SYNTHESIS OF CARBON CONTAINING COMPOSITES BY COMBUSTION

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INTRODUCTION

Composition materials are of practical interest for different branches of industry including production of refractory. There bore, the search for new methods of production as well as improvement of the existing technologies is a direction of scientific investigations of top priority. Composition materials based on ZrB_2- Al_2O_3 are resistant to high temperatures and corrosion, they are wear resistant and have high isolation properties and, what is important, are ecologically friendly [1,2].

METHODOLOGY

Samples for self-propagation high temperature synthesis (SHS) were prepared from the charge, the composition of which included powder zirconium silicate, borate are of Inder deposit of Kazakhstan (the content of B_2O_3 is up to 40%), carbonized rice husk (CRH) as carbon, aluminum (99% purity. The reaction in this system proceeds mainly according to the reaction:

$$3ZrSiO_4 + 2B_2O_3 + C + 8Al \rightarrow 2ZrB_2 + ZrC + 4Al_2O_3 + 3SiO_2$$

The adiabatic temperature of combustion and equilibrium composition of synthesis products for composition were calculated using the program "Thermo" developed at the institute of structural macrokinetics and problems of materials science of RAS (ISMAN) in Chernogolovka [3].

SHS of the samples was carried out in a muffle furnace at the temperature of 850°. Combustion temperature of the samples was measured with the help of optical pyrometer. The X-ray phase analysis of the products was performed on diffractmeter "DRON-4M"(Co-K_α radiation) in the range $2\theta = 10°\text{-}70°$.

RESULTS AND DISCUSSION

Using the calculations made with the help of program "Thermo", the adiabatic temperature of combustion of the investigated composition (Figure 1) and the expected composition of the final products of synthesis (Table 1) were calculated.

The experimental results showed lower temperatures in relation to theoretical combustion temperature 1600 - 1700°C. Apart from boron oxide, borate ore contains impurities which are likely to impede complete reduction of zirconium silicate and boron oxide by aluminum. In order to achieve a more complete reduction of boron and zirconium, it was necessary to increase the content of aluminum in the initial charge and carry out preliminary mechanochemical activation of the charge. The final products of combustion were subjected to X-ray phase analysis. As is seen from the results (Table 2), the increase in the amount of aluminum leads to more complete reduction of zirconium and boron from their compounds and the increase in the yield of high temperature SHS products ZrB_2-30%, Al_2O_3(corundum) - 45,5%, ZrC - 8.4%. The further addition of aluminum results in its excess in the charge and it remains unconsumed.

Thus, the investigation results allowed to show the possibility of using available mineral raw materials for production of multicomponent composition materials using the method of SHS.

REFERENCES
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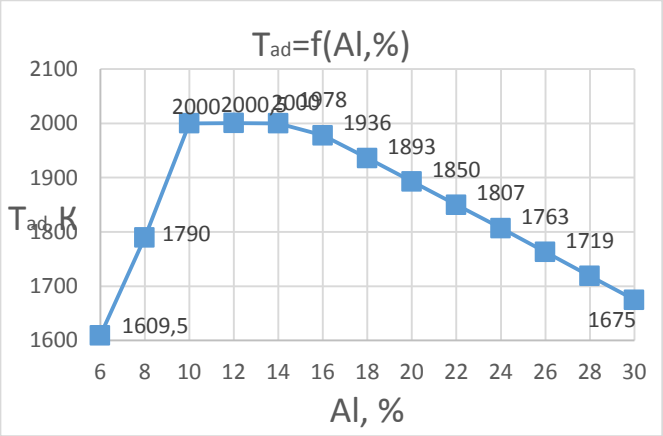

Figure 1. Dependency of the adiabatic temperature of combustion on the content of aluminum in the initial charge

Table 1
Theoretically calculated composition of combustion products

Init. amount Al,%	amount of products, %						
	Al	$Al_2O_{13}Si_2$	ZrB_2	SiC	ZrC	ZrSi	ZrO_2
8		47,12	29,56	1,7	4,00	1,38	16,24
14	4,72	52,87	27,51	0,55	10,96	1,66	0,52
20	11,46	50,27	25,75	0,53	10,42	1,58	-
26	18,1	46,5	23,82	0,49	9,64	1,46	-
30	22,52	43,99	22,54	0,46	9,11	1,38	-

Table 2
SHS-products $ZrSiO_4$ + B_2O_3 (40% in ore) + C(CRH) + Al

Composition of the initial charge	SHS products, %						
	Al_2O_3	ZrB_2	$MgAl_2O_4$	SiO_2	$ZrSi_2$	ZrC	CaS
$ZrSiO_4$ +Al+ B_2O_3 +C (Al 26%)	43,3	26,1	15,9	7,7	4,7	1,3	1,1
$ZrSiO_4$ +Al+ B_2O_3 +C (Al 30%)	60,4	27,4	-	6,7	-	5,5	-
$ZrSiO_4$ +Al+ B_2O_3 +C (Al 35%)	45,3	30,0	-	5,1	5,6	8,4	5,6