

Nanocomposites and nanomaterials

Reaction hot pressing as a method to produce ultra high temperature nanostructured composite ceramics

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The work in the field of creation of ultra high temperature ceramics (UHTC) based on borides of zirconium and hafnium is being done recently in the world. ZrB₂-SiC composites are currently considered to be the baseline ultra high temperature ceramic materials. Phase composition variations as well as the use of different methods of sample manufacturing allow achieving the necessary material characteristics.

This paper presents a study of the structure and properties of ZrB₂-SiC composite ceramics obtained by reaction hot pressing in accordance to the following reaction:

Several series of samples with SiC content from 0 to 50 vol. % were sintered at a temperature of 1800°C and a pressure of 27 MPa for 5 minutes without special protective atmosphere.

The dependence of densification kinetics on the initial charge composition was studied alongside with the structure and mechanical characteristics of manufactured composites. It is shown that material consolidation process is determined mainly by physical and chemical transformations occurring during hot pressing between the components of the charge.

It is shown that the use of the reaction hot pressing reduces temperature and time of material synthesis thus leading not only to production expenses reducing but also to unique composite nanostructure formation. The latter results high physical-mechanical characteristics of sintered ceramics: microhardness of 24 GPa and fracture toughness of 6 MPa·m^{1/2}, which is almost twice higher than corresponding values for individual ZrB₂ and SiC phases.