

Worldwide Superabrasives, LLC

EST 2004



# PRODUCT OVERVIEW CBN

Cubic Boron Nitride

Second in hardness only to diamond

CBN exhibits a high abrasion resistance and thermal conductivity when compared to conventional abrasives such as Aluminum Oxide and Silicon Carbide.

The thermal integrity of CBN and its ability to maintain sharp cutting edges when machining ferrous materials make it the product of choice in advanced grinding systems.



Karbon-Kore

Worldwide  
**SOLIDS**



**SPOC**  
Superabrasives Process  
Optimization Center

**THE WORLDWIDE GROUP**

# CBN OVERVIEW

## Resin Bond

systems are widely used for all-purpose superabrasive grinding applications in either phenolic or polyimide bonds. Resin bond systems can be utilized in either wet or dry grinding operations and offer excellent particle retention and part finish.

## Vitrified Bond

systems are manufactured from ceramic materials that are strong, durable and brittle. Vitrified bonds are very effective in advanced grinding operations because of their ability to hold the abrasive and reduce heat generation in the grinding zone due to their high porosity levels when compared to other bond types.

## Metal Bond

systems are the toughest formed bonds available and are recommended for wet grinding. Metal bonds exhibit high abrasive and heat resistance along with excellent form holding capabilities leading to extended tool life.

## Single Layer Bond

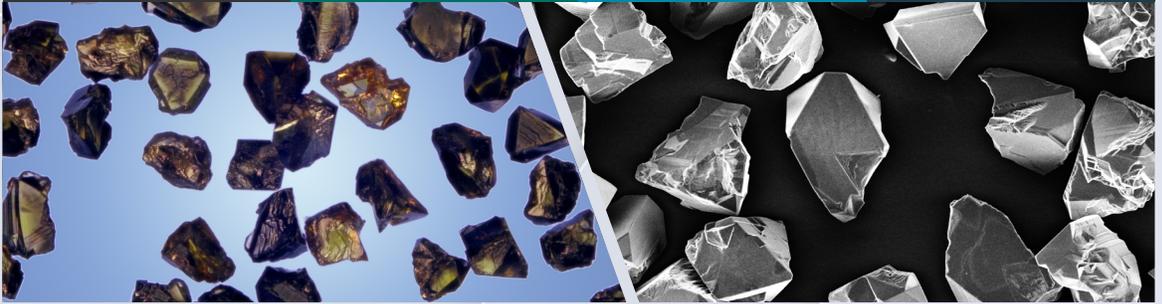
systems (electroplated and brazed) hold a single layer of superabrasive grains bonded to a precision machined form. Electroplated systems are bonded with a Nickel matrix and leave approximately 50% of the abrasive exposed while brazed systems leave approximately 80% of the abrasive exposed. Single layer bond systems typically do not require dressing.

· Resin Bond

· Vitrified Bond

· Metal Bond

· Single Layer Bond



### CBN-AMA

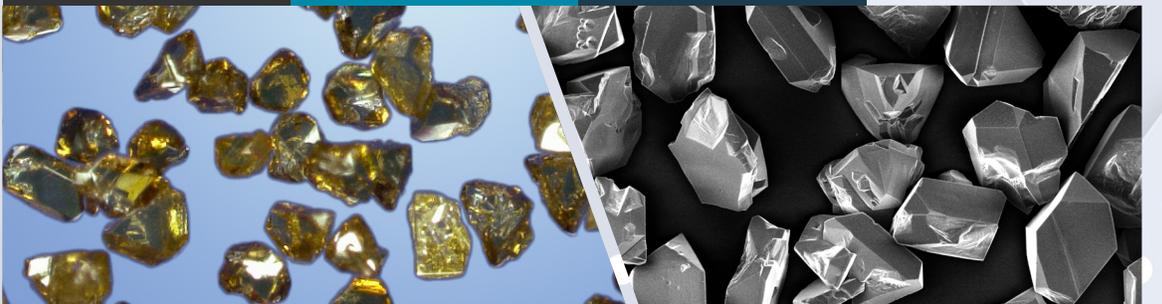
Low Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Dark brown, very high strength, with an angular morphology and very high thermal stability. The AMA's tendency to macrofracture under impact loading, coupled with its very high thermal stability provides both a free cutting action and longer wheel life.

· Resin Bond

· Metal Bond

· Single Layer Bond



### CBN-AMB

Very Low Friability  
Blocky Shape  
Density 3.48 g/cm<sup>3</sup>

Golden in color, very high strength, with a blocky morphology and very high thermal stability. The AMB's micro-fracturing characteristics, very high thermal integrity and very high fracture strength produce an aggressive cutting action while retaining the crystal in the bond as long as possible.

