EFFECT OF NANOADDITIVES ON THE PROPERTIES OF PARTIALLY STABILIZED ZIRCONIA

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The structure determining factor for of nanocrystalline materials is the extremely small grain size, the resulting large area of the boundaries and correspondingly the length of their joints in the volume unit, the difficulty or suppression of dislocation mechanisms of plastic deformation at grain sizes below a certain limiting value and the nonequilibrium state of the grain boundaries [1]. The developed surface of isolated nanoparticles initiates dimensional effects of thermodynamic quantities. Due to the existence of a significant number of atoms near the surface of the nanomaterial, as well as the lattice dynamics, which undergoes substantial changes due to a number of features of the nanostate, such substance characteristics as values of heat capacity [2], thermal conductivity [3, 4], melting temperature, Debye temperature depend.

In the case of a non-electrically conductive pure zirconia sample, there is no joule heating during current flow through the powder mixture, i.e. the initial heating of the sample is done by current flow through the graphite mold , in contrast to the case of tungsten carbide samples, where joule heating starts immediately, i.e. the structure formation occurs mainly already during heating to the dwell temperature. The high heating rate minimizes the influence of diffusion processes on the particle surfaces, which do not contribute to densification, and the samples reach high temperatures faster while retaining the ability to sinter. That is, rapid heating accelerates densification due to earlier activation of dislocation creep mechanisms and due to reduction of the low-temperature stage sintering, when surface diffusion dominates.

Various nanoadditives to zirconium dioxide affect primarily the hardness and strength of the composite as a whole. They increase these values in different ways, depending on their content and sintering regimes. Hot pressing by electrosintering, significantly activates the compaction process, contributes to the formation of a fine microstructure. The mechanism of the sintering process occurs differently, depending on the ability to conduct electric current, strengthening additives. creation of a functional gradient material, the top layer of which will be ZrO_2-Al_2O_3, the middle ZrO_2-SiC, the bottom layer ZrO_2-WC. The material can have a polyfunctional application, one of the most promising applications would be the production of laminated plates for cutting tools. The question of choosing the optimal composition for each layer will be determined by the working conditions of this material.

Reference:

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