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NANOSIZED STABILIZATION OF THE HIGH-TEMPERATURE PHASES

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The search of the conditions for obtaining high-temperature modifications of some the real stuff phase terms and stabilization of their structures in wide temperature range, starting from room temperature, is actual.

One of the most famous examples of those materials is so called stabilized ceramics on basis of zirconium oxide.

Another examples are rapidly tempered high-alloy instrumental steels, which contain complex cube (Mn-like) phases. The steels from the physical-chemical point of view are multicomponent systems on basis of Fe-C, where Mn-like phases in crystal-structural aspect are analogs of δ-, γ-, α- and β- polymorphous modifications of elementary Mangan.

The formation of substitutional and/or interstitial solid solutions on basis of binary π-and χ- (phase type - α-Mn) intermetallic phases of Fe–Mo systems is one of the famous methods of Mn-like structures stabilization in multicomponent alloy on basis of Ferum.

The purpose of this study is the ascertainment of the additional factors, which promote the stabilization of the high-temperature phases – cube polymorphous modification in the individual substance of zirconium oxide and phase with β-polymorphous modifications of elementary Mangan in binary Fe–Mo alloys structure type.

The samples for research were laser films of zirconium oxide vacuum condensates, powder of cast alloys of binary metallic Fe–Mo system and free and contact surfaces of rapidly tempered tape of Fe–Mo system. Vacuum condensates were obtained by the laser evaporation method. Original powder of zirconium oxide has been pressed into tablets. The evaporation of the tablets was in the vacuum chamber with excessive pressure 10^{-3} pascal.

The deposition of films occurred in one laser pulse. Condensates with thickness of ~0,5 micrometers have been researched. Cooling rate value of liquid phase was about 10^7 K/s.

Rapidly tempered tapes have been obtained by spinning method. Precursor components were rod Mo(99,96%) and zone melting Ferum.

The structure of given materials has been studied by diffraction methods. Phase composition has been ascertained by full-profile analysis of X-ray diffraction pictures.

The formation of zirconium oxide monoclinic modification have been registered with radiography in the vacuum condensates of zirconium oxide at all deposition temperatures.

By the method of the electron diffraction in the condensates, which have been obtained at all temperatures, also the formation of zirconium oxide monoclinic modification have been registered.

With radiography in $Fe_{63}Mo_{37}$ cast alloy have been registered the formation of the two phases - σ- and μ- stable binary intermetallic phases on basis of Fe-Mo and Fe_7Mo_6 stoichiometries accordingly. Mn-liked phases haven't been found by the diffraction methods.

The radiographic examination results of spinning types of the same composition affirm that enhancing of the cooling rate of the initial melt from 10^2 (cast alloy) to 10^5–10^6 K/s (free-contact surfaces of spinning types, accordingly) substantially changes the conditions of phase formation in the samples.

Electron microscopical study of the samples of spinning Fe–Mo types indicate the formation of nanodisperse crystallite with average linear dimension about 60 nm, their electron diffraction confirm the fact of π-phase formation.

The structure researches of different objects with different chemical nature and obtained in different ways demonstrated the possibility of formation and stabilization high-temperatures phases at low temperatures – cube polymorphous modification of ZrO_2 and π-phase β- polymorphous modifications of elementary Mangan type. Common factors of structure formation of samples, which contain those phases, are high cooling rate of initial liquid phase and the way of those phases formation – straight from melt. As a result, highdisperse crystallite of high-temperatures phases are formed and significant influence of the size effect on phase relation is observed.