AN INVESTIGATION OF SHS PRODUCTS IN TITANIUM, CARBON (BLACK CARBON) AND ALUMINUM POWDER MIXTURES [1]

*G.A. PRIBYTKOV**, *A.V. BARANOVSKIY***, *V.V. KORZHOVA**, *M.G KRINITCYN***

**Institute of Strength Physics and Materials Science, Akademicheskii pr., 2/4, Tomsk, 634055, Russia, e-mail: gapribyt@mail.ru*
***National Research Tomsk Polytechnic University, Lenin pr.,30, Tomsk, 634050, Russia*

Titanium carbide is the only phase in SHS product in titanium and carbon powder mixtures of equiatomic proportion. At the SHS in the mixtures containing titanium excess along with titanium carbide of non-stoichiometric composition there is a free titanium in the SHS products presenting metal-matrix composite consisted of carbide particles imbedded into titanium matrix (binder) [1]. It is interesting to investigate SHS regularities in three-component Ti-C-Al powder mixtures. An additional aluminum dopant complicates a picture of powder components interaction strongly because of double compounds formation ability. Double compounds in Ti-C-Al system are titanium aluminides and Al_4C_3 aluminum carbide. Besides, it is possible three component compounds formation having MAX of phases structure [2].

We studied a structure and phase composition of SHS products in Ti-C-Al powder mixtures, containing 10, 20, 30 and 40 mass % aluminum. Ti to C atomic ratio in the mixtures was constant and equals 1. Reaction mixtures were prepared from titanium (ТПП-8, 99,5 %, <160 μm.), black carbon (П-803, 300 nm. average particles size) and aluminum (ПА-4, 98 %, <100 μm.) powder mixtures. Ø 20 × 25 mm cylindrical samples were pressed from the mixtures to 35 % porosity. The combustion was initiated by heating of an igniting pellet by molybdenum wire coil. A resultant porous cakes were crashed and sieved to <125 microns granules of composite powders. The powders were investigated be X-ray diffraction (DRON-7 Burevestnik diffractometer, Russia), optical metallography (AXIOVERT-200MAT, Zeiss, Germany) and scanning electron microscopy (EVO 50, Zeiss, Germany).

According to X-ray diffraction data the basic phases in SHS products of all investigated compositions are titanium carbide and aluminum (tabl. 1). A small amount of Al_3Ti is present in the SHS products.

Table1. Phase composition of the SHS products

Reactive mixtures composition	A relative content of the particular phases, %		
	TiC	Al	Al_3Ti
Ti+C+10 mass. %Al	83	12	5
Ti+C+20 mass. %Al	80	15	5
Ti+C+30 mass. %Al	58	33	9
Ti+C+40 mass. %Al	58	38	4

According to scanning electron microscopy (SEM) the carbide inclusions size in the SHS composite powders depends on aluminum content in the reaction mixtures and decreases monotonously from 4,3 to 1,0 μm. while aluminum content rises from 10 to 40 mass. %. Carbide size dependence of thermally inert additives in the reaction mixtures is typical [3]. The reason is the burning temperature fall by inert additives which are not involved in exothermic reaction.

The synthesized and investigated composite powders will be used for cladding and sputtering of the coatings and for printing 3D samples and products by of selective laser fusion technology.

REFERENCES

[1] *G. Pribytkov, M. Krinitcyn, V. Korzhova //* Advanced materials. – 2016. – No. 5. – 59-68. (Russ).
[2] *A.Hendaoui, D. Vrel, A.Amara, P. Langlois, M. Andasmas, M. Guerioune //* Journ. Eur. Ceram. Soc. 2010. – 30. – 1049-1057.
[3] *Rogachev A.S., Mukasian A.S. //* Combustion for materials synthesis.-Moscow. Fizmatlit Publ. 2013. (Russ)

[1] This work was supported by Russian Scientific Foundation