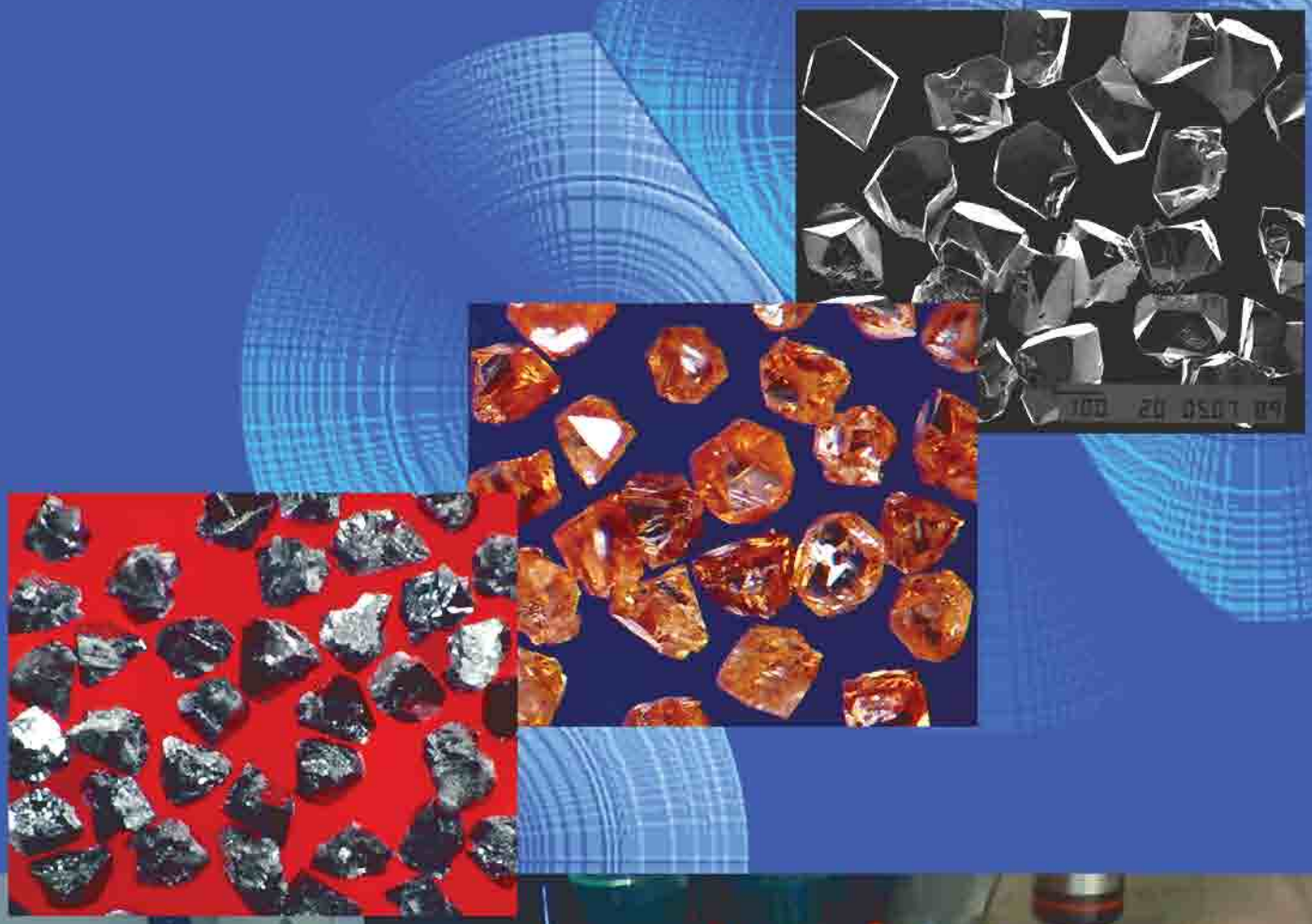
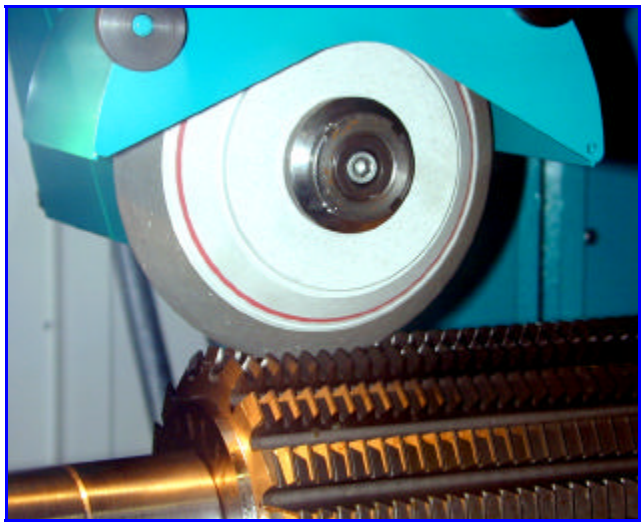