· Resin Bond

· Vitrified Bond

· Metal Bond



### CBN-AMT

Medium Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Dark to light brown in color in equal ratio, irregular with some angular particles in shape, the AMT is slightly weaker than CBN-AMA. The AMT's tendency to macrofracture under impact loading, coupled with its high thermal stability provides longer wheel life.



• Resin Bond

• Vitrified Bond

• Metal Bond

• Single Layer Bond

**CBN-AMU**

Medium Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

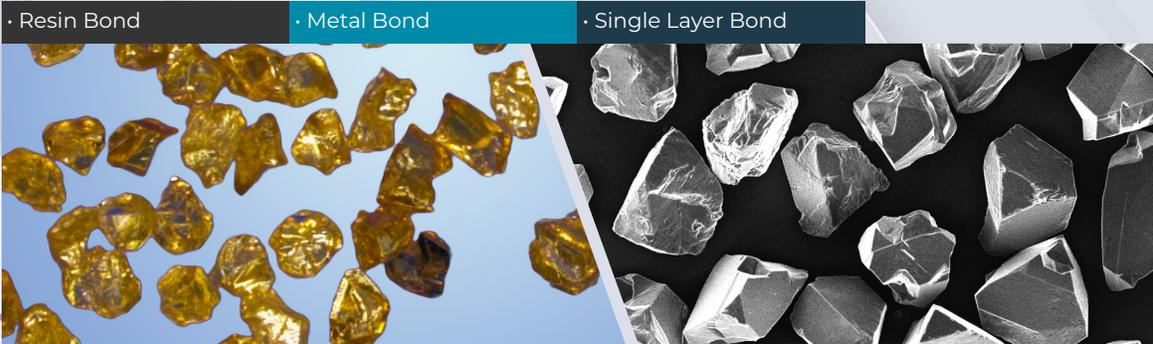
Dark to light brown in color in equal ratio. The material's shape is irregular with some angular particles. The AMU's tendency to macrofracture under impact loading, coupled with its high thermal stability provides longer wheel life.

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• Resin Bond

• Metal Bond

• Single Layer Bond

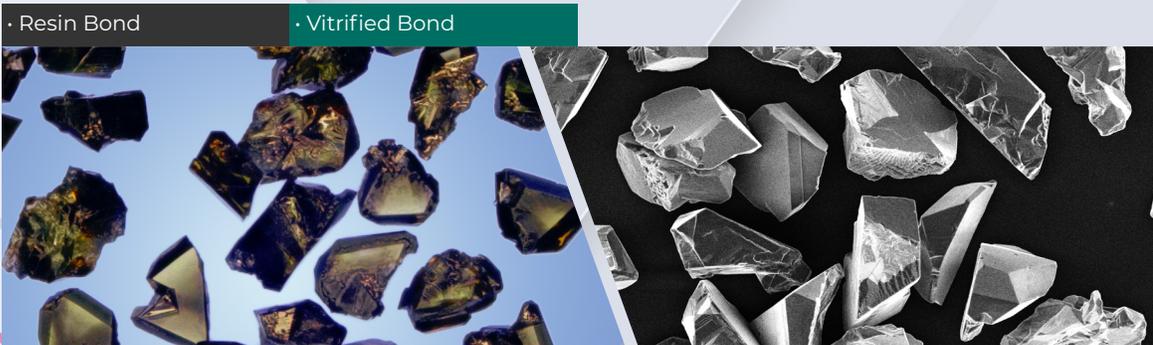
**CBN-AMX**

Very Low Friability  
Blocky Shape  
Density 3.48 g/cm<sup>3</sup>

A high strength CBN grit, its blocky shape with sharp edges maintains its strength, shape and free cutting action for the most demanding ferrous metal grinding operations; useful in high-speed grinding applications carried out with electroplated CBN wheels.

**Metal Bond**

systems are the toughest formed bonds available and are recommended for wet grinding. Metal bonds exhibit high abrasive and heat resistance along with excellent form holding capabilities leading to extended tool life.



• Resin Bond

• Vitrified Bond

**CBN-X45**

Medium Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Dark to light brown in color in equal ratio, angular with some irregular particles in shape. The CBN-X45 tends to macrofracture under impact loading, along with its high thermal stability and free cutting action, provides longer wheel life. Generally recommended for vitrified applications.

**Single Layer Bond**

systems (electroplated and brazed) hold a single layer of superabrasive grains bonded to a precision machined form. Electroplated systems are bonded with a Nickel matrix and leave approximately 50% of the abrasive exposed while brazed systems leave approximately 80% of the abrasive exposed. Single layer bond systems typically do not require dressing.

