Influence of B and Fe on the structure and the properties of superhard composite on the basis of nano-carbon at high pressure

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Using the method of high-energy consolidation by way of alloying with boron previously the obtained composite on the basis of inexpensive, not containing fullerenes, extraction fullerene soot C_{Extr} + 10% Fe obtained new isotropic very hard carbon-boron-iron amorphous- nano-crystalline composite with the high resistance to cracks and the elasticity.

The alloying 10% of boron led to the essential positive changes. The obtained composite has the sharply expressed heterophase structure, which includes: the amorphous carbon-boron-iron connecting phase-basis (Fig.1, a), filled with its strengthened crystallites of carbides and borides Fe and boron carbides of different degree of dispersion; the distributed at the basis super-solid particles of the carbonic phase; particles of new carbide of iron; with strengthened diffusion Fe-C by layer on the surface and with inculcated in it nano-particles of boron carbide B_4C (Fig. 1, b).

On the microstructure the body of models samples C-B-Fe the connecting phase-basis, which determines the basic properties of the composite: strength, hardness, resistance to cracks.

As a result structural changes – the microhardness of phase-basis grew in ~2-4 time, carbide of iron in ~2 time, – samples acquired resistance to cracks and elasticity.

The best samples, sintered at a temperature T=1200-1250°C and time – 60-90 s., have a microhardness of amorphous phase-basis in the limits 30,32…90,58 GPa, the inclusions of super-solid particles – to 100 GPa, particles of new carbide of iron – to ~15,75 GPa.

Composite C_{Extr}-10%B-10%Fe super-light – specific weight 2,13…2,168 of g/sm^3.

New composite on the structural state and the properties can be used as instrument, abrasive, wear-resistant and construction material.

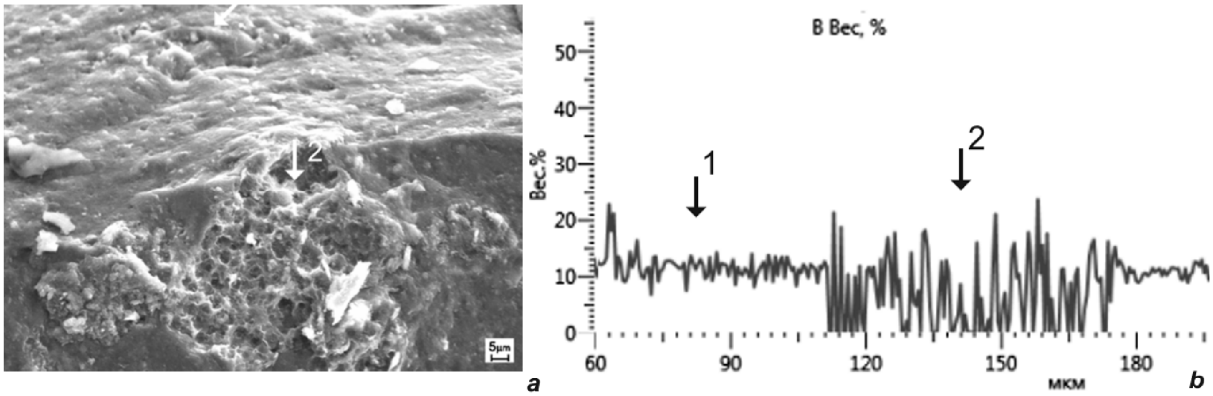

Fig.1. Sample C_{Extr}-B-Fe-34: a – fracture on phase-basis (on arrow 1) and on the particle of carbide Fe with the inclusions of dispersed Fe-B particles (on arrow 2), b – the concentration curves of distribution of boron during the scanning along the line through these sections

References

1. Urbanovich V.S., Kuis D.V., Okatova G.P., Svidunovich N.A., Oichenko V.M. Superhard composite material based on nanodispersed carbon. International Conference "Advanced Carbon NanoStructures" (ACNS'2013). St.Petersburg, Russia, July 1-5, 2013. Book of Abstracts ACNS'2013. 1-5 July, 2013. St. Petersburg, Russia. P. 346