HARIS DIVISION
INDUSTRIAL DIAMONDS



# Cubic Boron Nitride

Cubic boron nitride is being characterized by a unique combination of physical-mechanical and chemical properties. Disposition of atoms in crystal grate belongs to the structural type of spharelite, which determine high density and hardness of crystals CBN. (Fig.1). As a result of breaking away crystals along the shear plane, i.e. breaking of atomic bonding, at grinding cutting edges of CBN crystals permanently renew, due to this is reached high and stable cutting ability. (Fig.2)

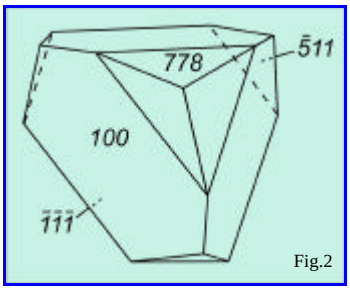


Fig.2

Combination of high toughness and heat resistance enables using high speeds of grinding at CBN tools. Owing to high hardness and low coefficient of friction grinding of high-speed steel with CBN tool is made with high-performance and quality result, without phase and structural changes in surface layer.

Mechanical toughness of CBN grains depends on perfection of internal structure and isometrics of grains. Modulus of elasticity of CBN (706 GPa) is significantly bigger than that of regular abrasives (296-365 GPa).

Specific heat of CBN (670 J/kg·°C) is low than that of electrocorundum. Coefficient of linear thermal expansion of CBN is 1,5 -3 times lower than that of electrocorundum. That is why grains of cubic boron nitride have lower thermal deformation.

Chemical passivity at interaction with metals is an important property of CBN, as opposed to diamond and silicon carbide it is inactive to iron, the basics of metals and iron-carbon alloy, which lowers diffusive and adhesive deterioration of grain. This excludes its gripping at interaction with treated materials, makes lower the grinding force and temperature.

