ABOUT MANNERS AND MECHANISMS OF REDUCTION OF THERMAL FIRMNESS OF Mg-,Ti-, Y-BASED MECHANICAL ALLOYS

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For today the problem of reception new hydrogen phases of systems Mg-H, Ti-H, Y-H, etc. with low temperature of their decomposition [1,2] is actual. Many scientific researches are devoted to improving kinetics and sorption characteristics of hydrides received by contemporary mechanochemical method in hydrogen under pressure or mechanical treatment. During too time mechanical dispersion, alloing on temperature of decomposition of its hydrogen phase not enough attention is given to a question on influence. In represented work, by methods thermodesorption hydrogen (TDH), x-ray analysis, scanning electron microscope (SEM) influence of dispersion and alloing by borom and iron upon thermal stability and temperature of decomposition hydrogen phases of mechanical alloys of systems Ti-B-H, Y-H and Mg-Fe-H was investigated.

The influence of high energy ball milling in a spherical planetary mill within 20 minutes and 1630 rpm on a powder of hydride Ti and Y has led to essential reduction of the size of particles (the average particles size are decreasing with 12 to 0,17 μ m ($TiH_{1.9}$) and with 1,7 to 0,17 μ m (YH_3), and the main thing to essential decrease in temperature of decomposition more, than on 100^0C at $TiH_{1.9}$ and on 300^0 C at YH_3 (fig. 1 and 2).

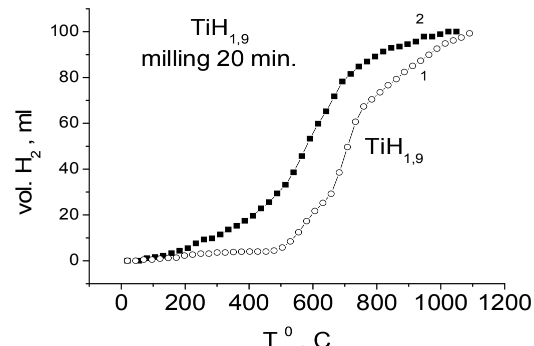

Fig.1

It is consequence of increase of thermodynamic potential of dispersion systems as a result of significant nuclear reorganizations due to the work spent for plastic deformation and formation of new surfaces, defects, expansion of areas drain boundaries. Dynamics of decomposition of hydrides Ti (initial and after processing of 20 minutes) is shown on spectra thermodesorption hydrogen (fig. 3).

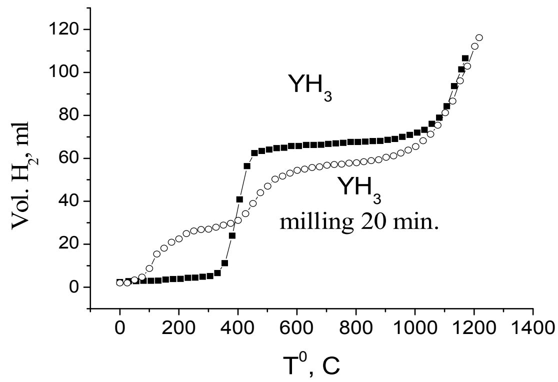

Fig.2

In each of spectra three peaks of allocation of the hydrogen, reflecting presence of three groups of atoms of hydrogen with distinguished energy of communication are observed: weak-, middle-and strongly-binding hydrogen. From fig. 3 it is visible, that after high-energy influence relative intensity of low-temperature peaks has increased, i.e. the share poorly and middle linked hydrogen has increased.