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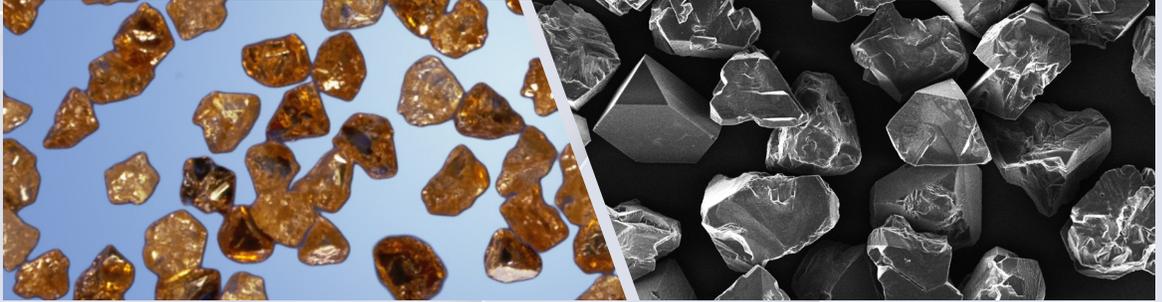
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· Resin Bond

· Vitrified Bond

· Single Layer Bond



### CBN-AME

High Friability  
Semi Blocky Shape  
Density 3.48 g/cm<sup>3</sup>

Amber, friable, semi-blocky shape with an irregular crystal morphology. The AME's controlled free cutting characteristics and consistent fracture mode enhance wheel life and surface finish. Generally recommended for electroplated and vitrified tools.

· Resin Bond

· Vitrified Bond



### CBN-AE4

High Friability  
Semi Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Golden amber in color, with a combination of angular and semi-blocky particles. The CBN-AE4 tendency to macro-fracture under impact, along with free cutting characteristics, enhance wheel life and surface finish.

· Resin Bond

· Vitrified Bond

· Metal Bond



### CBN-AMH

High Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Dark to light brown color in equal ratio, high friability, mostly irregular with some angular shaped particles. The AMH tends to macrofracture under impact loading, which coupled with its high thermal stability provides longer wheel life. Recommended for vitrified applications where more compressive residual stresses and high material removal rates are the goal.

### Size Availability

US Mesh (FEPA)	40/50 (B427)	50/60 (B301)	60/80 (B252)	80/100 (B181)	100/120 (B151)	120/140 (B126)	140/170 (B107)	170/200 (B91)	200/230 (B76)	230/270 (B64)	270/325 (B54)	325/400 (B46)
CBN-AMX	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AMB	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AMA	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AMU			Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AMT	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-X45			Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AME	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AE4			Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
CBN-AMH	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available

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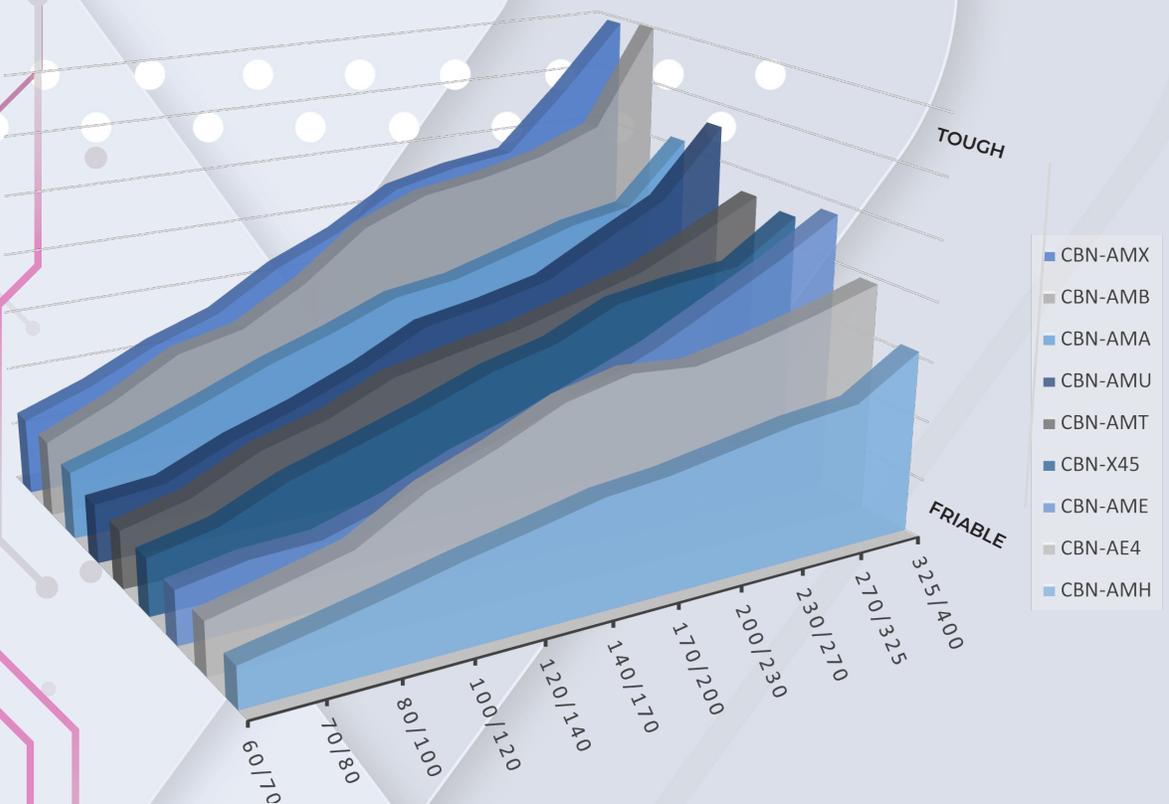
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#### Single Layer Bond