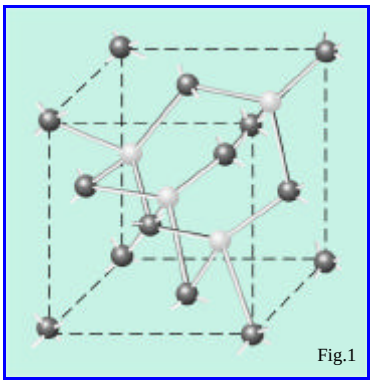


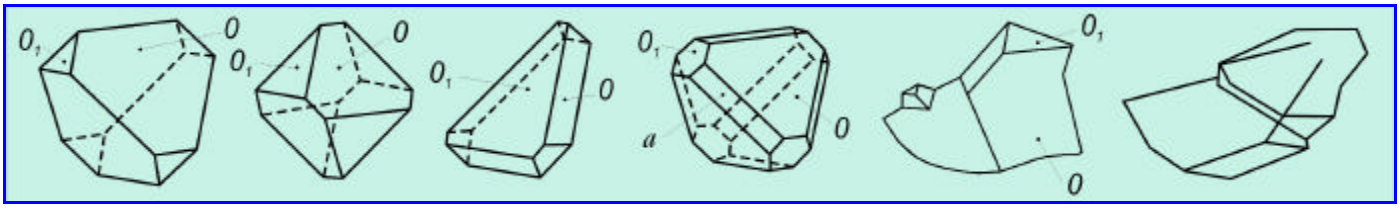
Fig.1

Crystals of CBN do not lose their cutting properties, phase structure and toughness till the temperature 1100-1200C°. Moreover, at temperatures of active oxidation the strength of grains is increasing, as grains are ovalized and appearing on them layers of boric anhydride $B_2O_3$ are cementing defects of surface. Formation of $B_2O_3$ layer on grains of cubic boron nitride hampers diffusion of oxygen. Obvious oxidation of CBN crystals starts at heating temperature more than 1200°C.

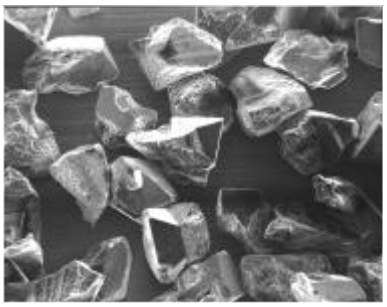
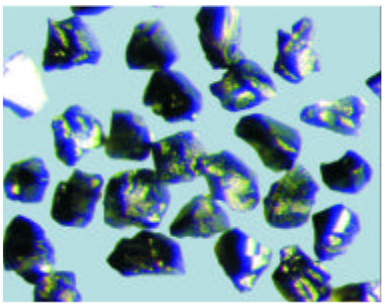
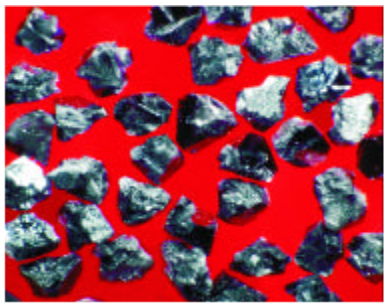
Thus, cubic boron nitride significantly supersedes toughness, endurance, abrasive ability, thermal conductivity and chemical stability of standard abrasive materials (electrocorundum, SiC), i.e. all parameters determining quality and efficiency of instrumental abrasive materials.

Depending on conditions of growth, composition and properties of crystallization environment, synthesized CBN appears to be aggregates, druses of recrystallization, growth twins and monocrystals of different degree of crystal perfection.

Forms of CBN crystals.



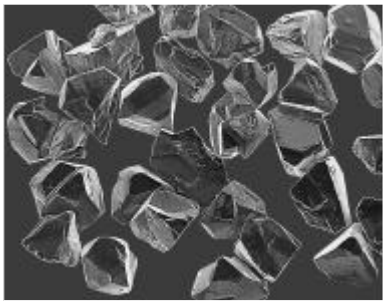
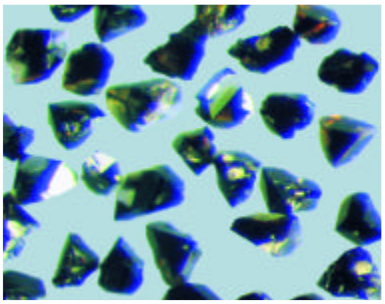
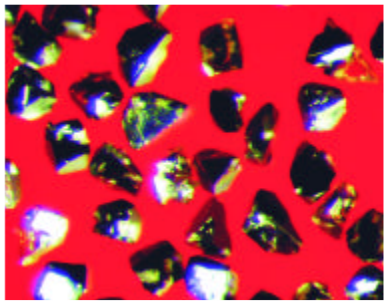
**CBN H200**

ÑBN H200 type has been produced for more than 15 years according to classical technology of synthesis of cubic boron nitride. These are monocrystals and their splices of semi-blocky shape, predominantly of black color, with inclusions of dark-gray grains. Owing their mosaic-sectored crystal structure the edges of crystals have advanced microrelief. High fragility morphologically predetermines self-sharpening of cutting edges of crystal due to breaking away of small fragments. Owing to advanced surface of edges, CBN H200 crystals well knit with ceramic and other kinds of bonds, which ensures firm retention of grains while the tool is at work.

