11th International Conference on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

HPHT Sintering of Nanostructured Diamond Composite

G. S. Bobrovnitchii[(1)], A. L. D. Skury[(1)] and R. C. Tardim[(1)*]

(1) LAMAV / Universidade Estadual do Norte Fluminense Darcy Ribeiro. Av. Alberto Lamego, 2000, Campos dos Goytacazes – RJ CEP 28013-600. e-mail: romulo.tardim@gmail.com

* Corresponding author.

Abstract – Nanosize diamond-based compacts represent the promising future of superhard materials. Under a physical mechanical point of view, nanostructured composites promotes higher properties than those of natural or synthetic monocrystals. The presence of small particles filling pores leads to the formation of a compact having a lower degree of porosity. Diamond composites with nanosize diamond crystals and nanosize SiC matrix were obtained at 6.5 to 7.7 GPa and temperatures varied between 1000 and 1600° C. X-ray diffractions of the obtained composites informed about crystallite size and dislocations.

Nanosize or ultra-dispersed diamond particles have been recently used as precursor for the development of a new generation of superhard composites[1]. Differences in the formation mechanism of these composites were found as a function of developed residual stress. In the present work, diamond composites were obtained by a compacting method at high pressure, almost hydrostatic, and high temperature conditions. Experiments were conducted inside a thoroidal type anvil of a high pressure device[2] with a 13,5 mm concavity installed in a 630 ton press. Temperatures of 1000 to 1600° C combined with pressures from 6.5 to 7.7 GPa were used for compacting. The composites were obtained by the infiltration method, using as starting materials: 48/40 µm and nano (0,01 to 0,004 µm) diamond particles, provided by FNPC "Altay", and Si powder as the binder. The sintered samples have a cylindrical shape with 5.0 mm diameter and 4.5 mm height. The characterization indicates density values no greater than 2.86 g/cm^3, a maximum hardness of 30.5 GPa and great homogeneity (Figure 1). These results can be explained by X-ray diffraction and suggest a plastic fragmentation of the larger initial particles. It contributes to an ultra-fine composite structure, revealed by the intensity of the lines <003> compared with the lines <111> of diamond. The compression strength of the polycrystalline diamond composites was found to be close to that of natural diamonds.

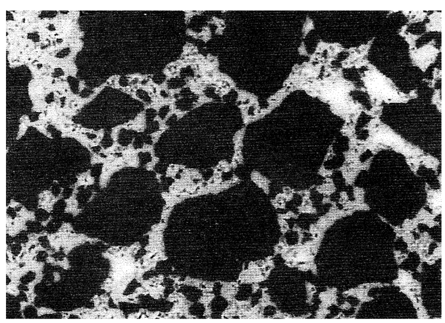

Figure 1: "Diamond-SiC" composite obtained via HPHT conditions with addition of nanodiamonds, in which: diamonds – dark regions; SiC – gray; free Si – white.

References

[1] A. A. Shulzhenko, A. A. Bochechko, G. S. Oleinik, V. G. Gargin, L. A. Romanko, et al. J. Superhard Materials 5 (2001) 29.

[2] L. F. Verestshagin and L. G. Khvostantsev, High Pressure Producing Apparatus, US Patent 3854854 (1974).