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### Friability<sup>1</sup> Comparisons



<sup>1</sup> Friability – A characteristic of superabrasives grains that describes their tendency to fracture or break apart when hit or placed under pressure. Highly friable grains cut more easily but wear faster than other abrasives. Less friable (tougher) grains do not cut as freely but tend to have longer wheel life.

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· Vitrified Bond



Medium Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

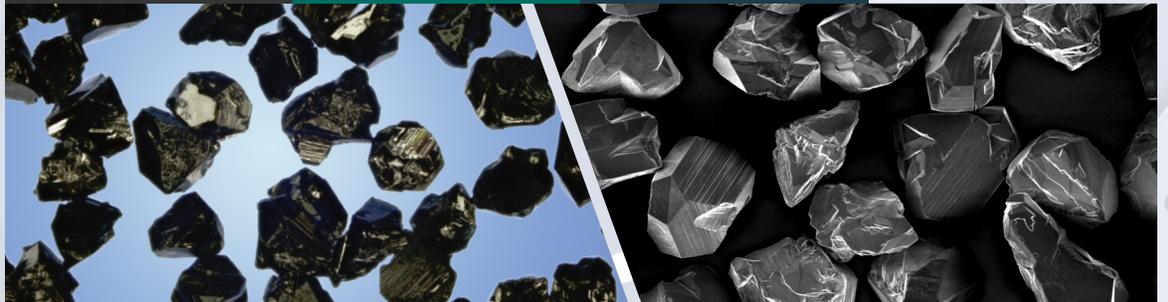
### CBN-BMA

Black, medium strength, with an angular morphology and high thermal stability. The BMA's angular morphology produces a free cutting action that reduces heat generation and power consumption while increasing grinding efficiency.

· Resin Bond

· Vitrified Bond

· Single Layer Bond



Low Friability  
Blocky Shape  
Density 3.48 g/cm<sup>3</sup>

### CBN-BMI

Black, medium strength, with a blocky morphology and high thermal stability. The BMI's blocky morphology provides a more controlled crystal micro-fracture, allowing the tool to better maintain its form while generating smaller particles under impact.

· Resin Bond

· Vitrified Bond

· Single Layer Bond



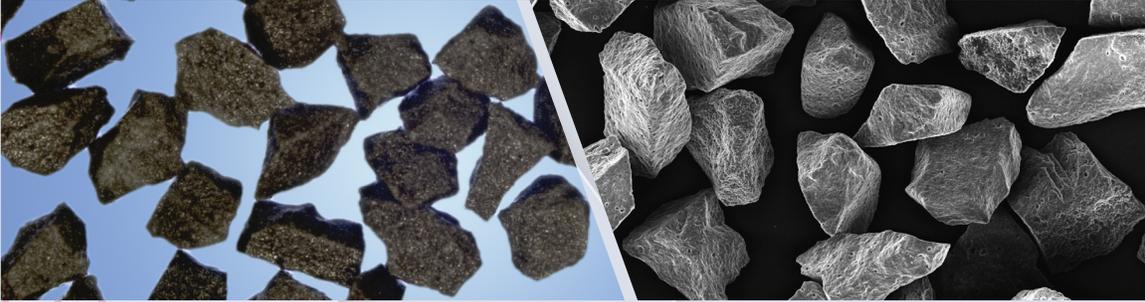
High Friability  
Semi Blocky Shape  
Density 3.48 g/cm<sup>3</sup>

### CBN-BMO

Black, friable, with an irregular shaped morphology. The BMO's semi blocky morphology produces controlled micro fracturing particles along with free cutting characteristics to enhance wheel life and surface finish.