CBN H200 performs well in ceramic or galvanic bond under medium power of grinding. With 60% nickel coating CBN H200 60N is successfully used for manufacturing tool on resin bond, as well as for grinding, finishing, honing of high-speed steels, alloys and cast iron >40 HRc.

**CBN H600**

CBN H600 is a product of hi-tech synthesis of cubic boron nitride. The color of crystals is black with inclusions of dark-brown grains with dense metallic brilliance and interchanging transparent and non-transparent sectors. Its typical crystallographic forms are combinations of tetrahedron and octahedral habitus. CBN H600 is mainly presented with monocristals with long, pronounced cutting edges. Mechanical strength of CBN H600 crystals is 1,5 times higher than that of CBN H200. If a tool of CBN H200 at work needs lower power consumption, CBN H600 is preferable when higher specific compression force and advance speed are needed. These properties in combination with high thermal stability ensure high performance of CBN H600 at aggressive grinding of fast-cutting steels, alloys, based on nickel and cobalt, as well as grinding of solid cast iron >45 HRc.

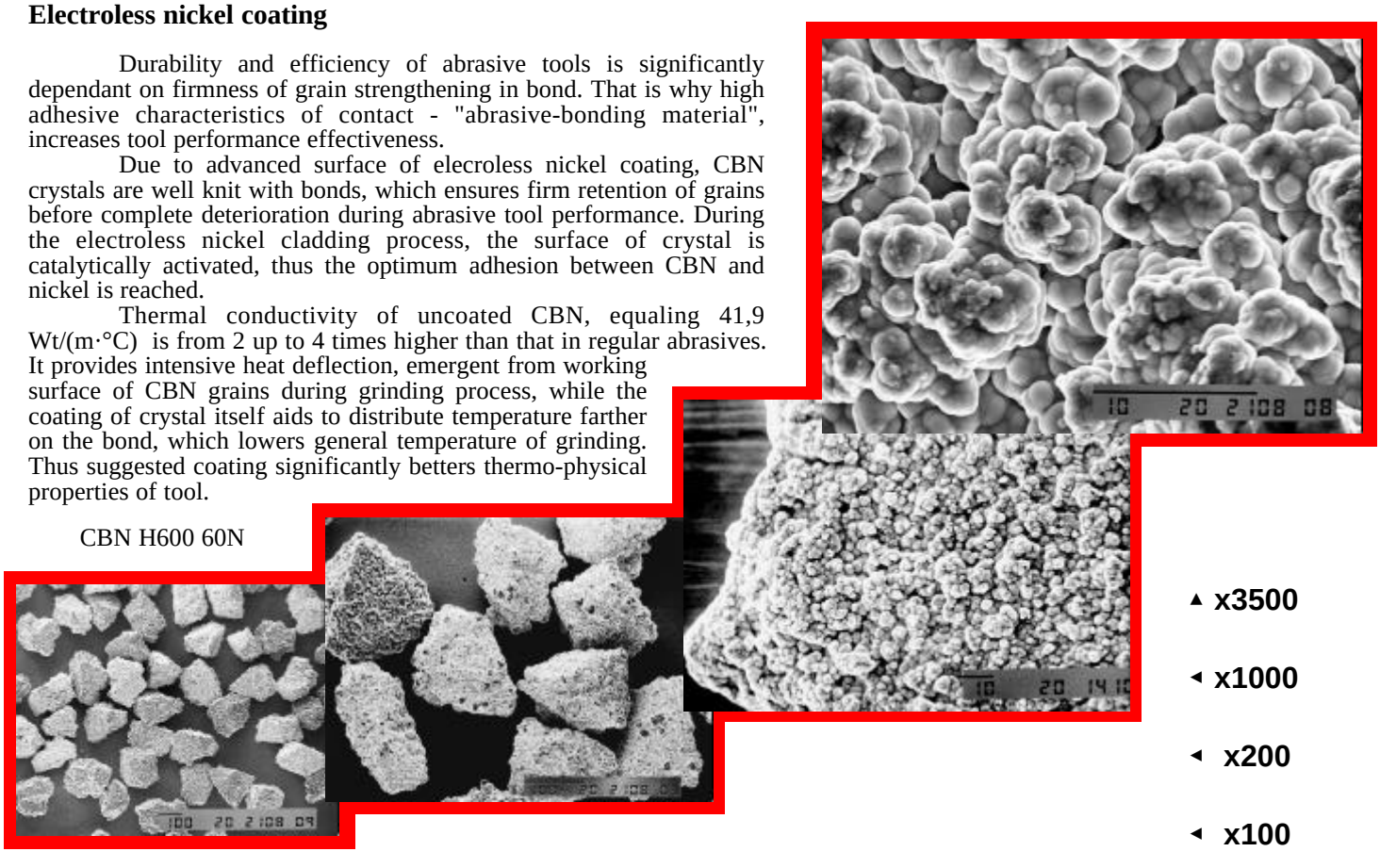
