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Effects of nanodiamonds adittion on the mechanical properties of polycrystalline diamond

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Abstract – The most important task of this problem is the consolidation or improvement of the processed polycrystalline diamond. It is worldwide recognized that the plastic deformation of the diamond particles performs the most important role on the diamond powder consolidation. In some cases, the contact and shear tensions reconstruct the compact structure. In this work the sintering process it was used a mixture of micro and nanodiamonds. The sintering process was carried out in a toroidal high-pressure device. Thus, the effects of nanodiamond addition and sintering conditions on the microstructure and mechanical properties sintered diamond bodies were studied. The nanodiamonds were obtained by high energy ball milling and, immediately after grinding, the mixture was prepared with the diamonds. The sintering parameters were pressure of 8.5 GPa and temperature 2050°C, and these conditions maintained for 25 seconds. Homogeneous sintered bodies were obtained, which have a Vickers' hardness 36 GPa, density of the 3,26 g/cm^3 and fracture toughness around 6,9MPa.m$^{-1/2}$

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After the process of sintering were determined the mechanical properties of the samples. Then the samples were fractured and analyzed in SEM. Homogeneous sintered bodies were obtained, which have a Vickers' hardness 36 GPa, density of the 3,26 g/cm^3 and fracture toughness around 6,9MPa.m$^{-1/2}$

The polycrystalline bodies obtained by high pressure and temperature from the adoption of nanopowder (around 20%) together with the size of 40/28μm have the superior mechanical properties as the basis only of polycrystalline micropowder. The best results showed the sample made with 14% adoption of nanopowder. The formation of polycrystalline from the mixture of micro and nano powders under action of high pressure of 8.5 GPa and temperature of 20500C is carried out in two stages: the first is the sharp decrease in porosity caused by mutual displacement of particles, fragmentation accompanied by elastic-plastic deformation, and the second - with no significant increase in density and significant plastic deformation of particles and generation of high-density deslocation. The mechanism of plastic deformation of the nanopowder particles between the surfaces of crystals of micropowder is very difficult and requires the deep search.