• Resin Bond

• Metal Bond



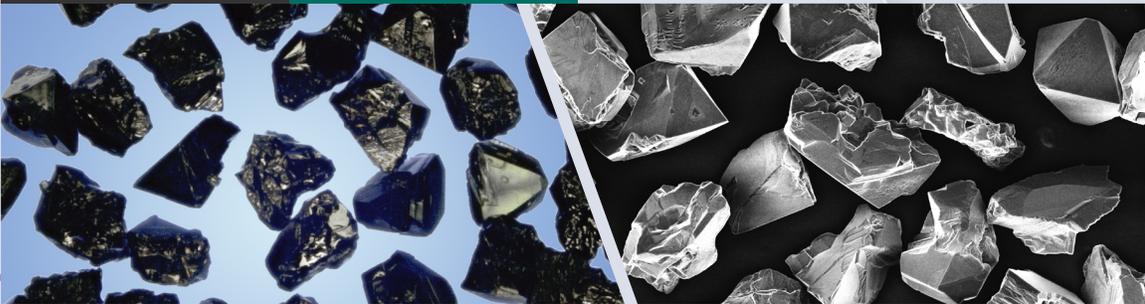
**CBN-BMS**

Very Low Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Dark gray in color with equal parts of angular and semi blocky shaped particles. The BMS is WWSA's highest strength micro-crystalline CBN. Optimal for demanding removal rate applications while providing very good surface finish. Recommended for a variety of honing applications.

• Resin Bond

• Vitrified Bond



**CBN-BWW**

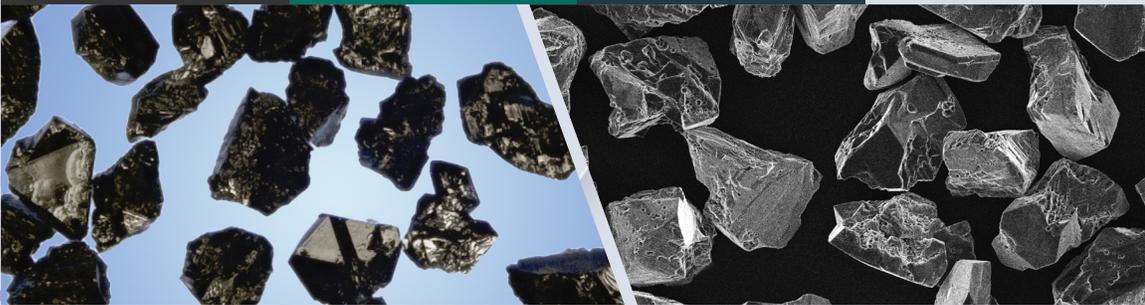
High Friability  
Angular Shape  
Density 3.48 g/cm<sup>3</sup>

Black, low strength, with angular shaped particles and medium thermal stability. The BWW's angular morphology produces a free cutting action that reduces heat generation and power consumption while increasing grinding efficiency.

• Resin Bond

• Vitrified Bond

• Single Layer Bond



**CBN-BLC**

High Friability  
Semi Blocky Shape  
Density 3.48 g/cm<sup>3</sup>

Black in color, with a general semi-blocky shape. The CBN-BLC's morphology provides low toughness and modified fracture characteristics.

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CBN-BMA		🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷
CBN-BMI	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷
CBN-BMO			🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷
CBN-BMS	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷
CBN-BWW		🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷
CBN-BLC			🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷	🔷

## Friability<sup>1</sup> Comparisons



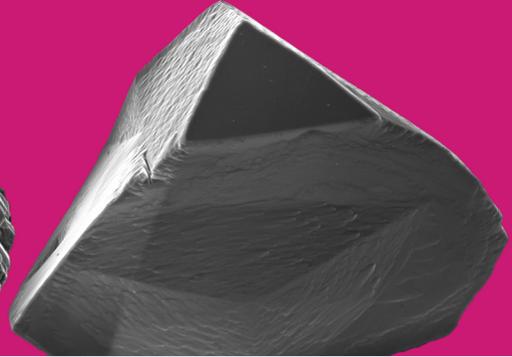
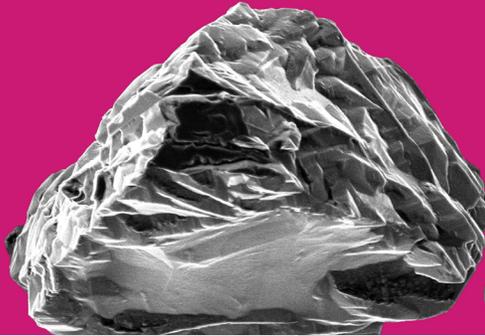
<sup>1</sup>Friability – A characteristic of superabrasives grains that describes their tendency to fracture or break apart when hit or placed under pressure. Highly friable grains cut more easily but wear faster than other abrasives. Less friable (tougher) grains do not cut as freely but tend to have longer wheel life.

# CBN ETCHED

ETCHED

NON-ETCHED

- Increase in cutting edges.
- Increased Surface Area for mechanical retention in the bond.
- Lower wheel wear and higher G-Ratios.
- Increased performance from existing bonds.