## Electroless nickel coating

Durability and efficiency of abrasive tools is significantly dependant on firmness of grain strengthening in bond. That is why high adhesive characteristics of contact - "abrasive-bonding material", increases tool performance effectiveness.

Due to advanced surface of elecroless nickel coating, CBN crystals are well knit with bonds, which ensures firm retention of grains before complete deterioration during abrasive tool performance. During the electroless nickel cladding process, the surface of crystal is catalytically activated, thus the optimum adhesion between CBN and nickel is reached.

Thermal conductivity of uncoated CBN, equaling 41,9 Wt/(m·°C) is from 2 up to 4 times higher than that in regular abrasives. It provides intensive heat deflection, emergent from working surface of CBN grains during grinding process, while the coating of crystal itself aids to distribute temperature farther on the bond, which lowers general temperature of grinding. Thus suggested coating significantly betters thermo-physical properties of tool.

CBN H600 60N



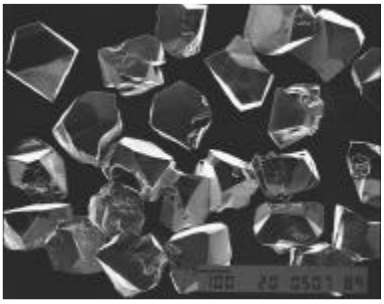
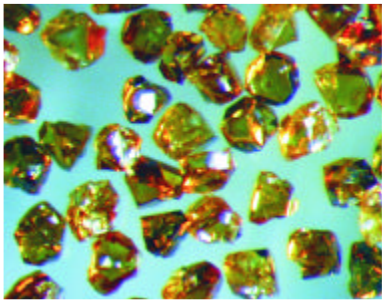
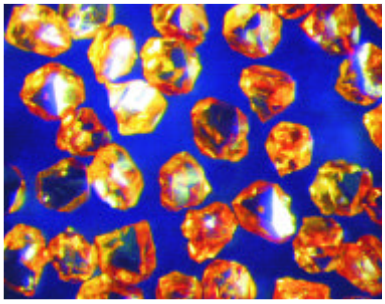
▲ x3500

