FORMATION OF METAL-CERAMIC COMPOSITES USING SHS IN TI-AL-C SYSTEM[1]

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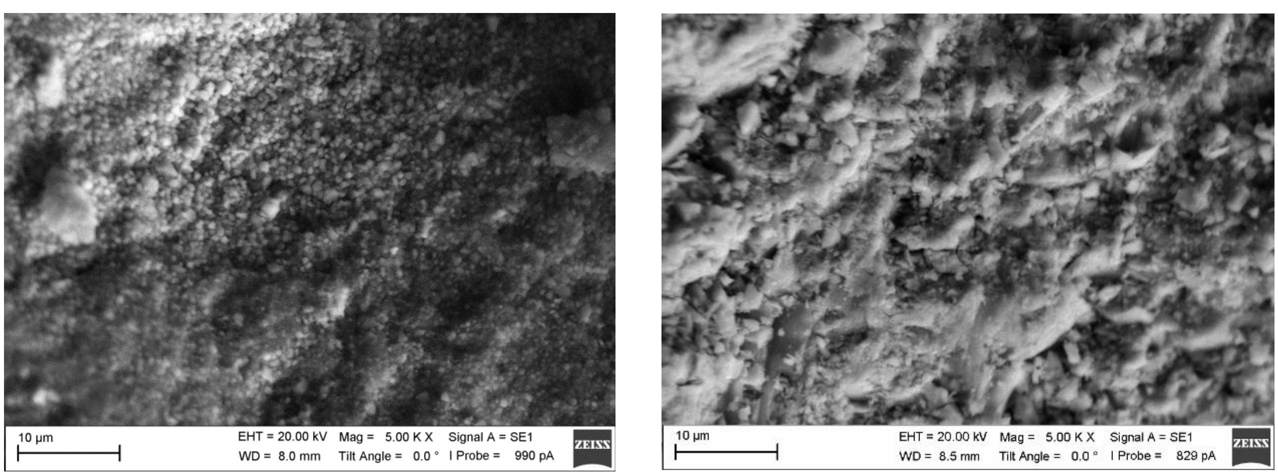
During the work on SHS in the titanium-carbon system, TiC-Ti powder composites were obtained and investigated. Composites were obtained after combustion of mixtures with a calculated content of an additional inertness of 30 to 60 vol.%. X-ray phase analysis of the obtained SHS products showed that in the samples with a calculated binding content of 30 and 40 vol%, there is no binding completely, and the lattice parameter of titanium carbide in these samples is below the tabulated value for titanium carbide TiC, indicating that samples form nonstoichiometric titanium carbide. Titanium carbide TiC_x has a wide range of homogeneity. Carbon content in carbide at temperatures in the vicinity of the melting temperature of titanium on a double equilibrium diagram varies from the equiatomic composition (stoichiometric coefficient X = 1) to X = 0.5. Since all the reaction mixtures studied by us have an excess of titanium, titanium carbide should in all cases have a non-stoichiometric composition in accordance with the equilibrium diagram.

The maximum combustion temperature for samples with a calculated binder content of 60 vol% is close to the lowest possible start temperature of the SHS process for this system. This limits the composition of the initial mixtures.

To modernize this system, aluminum was added up to 40% by volume in powder mixtures of titanium and carbon with a calculated titanium inert content of 50% by volume. In addition to layer-by-layer combustion, the powders of this system were burned using the technology of thermal explosion.

Before the thermal explosion, the powders were mechanically activated in the "Activator-2s" planetary ball mill. The structure and phase composition of the resulting powders were studied. The resulting powders were examined using a scanning electron microscope LEO EVO 50 (Zeiss, Germany), a transmission electron microscope JEOL JEM-2100 (Tokyo Boeki Ltd., Japan) and a metallographic optical microscope AXIOVERT-200MAT (Zeiss, Germany). The determination of the elemental composition was carried out by the EDX method with the scanning electron microscope LEO EVO 50, the phase composition was determined using the X-ray diffractometer DRON-07 (Bourevestnik, Russia). All of the above equipment is based on the NANOTEH Center for collective usage ISPMS SB RAS (CCU TNRC SB RAS).

It is established that the structure of powders obtained by the SHS method is close to the structure obtained without aluminum. In the thermal explosion, the structural components remain the same, but the size of the carbide particles decreases (Fig. 1). Aluminum in all cases completely reacts with titanium to form the corresponding intermetallides.



a b

Fig. 1. Morphology of the Ti-Al-C (a) and Ti-C (b) powder, obtained by SHS

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