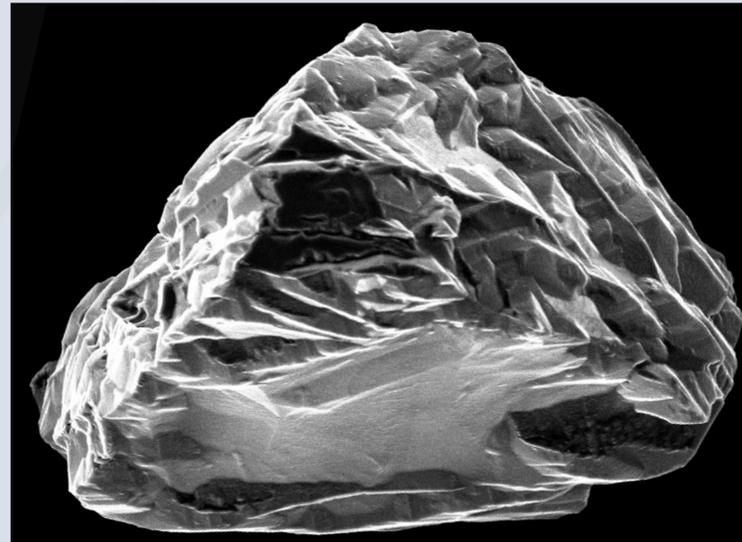
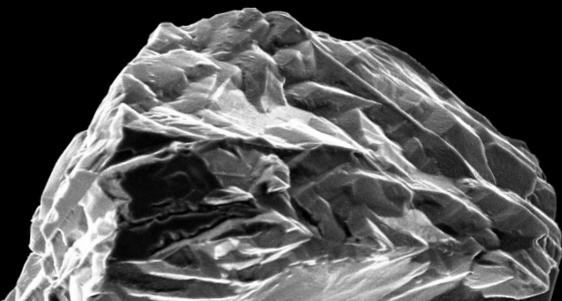
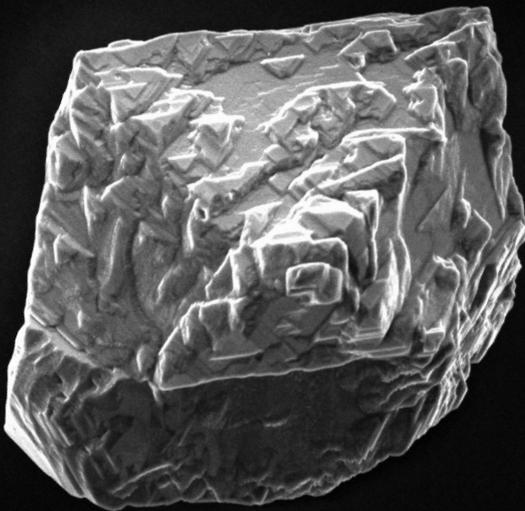
An increase in G-ratio using etched CBN  
Wheel wear was reduced

Surface finish was reduced using the etched CBN

Residual stress was not affected by using the etched CBN

Higher wheel Q primes can be achieved with less wheel breakdown

Can be tested in electroplated wheel systems to see if the same benefits can be measured



# S.P.O.C.

Superabrasives Process Optimization Center

## Welcome to the future of Superabrasives



In accordance with WWSA's commitment to continuous improvement, S.P.O.C. has been expanded to a new 2,000 sq. ft. location to accommodate our new ANCA™ TX Linear in addition to our ANCA™ TX7+.

While already one of the leading grinding labs in the world, we always try to improve and evolve. Being better than the competition is not enough.

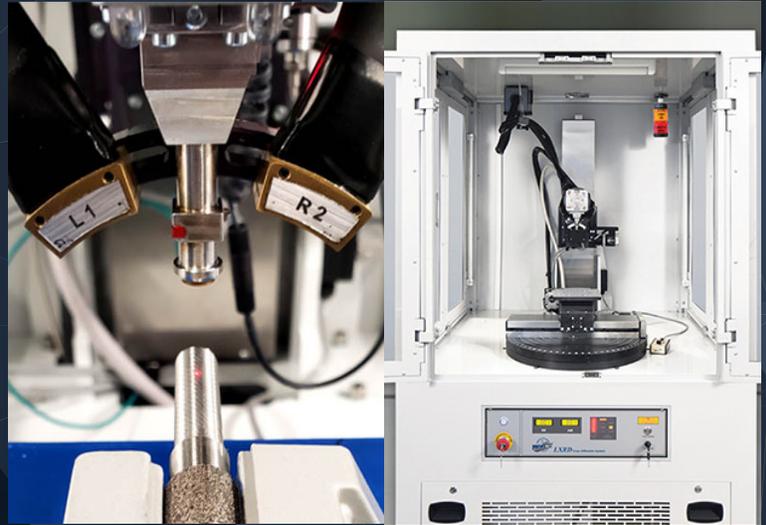
**Each day, we strive to be better than we were the day before.**



## PROTO LXRD RESIDUAL STRESS MAPPING MACHINE

The Proto LXRD is manufactured by the leading name in residual stress mapping and is the perfect tool to use where residual stress is a concern for critical fatigue components. Utilizing sophisticated x-ray technology and enhanced detection software this tool provides unparalleled accuracy.