◄ x1000

◄ x200

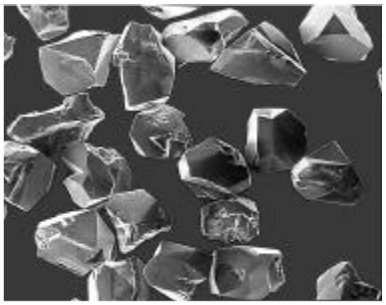
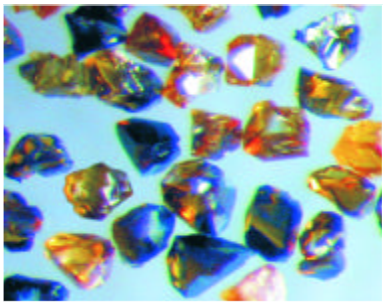
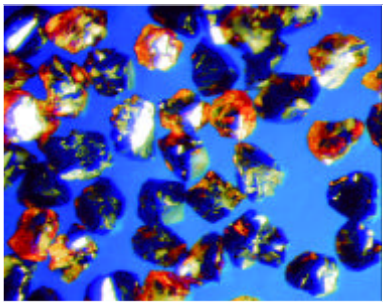
◄ x100

**CBN H500**

CBN H500 is a monocrystallic abrasive with blocky shape crystals of amber color and great number of transparent sectors. With the growing of their size the color of granules changes from light to dark.
The results of structural analysis along with IR-spectroscopy prove their high rate isometrics and perfection of crystal matrix. Low number of defects and inner inclusions determine high toughness and thermal resistance of this type of CBN. It is used for producing tools on ceramic, metal and galvanic bonds for processing ferrous and non-ferrous metals.

**CBN H800**

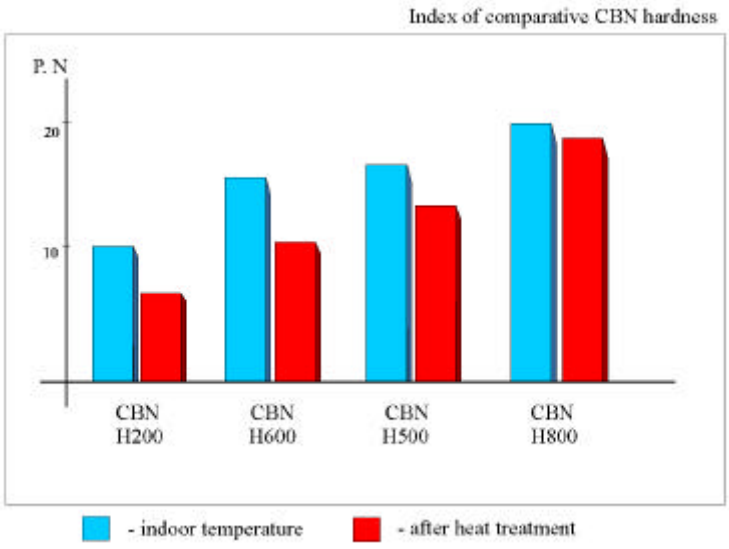




This product is presented with monocrystals of blocky form, harder than CBN H500. Chemical catalysts of this kind of synthesis in form of inclusions of colloid type determine the coloring of crystals with the color changing from amber to that dominant dark-brown.
CBN H800 crystals feature high resistance to compression and have high fracture toughness. This type of cubic boron nitride has the highest mechanical density of all monocrystalline CBN. Main characteristics of synthesis of this type predetermine high heat resistance, which proved to be good for sintered of metal bonds. But also in other bonds this type of CBN is excellently works in difficult conditions of grinding, under higher force of treatment, ensuring consistent grinding and extended tool life.

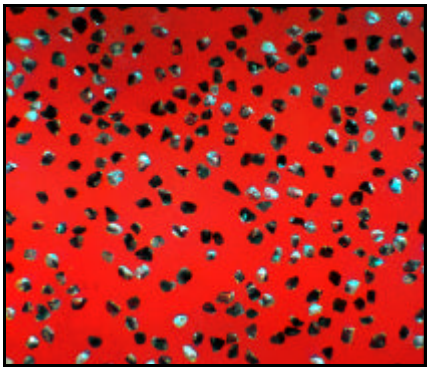
## Heat resistance

Main operational characteristics of abrasive instrumental materials is heat resistance - ability of materials to retain mechanical characteristics and structure upon multiple thermal disturbances. High heat resistance is ensured with, from one hand substance properties - low rate of coefficient of thermal expansion and modulus of elasticity, high rate of thermal conductivity, and, from the other hand, for its value affects the degree of perfection of crystal structure, number of impurities and defectiveness of material.

