

Diamond-tungsten carbide nanocomposite based on detonation synthesized diamond nanopowder

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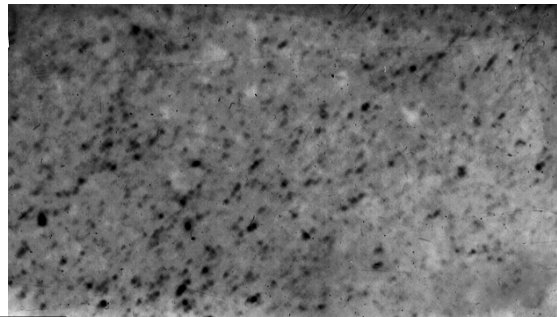
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The diamond-tungsten carbide nanocomposite was developed by HP-HT sintering of detonation synthesized diamond nanopowder – ultradispersed diamond (UDD) with nanoparticles of substance tungsten containing. The mixture was prepared by chemical method [1].

Composite samples were sintered from the mixture of UDD nanopowder with a nanopowder of tungsten trioxide. Before sintering, the mixture in a hydrogen atmosphere was heat treated. According to X-ray analysis, the composite includes tungsten carbide WC and tungsten oxide WO₃. Tungsten carbide was formed both the direct interaction of diamond with tungsten, and as a result of reactions in the W–C–O system [2].

Nanoparticles of tungsten carbide formed in voids between the diamond nanoparticles are chemically bonded with them. This improves the physico-mechanical properties of the composite. The composite has the structure, where the tungsten carbide and diamond grains are regularly placed and are uniform in size (Figure).



30nm

Figure. Typical SEM image of the structure of diamond–tungsten carbide nanocomposite.

Optimal sintering parameters and composition of the composite were determined. The composite combines high hardness ($H_V = 25$ GPa) and fracture toughness ($K_{IC} = 6.6$ MPa·m^{1/2}).

- [1] Novikov M.V., Bochechka O.O., Nazarchuk S.M., Gavrilova V.S., Oleinik G.S., Romanko L.O., Sveshnikov I.A., Zabolotnyi S.D., Patent of Ukraine 50931, 2010, Byull. 12
- [2] S.N. Nazarchuk, A.A. Bochechka, V.S. Gavrilova, L.A. Romanko, N.N. Beljavina, L.I. Alexandrova, V.N. Tkach, E.F. Kuzmenko, S.D. Zabolotnyi, *J. Superhard Materials* **1**, 3 (2011).