MAKING THE POINT METAL COATINGS ON THE PARTICLES OF HYDRIDE-FORMING INTERMETALLIDES

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INTRODUCTION

Hydrides formation in intermetallides results in increasing a specific volume of a lattice by ~25% that leads to destruction of conglomerats or an intermetallide grain and formation of dispersed powders. These powder masses have a very low thermal conductivity, and small pores give rise to substantial resistance to hydrogen flow. It results in the considerable deterioration in the main kinetic characteristics of sorption-desorption as the rate of direct (exothermic) and reverse (endothermic) reactions is directly concerned with the rate of abstraction-absorption of heat and hydrogen. In addition, migration of highly dispersed powder by the action of hydrogen flow may cause its local consolidation. Destruction of a container shell may occur because of large volume changes in hydrogenation of dense powder masses.

These problems are solved by developing the composite materials that do not have above-mentioned disadvantages largely. The materials consist of powder particles of an intermetallide phase and interlayers of an matrix binding phase from the materials inert to hydrogen.

RESULTS AND DISCUSSION

Method for making the microcapsulated composition materials on $LaNi_5$ and TiFe base using copper and nickel binders is known [2-4]. It consists in cladding the intermetallide powder (~20 µm) with Cu or Ni layer 5 µm thick chemically. In this case the binder content reaches 50 mass.%. In hydrogenation the compacts have increased in the volume by 2% and beared to 5000 cycles without destructions. Note that during cladding $LaNi_5$ particles are partly oxidized that results in decreasing hydrogen capacity of $LaNi_5$ itself by 30%. After 5000 cycles hydrogen capacity decreases again one-second of previous value.

In calculating such composition systems it is important to know hydrogen capacity of the composite (per 1 cm^3). Specific hydrogen capacity of material may be increased by decreasing amount of metal binder.

It can be done if the layer on the surface of intermetallide particles is not continuous but interrupted.

50 µm powders of Fe_2Zr intermetallide, and the mixture of Ni nanoparticles and inert easy evaporated filler have been taken for the model experiment.

Note that the simultaneous injection of Ni nanoparticles and inert filler has allowed to simplify technological operations for the composite preparation, i.e. compaction, measurements and weighing the samples etc. directly in air without any oxidation traces or ignition of higly dispersed powders.

The prepared mixture of Fe_2Zr intermetallide, nickel nanoparticles and filler has been compacted to form the samples with a diameter of 10 mm. The mixture and the samples made of it have been subjected to thermal treatment in hydrogen flow at 300, 400 and 500 ^{0}C for 2.5 hours. The heating time to the thermal treatment temperature has not exceeded 3 hours.

It has been determined that the initial powder consists of Fe_2Zr master phase of cubic syngony with a lattice constant, *a*, equals 7.065 Å and a volume of a unit cell, *V*, equals 352.64 Å^3. Ni lines have been detected on the diffracrogram of the powder and the compacts subjected to chemical thermal treatment (Table 1).

The lattice constant and the volume of a unit cell are identical for the compressed Fe_2Zr sample and the initial powder subjected to chemical thermal treatment at the same temperature.

Note that the lattice constant and the volume of Fe_2Zr unit cell increase with increasing the temperature of chemical thermal treatment, but Ni lines remain (Table 1).

CONCLUSIONS

The study of the initial powder of Fe_2Zr intermetallide and that subjected to chemical thermal treatment (cladding with Ni nanoparticles) by JAMP-10S Auger spectrometer has allowed to determine that there appear Ni lines in the spectrum of the cladded powder. Intensity of Ni lines from particle to particle is distinguished by several orders of magnitude that evidences the irregular point distribution of Ni nanoparticles conglomerates on the surface of Fe_2Zr intermetallide.

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Table 1

	Lattice constant, *a*, Å	Volume of unit cell V, $Å^3$
Initial powder Fe_2Zr	7.065	352.64
Fe_2Zr powder cladded with Ni at 300 ^{0}C	7.089	356.25
Compact 300 ^{o}C	7.089	356.25
Compact 400 ^{o}C	7.091	356.55
Compact500 ^{o}C	7.092	356.55

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