THE GENERAL REGULARITIES OF FORMATION IN HYDRIDE CYCLE OF ALLOYS IN Ti-Zr-H; Ti-Hf-H; Zr-Hf-H; Ti-Zr-Hf TRIPLE SYSTEMS

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Introduction

In the Laboratory of high-temperature synthesis of IChPh of Armenian NAS, an essentially new, earlier unknown effective method has been developed for receiving the alloys of refractory metals. It consists in compaction of mixture of powders of metal hydrides followed by dehydrogenation [1]. The method is based on the reaction:

$x\text{Me}'\text{H}_2+(1-x)\text{Me}''\text{H}_2 \rightarrow \text{alloy } \text{Me}'_x\text{Me}''_{(1-x)}+\text{H}_2\uparrow$

This method was named "hydride cycle" method of alloys receiving. The initial hydrides used in this method were received by Self-propagating High-temperature Synthesis (SHS) technique. These hydrides are characterized by high dispersibility down to micro and sub-micro sizes of grains (the size of crystallites 20-80 nm), as well as by ability to compaction and formation providing good contact of grains and consolidation of initial reagents**.**

Results and discussion

As a result of curried out investigations, a series of alloys of IVB group metals has been received of α-modification (in accordance with the state diagram) but the unusual for the state diagram of Ti-Zr and Ti-Hf systems, ω-modification alloys have been received also. The formation of binary and triple alloys from the hydrides is conditioned by the several processes occurring simultaneously. The process has been essentially influenced by: the nature of Me-H chemical bond, hydrogen content, crystal structure and structural defects of initial hydrides, their plasticity, phase transitions at dehydrogenation, high dispersibility, rather low temperature of decomposition, etc. The interaction of the received compact alloys with hydrogen in SHS regime was investigated also, and the hydrides of alloys of IVB group metals had been synthesized.

The received results have allowed the construction of concentration triangles - pseudo-phase diagrams of the studied systems. On Ti-Zr-H, Ti-Hf-H and Zr-Hf-H triangles, the compositions of received hydride phases, as well as the data known from the literature are shown. On the concentration triangles, the existence of extended area of hydrides of maximal hydrogen concentration H/Me ≥ 2 is fixed. On concentration triangle of Ti-Zr-H system (Fig. 1), the compositions of alloys and hydride phases, and the known from the literature data [2] are shown.

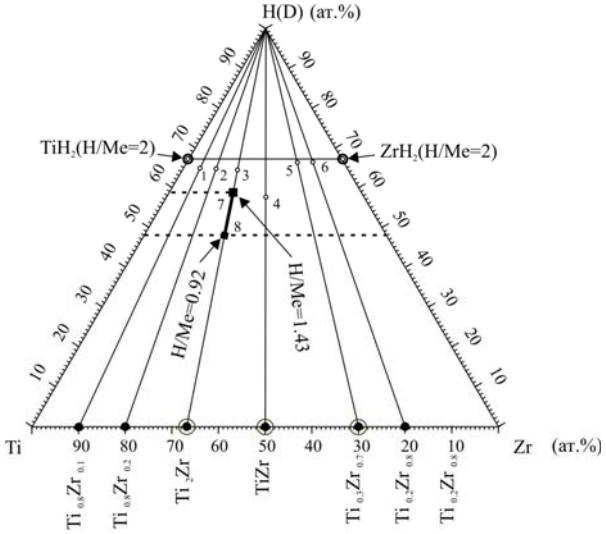

Fig. 1. Concentration triangle of Ti-Zr-H system.

On the concentration triangle of Ti-Zr-Hf system (Fig. 2), two single-phase areas of α-modification alloys (1 and 3), and one two-phase area of α- and ω-modification alloys where ω-modification constitutes 60-70 % (area 2), are allocated. The two-phase area of triple alloys is contiguous with two-phase binary alloys of α- and ω - modifications on Ti-Zr and Ti-Hf lines. This area is not contiguous with Zr-Hf line, since in Zr-Hf system, the formations ω-modification was not observed. Therefore the border of two-phase area passes above Zr-Hf line in the proximity of which, α-modification triple alloys are formed.

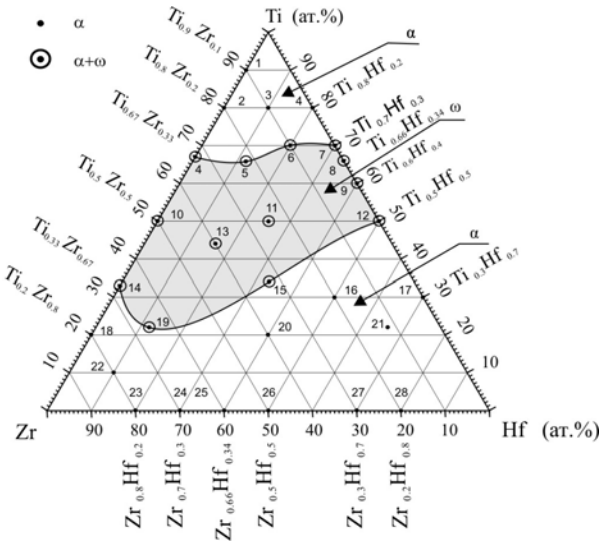

Fig. 2. Concentration triangle of Ti-Zr-Hf system.

Conclusions

1. On the basis of the implemented investigation of process of formation of alloys in «hydride cycle», pseudo-concentration traingles of Ti-Zr-H, Ti-Hf-H, Zr-Hf-H, and Ti-Hf-Zr systems are constructed, on which the evolution of phase composition in alloys and their hydrides is presented.

2. It is shown, that the method of alloys receiving in "hydride cycle" in combination with SHS process successfully can be used for receiving of alloys in Ti-Hf, Zr-Hf, Ti-Zr-Hf systems, and their hydrides with high concentration of hydrogen (H/Me ≥ 2).

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References

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