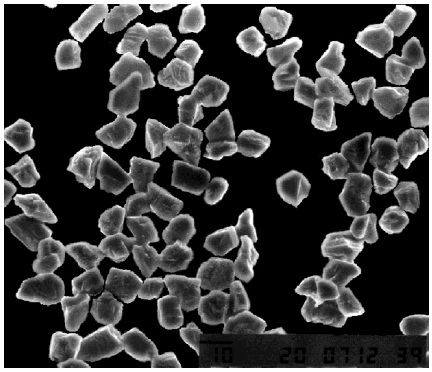
The degree of thermal stability is being evaluated as a result of comparison of basic mechanical hardness of crystals and corresponding hardness after thermal treatment, including heating, isothermal exposure and cooling. Thermal treatment is made in hydrogen environment at 1200°C and time of thermal exposure makes 20 minutes.



**CBN Micron Powder**

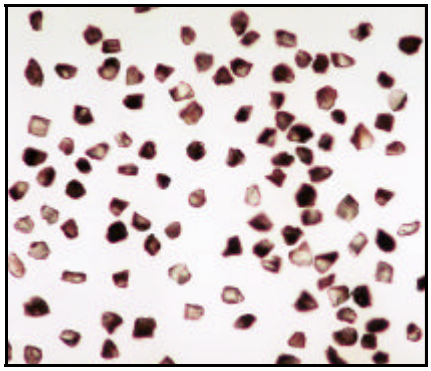


CBN HM1

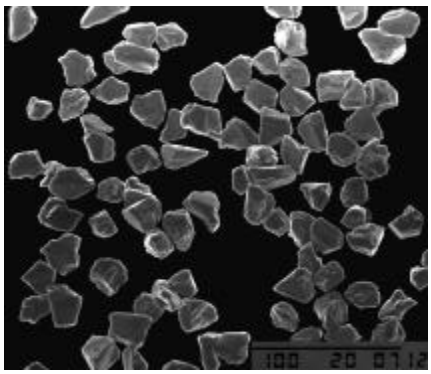


CBN HM1

Haris Division supplies 2 types of CBN micron powder - of black and amber color. CBN HM1 is a derivative product from CBN H200 mesh size. Angular shapes of grains promote high abrasive properties of powder, which is good for high specific removal rates. Variant CBN HM1 60N with Ni 60% coating is offered for resin bond.
CBN HM2 is a derivative from CBN H500 with the amber color. Grain shape of this micron-size powder is more regular, than that of CBN HM1. High degree of chemical homogeneity and minimal inclusion of CBN H500 dashes, as a basic material, endow CBN HM2 with hardness and thermal stability. These properties make CBN HM2 popular in using it for sintering plates of PCBN for blade tools.
CBN HM1 and HM2 are used for finish grinding and super-finishing applications, as well as for fine-grinding, finishing and polishing of hardened steels, super-alloys and other metal materials and abrasive pastes and emulsions also.



CBN HM2



CBN HM2

Comparative spectrographic analysis of basic chemical content of samples of two types of CBN Micron. Spectral foldover of CBN HM1 and CBN HM2 is made on roentgen fluorescent spectrometer BAIRD EX-6500.

