COMPACTION OF HYDRIDES AND FORMATION OF COMPACT SAMPLES OF TRANSITION METALS (LINK 3)

At studying the physico-chemical properties of SHS hydrides, their unique ability to plastic deformation was revealed. On this property, a fundamentally new direction of our further researches was based with usage of SHS hydride powders as raw materials:

- formation of compact hydrides of refractory metals;
- formation of products from hydrides of refractory metals.

Under cold pressing, the SHS hydrides easily became compacted to samples of high density and hardness, comparable with those of metallic samples (Table 1).

It is worth to note, that one of the most important fields of application of compact hydrides is nuclear power. It is known that hydrogen is the best moderator of neutrons. Compacted metal hydrides are rich in hydrogen and are of practical interest, because they combine the advantages of metals (strength and stability), with unique neutron-moderating ability of hydrogen.

Fig. 1 shows microstructures of titanium hydride samples as powder (a) and as compacted to tablet with diameter of 50 mm and height of 5-6 mm (b). Figure 2 shows a series of compacted TiH_2 samples.

The wares of refractory metals and alloys were made by compacting and subsequent dehydrogenation of their hydrides. The method is based on the reaction: $\mathbf{MeH_2 \leftrightarrow Me + H_2\uparrow;}$

The hydrogen was removed from the compacted sample at relatively low temperature (below 1000ºC). This hydrogen removal does not lead to the loosening of sample. On the contrary, at the temperature of hydrogen dissociation, the grains became sintered. The process proceeds continuously until the hydride is completely decomposed. The compact, nonporous samples of titanium, zirconium, hafnium, etc. formed.

Table 1. Characteristics of compacted hydrides

MeH_2	H_2-content, wt. %	Crystal lattice, parameters, Å	Temperature range of dissociation, ºC	Pressing pressure, kgF	Density, g/cm^3	Hardness, HRA
TiH_2	4.01	fcc, *CaF_2 type*	480 – 610	30000	3.71	49.8 ± 0.8
ZrH_2	2.16	bct, *ThH_2 type* a=3.495; c =4.463;	450 – 810	35000	5.39	41.6 ± 1.0
HfH_2	1.09	bct, *ThH_2 type* a=4.91; c=4.505	420 – 830	40000	11.35	45.7± 0.7

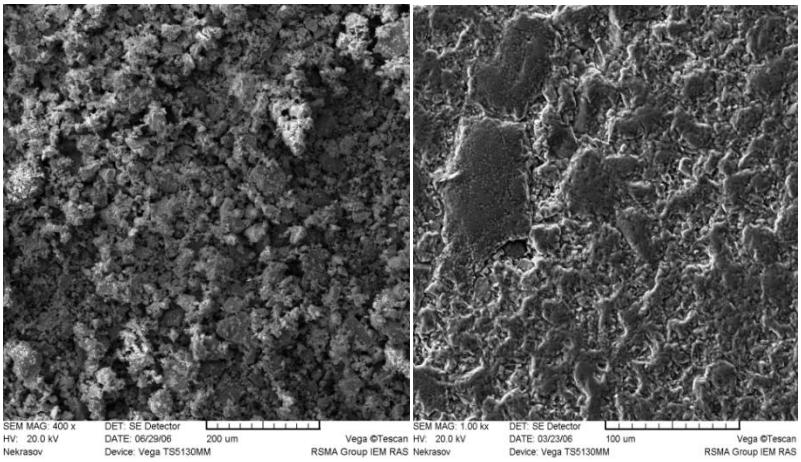

Fig. 1. Microstructures of titanium hydride powder (a) and compacted (b) samples

Fig. 2. Several compacted samples of titanium hydride

Currently, the wares made of refractory metals and alloys for the needs of machine building, aviation, space, etc. mainly are manufactured by cutting (machining) the cast metals. The process of producing the initial cast refractory metals and alloys is also expensive and time consuming, requiring high-temperature technology. At their machining, a huge amount of waste (chips) of expensive rare metals is formed and a problem of their utilization arises

LIST OF MAIN PUBLICATIONS

1. S.K. Dolukhanyan, A.G.Aleksanyan, K.A.Abrahamyan, S.S.Mardanyan, V.Sh.Shekhtman, at al, Formation of porousless compact produces from hydrides of refractory metals. *NATO Science Series,**ICHMS`2007**,in B. Baranovski et al. (eds.),**Carbon Nanomaterials in Clean Energy Hydrogen Systems.** Springer, 2008, 795-803.*
2. V.P.Korzhov, M.I. Karpov, V.Sh. Shekhtman, G.E. Abrosimova, A.G. Aleksanyan, S.K. Dolukhanyan. Structure of the Ti-45 wt % Zr alloy obtained by the powder metallurgy method from TiH2 and ZrH2 powders. Proceedings of *the Powder Metallurgy World Congress and Exibition EURO PM2007.*15-17 October 2007, **Toulouse**, France , p.363-367.
3. V.P.Korzhov, M.I. Karpov, A.G.Aleksanyan et al. Structure and certain properties of zirconium produced out of its hydride powder. Materialovedenie. Issue 11, p. 16-19, 2008.
4. V.P.Korzhov, M.I. Karpov, A.G.Aleksanyan , S.K. Dolukhanyan. Structure and properties of titanium obtained by sintering TiH powders. Structure and properties of materials. Materialovedenie (Materials Science). N 2. p.26-31, 2009.
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6. В.П. Коржов, М.И. Карпов, А.Г. Алексанян, С.К. Долуханян. «Структура и плотность сплава Ti-45%Zr, полученного методом порошковой металлургии из гидридов TiH2 и ZrH2». Материаловедение, 2009, № 3, с. 25-29.

Patent of the Republic of Armenia

S.K. Dolukhanyan, A.G. Aleksanyan. Method for the preparation of compact hydrides of transition metals. PA Patent No. 2299A