## Nanocomposites and nanomaterials

# Diamond-tungsten carbide nanocomposite as working element for fine turning

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The diamond-tungsten carbide nanocomposite was produced by HP-HT sintering of diamond nanopowder with nanoparticles of a tungsten-containing substance. The mixtures were prepared by chemical method [1]. We have used ASM5 0.1/0 statically synthesized diamond nanopowder, and a tungsten trioxide nanopowder as components of the mixtures. Before sintering the mixture was heat-treated in a hydrogen atmosphere.

According to X-ray analysis, the sintered samples include WC tungsten carbide and $WO_3$ tungsten oxide. Tungsten carbide was formed as results of both the direct interaction of diamond with tungsten and 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 physico-mechanical properties of the composite. The composite combines high hardness (*HV* = 25 GPa), fracture toughness ($K_{IC}$ = 6.6 MPa·m$^{1/2}$), and thermal stability (at 1370 K $K_{ts}$ = 0.86).

Fine turning of aluminum alloy A6 sample of diameter of 60–65 mm was made. Round cutting insert of nanocomposite of diameter of 7±0.025 mm served as the working element of the tool. Fixation was carried out mechanically. Cutter had a rake angle $\gamma$ of 0°; flang angle $\alpha$ of $10^0$. Feed was 0.25 mm/rev and cutting speed was 4.5 m/s. The formed surface has a surface roughness *Ra* of 0.4 μm and waviness *Raw* of 0.7 μm.

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 // Byull. – 2010. – **12**.
2. *Nazarchuk S.N., Bochechka A.A., Gavrilova V.S. at al.* The diamond-tungsten carbide polycrystalline composite material // J. Superhard Materials.–2011.–**33**, N. 1.–P. 1–12.