Секція: МАТЕРІАЛОЗНАВСТВО, МІЦНІСТЬ КОНСТРУКЦІЙ ТА БУДІВНИЦТВО

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P. Vasylyuk
Тернопільський національний технічний університет імені Івана Пулюя, Україна

STRUCTURE-PHASES TRANSFORMATION OF THE Fe-Cr ALLOYS

The work is dedicated to development of theoretical approaches and methods of solution of the scientific-techical problem of new corrosion resistant and heat resistant alloys of the Fe-Cr system creation, which are based on physical-chemical processes control on the border alloy- silicate melt, air under the influence of electromagnetic field and give the possibility to construct-phase of the surface layers and predict the service characteristics value.

Sanctified to research of structure-phases transformations of high temperature alloys of Fe – 35, 40,75, 85, 95%Cr, alloyed Al, Si, Mo, W, Ti, Co, La, Ce, Y for the workers of temperatures to 1673K both as to the loss and to the increase weight, that gives an opportunity to work out new casting alloys. Influence of every element is described, or them compatible operating on firmness of alloys in oxidation environments.

The physical-chemical approaches of the base alloys are worked out. In these approaches calculation of electronic vacancies in solid solutions is used, which allows to avoid the brittle σ –phase formation. The influence of the alloys corrosion constants, values of the –exponential factor, as well as the influence of diffusion coefficient values of the alloys components in oxides on the kinetics of structural-phase state formation in the surface layers are evaluated.

The influence of the alloying elements of the alloys on the interaction with silicate melts of various chemical composition is also studied.The discovered structural-phase transformations are connected with σ –phase formation as well as with the low temperature eutectic $Fe+Fe_2B$ formation for the alloys on the Fe base and the high temperature eutectic $Cr+Cr_2B$ formation for the allos on the Cr basis when interaction with Al-B-Si melt takes place.

As it follows from equation such elements as N, Al, Si, Ti, Co decrease and such elements as Mo, W increase the value N_v.

N_v =3,495-12,93N-6,278Al-6,021Si-3,203Ti-0,847Co –1,45AlW-1.386SiW-1.389CoN-0.67AlCo +2,068Mo +1,164W (1)

Carried out calculation show that for the alloys content more than 56% Cr possible the transformation phases α→ α+σ, with addition Al and Si. But addition 2% Mo or 4% W are results opposite. transformation phases: α+σ→ α.

N_v =27475-2558.7Ti-1431.3Al-1408 Si-520.9N-405.9 Co+ 666.3W + 652Mo-16.46AlW-8.2SiCo-7AlCo-3.44AlMo+ $7.8N^2$ +9.2 W^2+7.5 AlN +4.96SiN (2)

As it follows from equation (2) such elements as N, Al, Si, Ti, Co , and also alloying addition Al-W, Si-Co, Al-Co decrease and such elements as Mo, W and AlN, SiN increase the value N_v.

Using mathematical planning of the experiment by the FACOMP system, that allows to prevent the σ-phase formation on the basis of calculation of the uncompensated d-electrons quantity per atom at alloying, the composition of the basic investigation objects was determined (Fe-35%Cr and Fe-75%Cr) as well as the optimal alloying systems on the basis of Al, Si, W, Mo, Co and REM were selected. It was demonstrated, that they consist of surface oxides, an internal oxidation zone, a nitride layer and the σ-phase; the presence of the two last components worsens corrosion- and heat-resistance. The features of the multilayered oxide

film formation on the Fe-Cr alloys were studied; the structural-phase composition of the film was established and the components diffusion mobility was determined. For the first time the effect of Al and Si diffusion mobility increase as well as Fe and Co diffusion mobility decrease in the alloyed Fe-Cr alloys under the action of alternate electromagnetic field was discovered. The model, which describes the process of the multilayered oxides formation under the action of electromagnetic field at the temperatures 1273-1673 K in the air and in the Al-B-Si melts, was suggested.

Investigational to cooperating of alloys with silicate fusion, on air in the conditions of the electric heating of alloys to the working temperature. The educed effect of extrusion of aluminium and silicon is on a surface in the conditions of the electric heating what gives an opportunity to manage forming of oxides of aluminium, silicon and magnetic oxides of spinel type-$FeCr_2O_4$, $CoCr_2O_4$.

The mechanism of cooperation of alloys is described in oxidation environments and in the conditions of action of electric current.

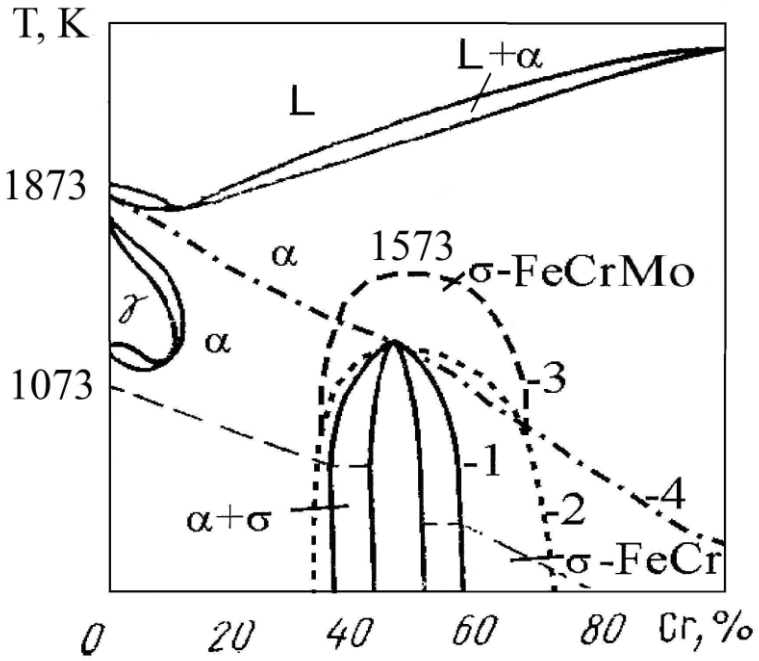

Fig.1. Diagrame state of system Fe-Cr
1-balance; . 2- calculated; 3- experimental; 4- metastability

The feature of this monograph are descriptions of structure-phases transformations of alloys depending on the temperature-sentinel modes and their influence on operating properties. The described calculation model gives an opportunity to forecast structure-phases transformations and, thus, shorten the search of the alloying systems. The special attention is spared to forming and transformation of fragile σ -phase.

Gradient structure is formed under the influence of simultenous effect of high temperature and electromagnetic field. They may operate in the conditions of high frequency when the generater is used as well as in the conditions when the powerful transformators of the production frequency are used too. The action of the electromagnetic field is different for different elements, especiflly for the diamagnetic atoms.

It was found that the electromagnetic field effect leads to the formation of multi-level alloy structure, that is, layer distribution according to chemical and phase composition. The effect of diamagnetic particles pushing out of the alloy into the surface metal layers and formation of the Al, Cr oxides layer by layer is determined.