

Diamond–Tungsten Carbide Polycrystalline Composite Material for Working Elements of Drilling Tools

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Problem Description

The optimal sintering parameters and formulation of a diamond composite from diamond and tungsten powders of submicron and nanosizes at high pressure and temperature have been defined. It has been shown that as a result of the diamond and tungsten interaction tungsten carbide particles, which are chemically bonded to diamond particles, form in spaces between them. Over the whole volume of the composite the structure has been observed, where tungsten carbide and diamond grains are regularly placed and are uniform in size. An addition of a coarse diamond component to the composite has been found to contribute to an increase of the composite wear resistance. We propose to use this material as a work item for the various types of rock cutting tools.

The way of problem solving

The composite has a high hardness ($HV5 = 25 \text{ GPa}$), fracture toughness ($K_{Ic} = 6,6 \text{ MPa}\cdot\text{m}^{1/2}$) and thermal stability (at 1100°C $K_{TS} = 0,86$). We conducted laboratory tests of cutters for rotary drilling holes with a diameter of 33 mm for anchoring mines equipped with working elements of this composite. On the road cutting 182 m average width of wear and tear of the unit area of the plate was 1.6 mm, which corresponds to the deterioration of the standard ATP under the same conditions. Increased wear resistance of the plates will be achieved by increasing the hardness of a coarse diamond component.



Cutters for rotary drilling holes equipped with working elements of diamond–tungsten carbide polycrystalline composite

Basic publications

1. S. N. Nazarchuk, A. A. Bochechka, V. S. Gavrilova, L. A. Romanko, N. N. Belyavina, L. I. Aleksandrova V. N. Tkach, E. F. Kuz'menko, and S. D. Zabolotnyi Diamond–Tungsten Carbide Polycrystalline Composite Material // Journal of Superhard Materials. - 2011. - N 1. - P.3-17.
2. Патент на винахід №93803 Україна, М. кл.⁶ МПК, В24D 3/02, В22F 3/14. Спосіб отримання алмазного композиційного матеріалу / М. В. Новіков, О. О. Бочечка, С. М. Назарчук, В. С. Гаврилова, Г. С. Олейник, Л. А. Романко, І. А. Свешніков, С. Д. Заболотний. – Опубл. 10.03.11. Бюл. № 5.
3. Бочечка О. О., Свешніков І. А., Назарчук С. М, Заболотний С. Д., Гаврилова В. С., Боженок В. М., Луцак Е. М., Романко Л. О., Гльницька Г. Д., Смекаленков С. В. Алмазний полікристалічний композиційний матеріал алмаз – карбід вольфраму для бурового інструменту // Інструментальний світ. – К. : ПІЦ АЛКОН НАН України, 2011. № 1–2 (49–50). – С.50–52.

Innovative Aspects of the solution / development/ methodology, tool, prototype

Thermal stability of the material exceeds the thermal stability of the standard diamond-carbide plates at 400 degrees.

Main advantages of the solution / development/ methodology, tool, prototype

The economic benefits include increased rates of penetration due to the increased thermal stability of the working elements of the instrument..

Financial and Economic Parameters**Investment Offer** *(is not obligatory)***Current stage of development** of the offered solution / development/ methodology, tool, prototype

(please, select)

Development phase – laboratory tested

Available for demonstration – field

Already on the market

Comments:

Intellectual Property Rights *(please, select)*

patent applied for (name countries in which you have applied for patents in)

patents granted **Ukraine** (enter the countries that have granted the patents; where the initial patent was granted and say a few words about the company)

copyright

exclusive rights

secret know-how

others (registered design, plant variety right, etc.)

Comments

Collaboration Details (Type of collaboration sought; *more than one option can be selected*)

Technical co-operation

Commercial agreement with technical assistance

Joint Venture agreement

License agreement

Manufacturing agreement

Financial resources

Comments:

Technology Key words

Diamond composite, sintering, high pressure, diamond nanopowder, tungsten carbide, drilling tools.