Our Materials Characterization Laboratory uses the Proto LXRD to carefully measure the levels of material stress after grinding to provide a closed-loop grinding



## JEOL SEM WITH EDS CAPABILITIES

The JEOL low vacuum Scanning Electron Microscope with integrated Energy Dispersive X-Ray Spectroscopy is ideal for performing advanced analytical analysis.

Utilizing the latest Silicon Drift Detector (SDD) technology, the JEOL SEM allows engineers, scientists, and technicians to carefully assess and analyze the morphology and elemental chemistry of super abrasive grains and their coatings.

The JEOL SEM has been carefully designed for ease of use and versatility.

## SONOSCAN D9600 ACOUSTIC EMISSION MICROSCOPE

At the very forefront of C-SAM acoustic micro imaging systems, the Sonoscan D9600 is the perfect general purpose tool for failure analysis, process development, material characterization and low volume product inspection.

Using high-frequency, non-destructive sound waves, we can utilize the Sonoscan D9600 to produce an accurate image of solid and porous samples. The performance levels of the D9600 are truly unrivaled on the market.



# S.P.O.C.

Superabrasives Process Optimization Center

# TX ANCA LINEAR

## ANCA TX Linear

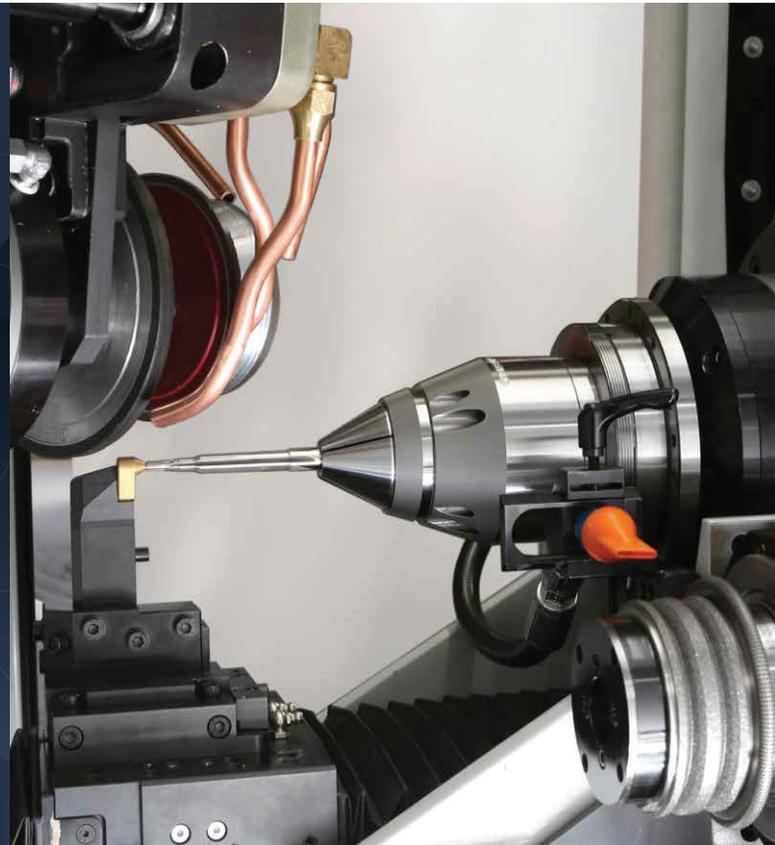
### The new benchmark universal

TX7 Linear is ANCA's premium grinding machine, aimed at the most demanding and diverse applications.

The TX7 Linear's large working envelope allows you to grind the widest range of tools, from a simple 3mm endmill, to a 400mm long drill or a 300mm diameter face cutter.

The 37kW grinding spindle, mounted in a rigid machine design, ensures heavy grinding operations can be completed with ease.

TX7 Linear includes, LinX linear motors on X, Y and also Z axis, ensuring a life time of uncompromised precision. Automation and a range of machine accessories mean the TX7 Linear can be equipped to meet the specific needs of tomorrow's most stringent grinding applications.



