PREPARATION OF NANOLAMINATES IN THE TI-CR-AL-C SYSTEM BY THE SHS METHOD

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The peculiarities of the structure of the crystal lattices of nanolaminates cause a unique combination of the properties of both metals and ceramics: high electrical and thermal conductivity, easily processed by cutting, crack resistance, resistant to high temperature oxidation and thermal shocks, elasticity at high temperatures, excellent corrosion resistance in aggressive liquid media and at the same time low density, high elasticity, are stable at temperatures above 1000 °C. Materials based on the MAX phases of the Ti-Cr-Al-C system are promising for use in machinery operating under extreme operating conditions, such as electrical contacts, bearings, heating elements, heat exchangers, as high-temperature ceramics [1].

The aim of the work is to obtain materials based on the Ti-Cr-Al-C system by the SHS method, to study the physicochemical properties of materials and the mechanism of phase and structure formation.

The data of high-speed video recording showed that burning of powder mixtures, with a chromium content of more than 30% and a relative density of 0.86, occurs in a non-stationary mode. After ignition, a flat decaying reaction wave propagates from the beginning of the sample with a velocity monotonically decreasing along its axis from 6.5 mm / s to zero for 0.04 s. (fig. 1)Then, in the low-temperature zone of the wave (T = 1380 K, according to the data of dynamic spectrometry) reaction foci originate and begin to move across the sample, which initiate the next damped wave. The speed of distribution of the foci is 12.9 mm / s, their temperature is 1860 K.

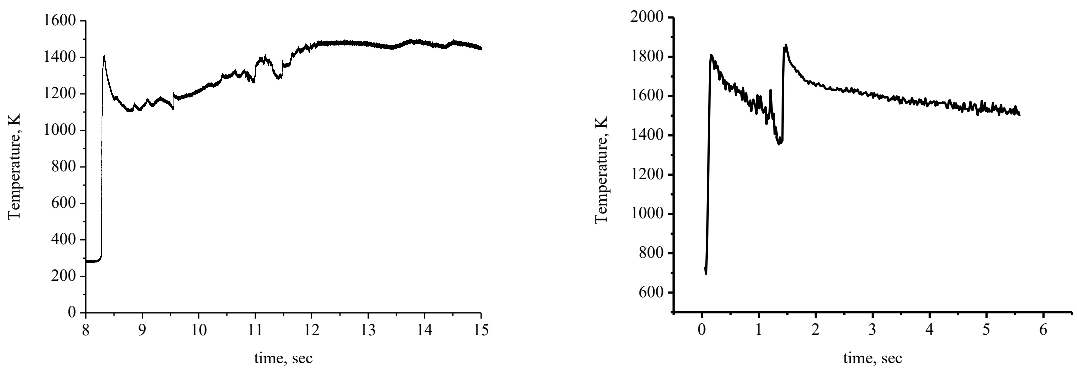

Fig. 1 The sample thermogram. Measurement: a) using a thermocouple, b) using dynamic spectrometry.

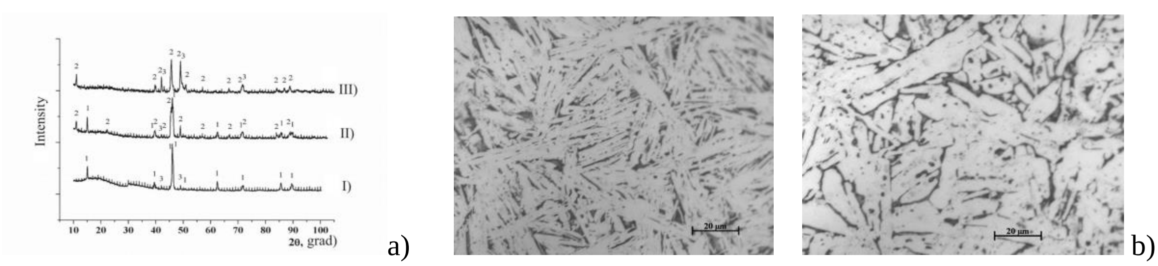

Fig. 2 a) Diffraction pattern of the sample. I) stoichiometry of Ti_2AlC, II) $Ti_{1.9}Cr_{0.1}AlC$, III) $Ti_{1.5}Cr_{0.5}AlC$. Phases: 1 - Ti_2AlC, 2 - Ti_3AlC_2, 3 - TiC. b) Microstructure of the samples.

Metallographic studies and X-ray phase analysis revealed phases of Ti_2AlC, Ti_3AlC_2, Cr_2AlC, TiC. The phase composition of the samples depends on the ratio of the components. Formulations with high plasticity and heat resistance were found (fig. 2). Materials are promising for use as heat-resistant structural materials.

REFERENCES

[1] *Zhimou Liua, Erdong Wua, Jiemin Wanga and all* // Acta Materialia. – 2014. – 73. 186–193.