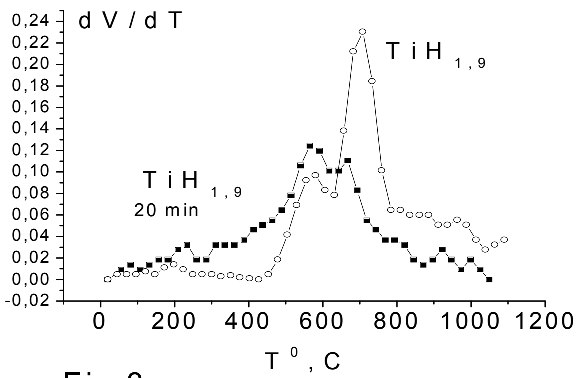

Fig.3

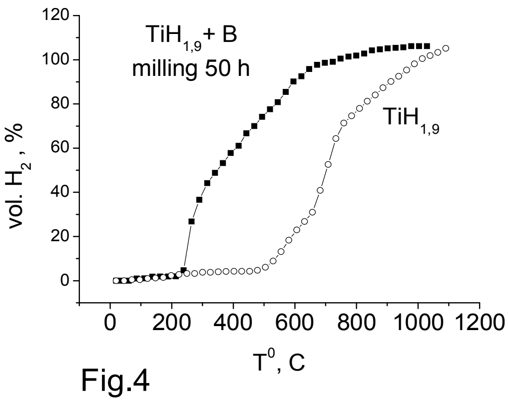

Fig.4

Addition of boron reduces thermal firmness more, than on 300^0 C (fig. 4). The boron, entering in lattice $TiH_{1.9}$, influences a charging condition of atoms of the titan and hydrogen, hence on character of chemical connection Ti-H, which in hydride Ti mainly covalent. The increased thermal firmness of this hydride is caused with an ionic component of connection Ti - H. We mean that, boron reducing a positive charge on atoms of titanium, reduces an ionic component, as results in decrease in thermal firmness.

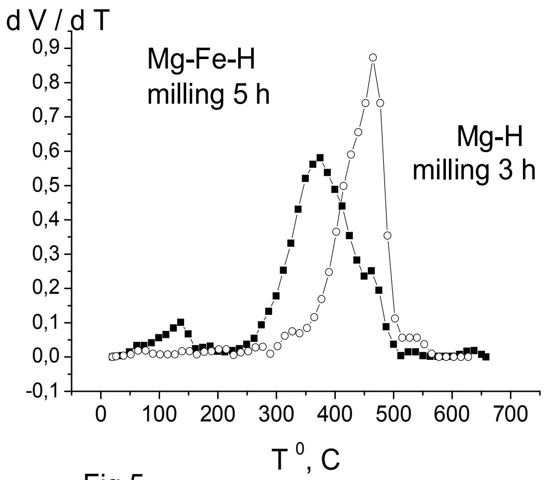

Fig.5

Processes of formation of hydrogen phases of powders Mg and Mg + 10wt % Fe are investigated at the condition of high-energy ball-milling in the environment of hydrogen under pressure 1,2 MPa. The average particles size the Mg powder after milling for 3h and 1350 rpm is 3 μ m, the Mg +10wt.% Fe powder after milling for 5h is 0,23 μ m. The starting powders of Mg and Fe with purity 99,9 % have the average particle size about 3,2 and 10 μ m. It is shown, that addition of iron interferes with sintering of the crushed particles of mechanical alloy (MA), promotes higher degree of dispersion of a magnesium hydride obtained due to milling.The hydride contains maximum quantity of weak- and middle-binding hydrogen (fig. 5). The middle-binding hydrogen is positioned mainly in the region of grain boundaries; their quantity increase with increasing dispersion degree.

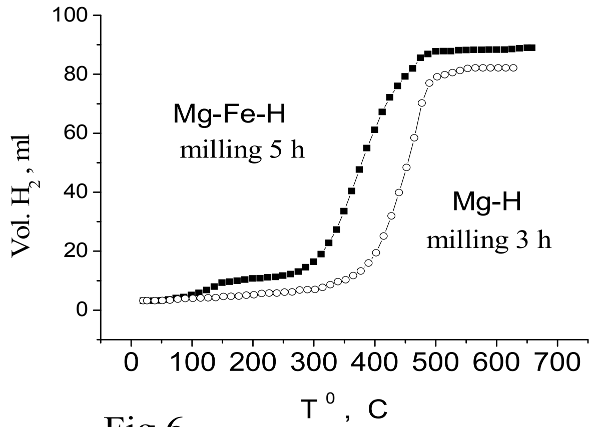

Fig.6

The process of accumulation of defects in the mentioned region accompanies by incresing of the thermodynamical potential. This promoter decreasing both the temperature of decomposition of the hydrogen phase by 100^0C and phase thermal stability (fig. 6).

References

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