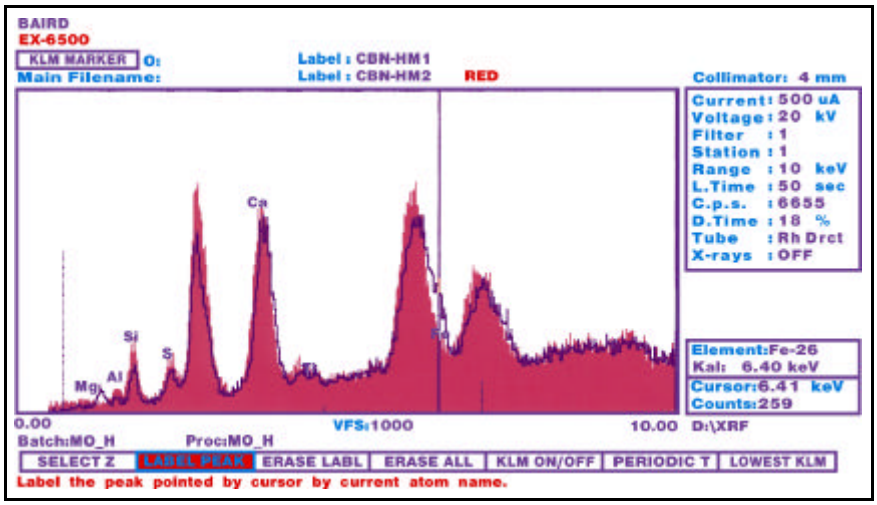


Table of size availability.

| | FEPA | ANSI MESH SIZE | CBN H200 | CBN H200 60N | CBN H600 | CBN H600 60N | CBN H500 | CBN H500 60N | CBN H800 | CBN H800 60N |
|---|---|---|---|---|---|---|---|---|---|---|
| Grinding-Sawing | B301 | 50/60 | • | • | • | • | • | • | • | • |
| | B252 | 60/80 | • | • | • | • | • | • | • | • |
| | B181 | 80/100 | • | • | • | • | • | • | • | • |
| | B151 | 100/120 | • | • | • | • | • | • | • | • |
| | B126 | 120/140 | • | • | • | • | • | • | • | • |
| | B107 | 140/170 | • | • | • | • | • | • | • | • |
| | B91 | 170/200 | • | • | • | • | • | • | • | • |
| | B76 | 200/230 | • | • | • | • | • | • | • | • |
| | B64 | 230/270 | • | • | • | • | • | • | • | • |
| | B54 | 270/325 | • | • | • | • | • | • | • | • |
| | B46 | 325/400 | • | • | • | • | • | • | • | • |
| | Bond System ▸ | | V T | R | V T | R | T V M | R | M V T | R |
| | MICRON SIZE | | CBN HM1 | CBN HM1 60N | | | CBN HM2 | | | |
| | 40-60 | | • | • | | | • | | | |
| | 20-40 | | • | • | | | • | | | |
| | 15-30 | | • | • | | | • | | | |
| | 10-20 | | • | | | | • | | | |
| Polishing-Lapping | 8-15 | | • | | | | • | | | |
| | 6-12 | | • | | | | • | | | |
| | 4-8 | | • | | | | • | | | |
| | 2-6 | | • | | | | • | | | |
| | 2-4 | | • | | | | • | | | |
| | 0.5-3 | | • | | | | • | | | |
| | 0-2 | | • | | | | • | | | |
| | 0-1 | | • | | | | • | | | |
| | 0-0.5 | | • | | | | • | | | |

**V** - Vitrified **R** - Resin **M** - Metal **T** - Electroplated

Table of physical properties.

| Product, type | Color | Coating, by weight | Density, g/cm$^3$ | Specific volume, cm$^3$/gr |
|---|---|---|---|---|
| CBN H200<br>CBN H600<br>CBN H500<br>CBN H800 | black<br>black<br>amber*<br>brown* | uncoated | 3,48 | 0,287 |
| CBN H200 60N<br>CBN H600 60N<br>CBN H500 60N<br>CBN H800 60N | gray<br>gray<br>gray<br>gray | Nickel, 60% | 5,25 | 0,190 |

*Gradation of colors is changing depending on size of crystal.

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