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Thermo-stable Diamond Composite

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Abstract – Thermo-stable composites can be sintered by using the infiltration method under high-pressure and high-temperature conditions. This method is based on the formation of a diamond grains skeleton, having used special devices. In a posterior heating the silicon powder layer, which is in the compression chamber, melts and infiltrates into diamond skeleton, forming another skeleton of SiC.

Diamond composite materials are widely used in cutting tools of non-ferrous metals and drilling devices of petroleum wells. The formation of the polycrystalline structure depends on its physical-mechanical properties, dispersion, and temperature – pressure – time parameters of sintering [1]. Sintering conditions through high pressures and high temperatures are not uniform due to the presence of gradients of pressure and temperature in the treated sample. By sintering diamond powder without binder under pressures above 6.0 GPa and under temperatures above of 1400° C, the contact pressure between diamond particles can reach the value of 130.0 GPa [2] that makes possible the formation of the diamond skeleton with closed porosity. The use of binders makes possible the closing of the pores.

Among the polycrystals it is distinguished the composite that is composed of diamond and silicon carbide (SiC) with high thermal stability. To get this type of composite the infiltration method is used. This method is based on the formation of the composed skeleton of diamond grains that are previously compacted by the high pressure (above 6.5 GPa) in ambient temperature using special devices capable to generate this pressure. In a posterior heating, the silicon powder layer, that is in the compression chamber above diamonds, melts and penetrates into the diamond skeleton forming another skeleton of SiC. The formation of silicon carbide, with consumption of diamond carbon, affects the properties of the gotten composites. To eliminate this defect it was considered to mix silicon with graphite in 1:1 ratio in mass and to carry the reactive cell through the same sintering p, T - parameters. Silicon carbide is formed outside of the diamond skeleton and, during its penetration, no damage in diamond crystals is observed. The productivity of attainment of composite without defects increases in 20% and wear resistance in 16% because of reduction of the free silicon in the composite.

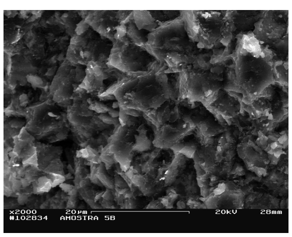

Figure 1: Distribution of the binder phase between the diamond grains.

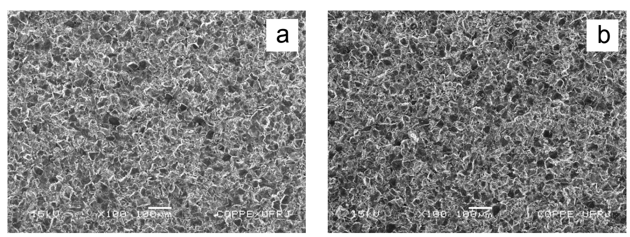

Figure 2: Homogeneity of structure sintered under pressure of 8.0 GPa at 1800° C for different granulations: **a)** 14/10 μm and **b)** 40/28 μm.

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