cycle and 100 cycles were equal $2{,}95*10^{-13}$ and $9{,}29*10^{-13}$ cm^2/s respectively.

The crystal structure defects formation in metastable alloys under the cyclic martensitic γ-ε-γ transformations and the following significant increase of the diffusion mobility of substituents at low temperatures opens up new opportunities for the creation of more intensive methods of chemical and thermal treatment. Due to the preliminary phase hardening, the temperature of the surface metallization of metastable iron-manganese alloys can be reduced by several hundred degrees.

1. *Gercriken S.D., Dekhtyar I.Yu.* Diffusion in metals and alloys in the solid phase // Moscow: Nauka.- 1960.
2. *Brick V.B., Kumok A.M., Nickolin B.I., Falchenko V.M.* Effect of phase transformations on the diffusion mobility of atoms in iron-and cobalt alloys // Metalls.- 1981. -**4.** P. 131-135.
3. *Kolobov Yu.R., Valiev R.Z., Graboveckaya G.P.* Grain-boundary diffusion and properties of nanostructured materials // Novosibirsk: Nauka.- 2001.