THE EFFECT OF HEATING RATE DURING THE PRESSURE SINTERING OF B_4C–SIC POWDER MIXTURE ON THE STRUCTURE AND PROPERTIES OF SINTERED COMPOSITE

Kovalchenko M. S., Tkachenko Y. G., Britun V. F., Yurchenko D. Z.
Frantsevich Institute for Problems of Materials Science, NAS of Ukraine
Krzhizhanovskogo str., 3, Kyiv-142, 03680, Ukraine, e-mail: mskoval@ipms.kiev.ua

The study of the effect of heating rate during the pressure sintering powder mixture B4C–20 % SiC in the mode of non-isothermal heating on the structure and some properties of the sintered composite is carried out. The initial components of the mixture were B_4C powder of Donetsk chemicals plant production and refined SiC powder with an average grain size of 1 μm for the main fraction. A powder mixture after the mixing in a planetary mill were sintered at temperature higher than 900 °C under a pressure of 30 MPa in a nonisothermal heating mode with rates in the range from 30 to 85 °C/ minutes. The structure, micro-hardness *HM* at a load of 2 N and fracture toughness K_{Ic} at a load of 5 N for the sintered samples were studied.

Table 1 shows structural characteristics of the sample depending on the heating rate during the pressure sintering of them.

Table 1

Heating rate, °C/мин	Volume fraction of B_4C without SiC	Fraction of SiC in cluster, %	Smooth segment size of the fracture, μm
30	Up to 15	60	3–10
50	The same	60	<3
70	30	70	10
85	Up to 70	90	15

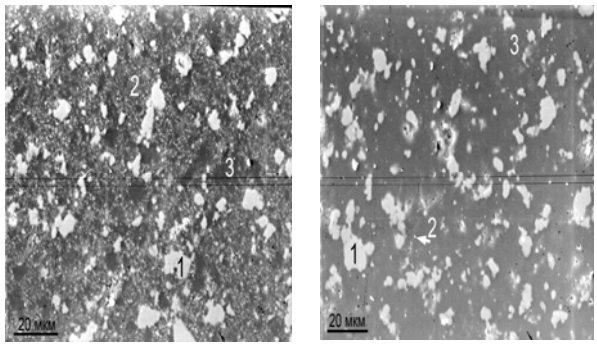
With the elevation of heating rate during the pressure sintering of B_4C–20 % SiC powder mixtures the heterogeneity in the distribution of structural components as well as the proportion of transcrystalline fracture of samples are increased.

Table 2 shows micro-hardness and fracture toughness K_{Ic} of the samples depending on the heating rate during their pressure sintering.

Table 2

Heating rate, °C/minutes	*HM*, GPa	K_{Ic}, MPa·m$^{1/2}$
30	40.0	4.74
50	43.7	4.51
70	43.9	4.30
85	44.7	4.16

The figure shows the samples structure sintered at different heating rates.



a *b*

Fig. Structure of B4C–20% SiC samples, sintered at a heating rate of 30 (*a*) and 85 °C/minutes (*b*)

The specific structural state of composites correlates with the obtained values of the micro-hardness and fracture toughness of B_4C–20 % SiC samples, depending on the heating rate during the pressure sintering of powder mixtures. A maximum heterogeneity of the distribution of the structural components corresponds to the highest heating rate consisting of 85 °C/minutes in carried out study.

The data obtained enable to optimize the process parameters of pressure sintering boron-carbide-based ceramics.