Obtaining Nanostructure-containing Ceramic Material for Practical Application and Increasing Technology Readiness Level

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Abstract

Self-propagating high-temperature synthesis (SHS) is one of the convenient methods for obtaining modern metallic and ceramic materials with unique, improved properties . SHS is applied to produce refractory compounds such as: carbides, borides, nitrides, carbonitrides, oxides and their various compositions to obtain ceramic materials.

The direct synthesis of such materials became possible with the development of following SHS technologies: SHS-Gas-Isostatization, SHS-thermovacuum, SHS-compaction and others.

The interaction of elements and compounds in SHS mode takes place at high speeds at high temperatures, which is characteristic of synthesis processes.

The analysis shows that the SHS method can be used to obtain compounds with a high enthalpy of formation, which in turn determines the high strength of the compounds.

For obtaining non-porous or low-porous (1-5%) high-quality ceramic materials and alloys with SHS-compaction technology, the necessary conditions in terms of time interval are the following processes: Preliminary pressing, Thermal impulse, Ignition, End of combustion, Start of Compaction, release of compact pressure, discharge of the product;

One of the main components for the proper management of the process is the selection of optimal times at different stages. On the other hand, the optimal time values are different for different chasms and it is determined based on the analysis of experimental data. In addition, the optimal values of the compressive pressures are determined experimentally.

Despite the growing demand, the practical application of composite materials are hindered due to the following factors:

1. High cost.
2. Low lifetime.
3. High consumption of material, energy and hardware resources;

The goal of the work is to develop a consolidated material containing a ceramic nanostructure and an innovative technology for its production, and to obtain pilot samples based on the Ti-B-N system; to develop laboratory technology for its adoption and generalization of processes to small-scale production process, development of preliminary technological regulations.

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