

INSTITUTE FOR SUPERHARD MATERIALS

Department Computer Material Science of the Structured Superhard materials for Drilling and Mining Tools

Who we are

For a long time the main task of the department was creation of diamond containing composite materials and experimental and theoretical scientific researches of their properties, implementation of experimental and diagnostic tests of drilling and mining tools on a modern equipment.

Researchers of department study phase transitions at pressures up to 8 MPa and temperatures up to 2500K. They establish correlation between formed structure and physico-mechanical and chemical properties of sintered materials. They are looking for technology of new superhard materials synthesis. One of the main advantages of research equipment of the department is ability to treat with extremely high pressure and temperature samples having 14 mm in diameter and 4 mm in height.

Collaboration interests

The department of synthesis and sintering of superhard materials at extremely high p,T-parameters is interested in participating in EU projects under FP8 program and also in other forms of international and projects in the following research areas: materials science, chemistry of materials and high pressure physics. We are able to synthesize materials at high pressure and temperature and interested in thorough characterization of synthesized samples with the use of modern research facilities.

Potential role: major partner, scientific expert, technology provider.

Research Areas

- development of theoretical bases of creation of diamond containing composite materials
- technological researches of processes of hot and intensive electrical sintering at an increase pressure of diamond containing composite materials for drilling and mining tools
- it is Research of structure and forming of properties of composition materials in the conditions of high pressures and temperatures
- it is Development of scientifically-technological bases and creation of new technologies with the use of technique of high pressures and temperatures for the receipt of composites on the basis of diamond and metallic or hard-alloy matrix
- it is the Computer design and planning of structural parameters of drilling tools, that is equipped by different functional elements depending on the type of rocks.
- it is Research of thermophysical processes and migrations of liquid phase

at sintering of diamond containing composite materials

- it is Study of conformities to law of process of destruction of mountain rocks and wear of diamond tool
- it is Research of physico-mechanical properties of diamond containing composite materials
- it is the Computer design and researches of processes of electrical sintering of diamond containing composite materials and constructions of tools on their basis
- it is the Computer design of the stress - streine state of functional elements for drilling and mining tools
- it is the Computer design and planning of structural parameters of drilling tools, that is equipped by different functional elements depending on the type of mountain rocks;
- it is Study of conformities to law of process of wear during cutting of mountain rocks;
- it is Planning of new constructions of drilling and mining tools.



Main achievements

- The analytical model of propagation cohesive crack is offered and grounded in the crystals of synthetic diamond, which explains the mechanism of decline of durability of crystals of synthetic diamonds with different alloy-catalyst at heating.
- Developed and tested on wearproofness of PDC of new type with 1,8 mm thick of diamond layer, which increase the resource of drillers for degassing of methane from coal intended in 3 times.
- On the basis of granulometric analysis of products of destruction of mountain rock got at cutting by hard-alloy cutter and mikrocutting by grains of diamond, fastened in elements from diamond containing composite material (slavutich, tvesal), set identity of mechanisms, formed in both noted processes of destruction of mountain rock.
- The three-dimensional model of source of selection of heat in the area of contact of PIN and metall

plate (copper-copper and nickel-copper) is developed in the process of their welding by Friction Stir Welding method (FSW).

- Developed new construction of hard-alloy cutter of circulating type with a discrete contact surface for destruction of mountain rocks, in basis of which the fixed principle of friction of woobling in place of friction of sliding, which allowed cardinally to reduce a temperature in the area of contact of tool with a rock and reduce of rate of wear.

Reference projects

NATO ARW, 12-15.05.2004, N° 980377, project «Innovative superhard materials and sustainable coatings»

Contact information

Full name of the Research Department:
Computer Material Science of the Structured Superhard materials for Drilling and Mining Tools

Well-qualified researchers: 3 Dr. Sci., 9 Ph.D..
 Well-qualified workforces to operate with high pressure equipment, analytical and technological facilities.
 Wide experience on materials science, mechanics of materials.
 We have experience of co-operation with partners from China and USA.

What makes us a good partner

Full name of the Institute:
 V.N. Bakul Institute for Superhard Materials of the National Academy of Sciences of Ukraine

Country: Ukraine

Number of employees working in the research division: 40

Working languages: English, Russian, Ukrainian

Contact person: Prof. Dr. A. Maystrenko

Position: Head of Department

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