HP-HT Sinthering of Polycrystals and Composites Bsed on Diamond Nanopowders

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The model of HP-HT sintering of diamond nanopowders is suggested. According to this model summation of external and capillary pressure is not a unique and uncontested variant. This idea distinguishes this model from classical systems. The decrease of polycrystals density with lessening of the size of sintered particles occurs because capillary forces counteract external influence. This conclusion is confirmed experimentally.

For diamond nanopowders pressure upon a free surface of diamond particles at sintering under action of a high pressure corresponds to thermodynamic area of stability of diamond that excludes graphitization due to direct phase transformation of diamond into graphite. The diamond nanopowders graphitization occurs due to interaction with oxygen and oxygen-containing groups on a surface of particles. Carrying out of the desorption of gases from a surface of diamond nanopowder particles of static synthesis by its vacuum treatment with a combination of hermetic sealing of working volume increases hardness of sintered polycrystals in 1.5-2 times due to reduction of diamond particles graphitization.

The additive of tungsten carbide in a diamond nanopowder of detonation synthesis UDD facilitates its sintering under action of pressure 8 GPa at temperatures above 1600ºC. At UDD sintering without additives and without degassing the intensive graphitization begins at $T > 1200$ºC. The highest level of physicomechanical properties of examined composites based on the UDD is reached at use of this additive. By hardness and by fracture toughness the obtained composites exceed other composites based on the UDD and polycrystals based on a diamond nanopowder of static synthesis ASM5 0.1/0.