- ANCA LinX linear motors and linear scale feedback on X, Y and Z axis
- ANCA Motion AMC5 CNC with touch screen user interface
- 37kW (49HP) peak power direct drive spindle with BigPlus arbor
- 2 wheel pack changer with up to 4 wheels per arbor, maximum wheel diameter 200mm (8")
- On machine tool measurement with standard touch probe and optional LaserPlus and iView
- Variety of tool support options including fixed and travelling steady
- Two independent wheel dressing options
- Tool loading option with ANCA's RoboMate loader

# ANCA TX7+

## ANCA TX7+

### The Tough Production Performer

ANCA's premium machine – the result of 20 years of ongoing R&D and the implementation of customer feedback. The basis of the powerful TX7+ is our expertise in CNC technology, mechanical and electrical design and software engineering. It is a machine that is an industry benchmark in CNC tool grinding.

Flexible software and tooling, combined with a large working envelope mean the TX7+ is also capable of manufacturing much more complex tools than endmills and drills. It can also be used to manufacture rotary medical instruments, standard and key hole press punches, and components for the medical, aerospace and automotive industries.



- Suitable for heavy-duty manufacturing and reconditioning precision cutting and drilling tools, plus component manufacture
- Automatic wheel changer enables up to 8 grinding wheels to be used in one set-up
- Wide variety of workholding and support tooling to meet individual needs
- RoboMate automation for unmanned operation
- 37 kW (49 HP) peak spindle power
- Integrated dresser roll on the headstock

S.P.O.C.

Superabrasives Process Optimization Center

# KEYENCE

## Keyence VHX 2000 Digital 3D microscope

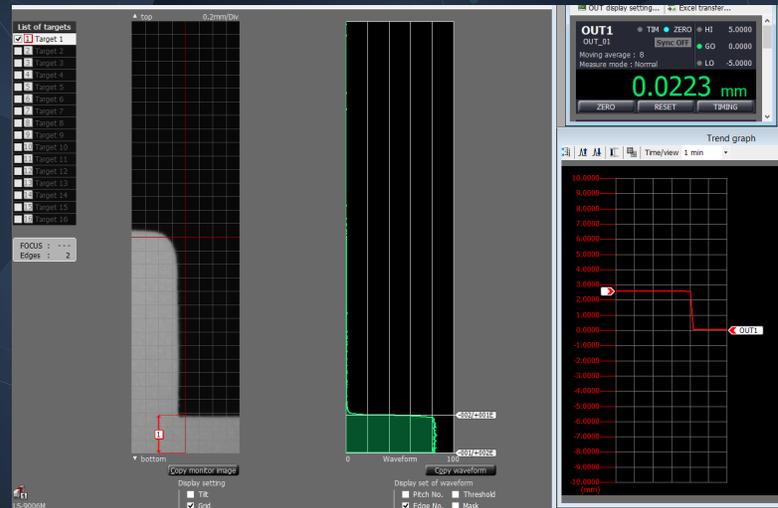
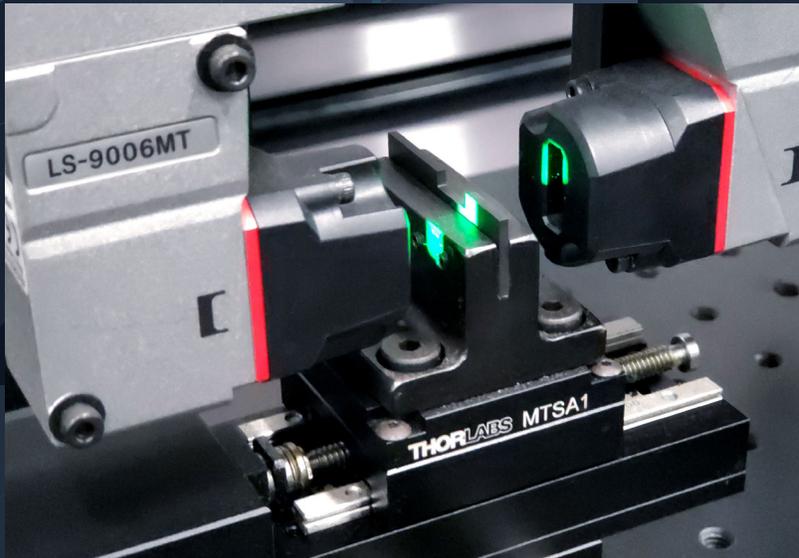


- Depth composition function for full focus imaging
- 2D/3D imaging and measurement capability
- 0.1x - 5,000x magnification range
- Super Resolution imaging mode
- High-speed image stitching
- 54 megapixel 3CCD camera
- High Dynamic Range [HDR]
- 360 degree observation
- Motorized XYZ control
- Large depth-of-field



## KEYENCE LS-9000 Series High-speed Optical Micrometer

Fitted with a high-speed exposure CMOS and a high-intensity Green-LED to produce a 16,000 Hz sampling rate.



The "Monitor CMOS" determines the alignment of the target to enable accurate measurement of tilted targets.

The use of an LED light source ensures no errors due to external sources.

This combination of no moving parts with an LED light source means it can be used on-site for extended periods of time without requiring regular maintenance.

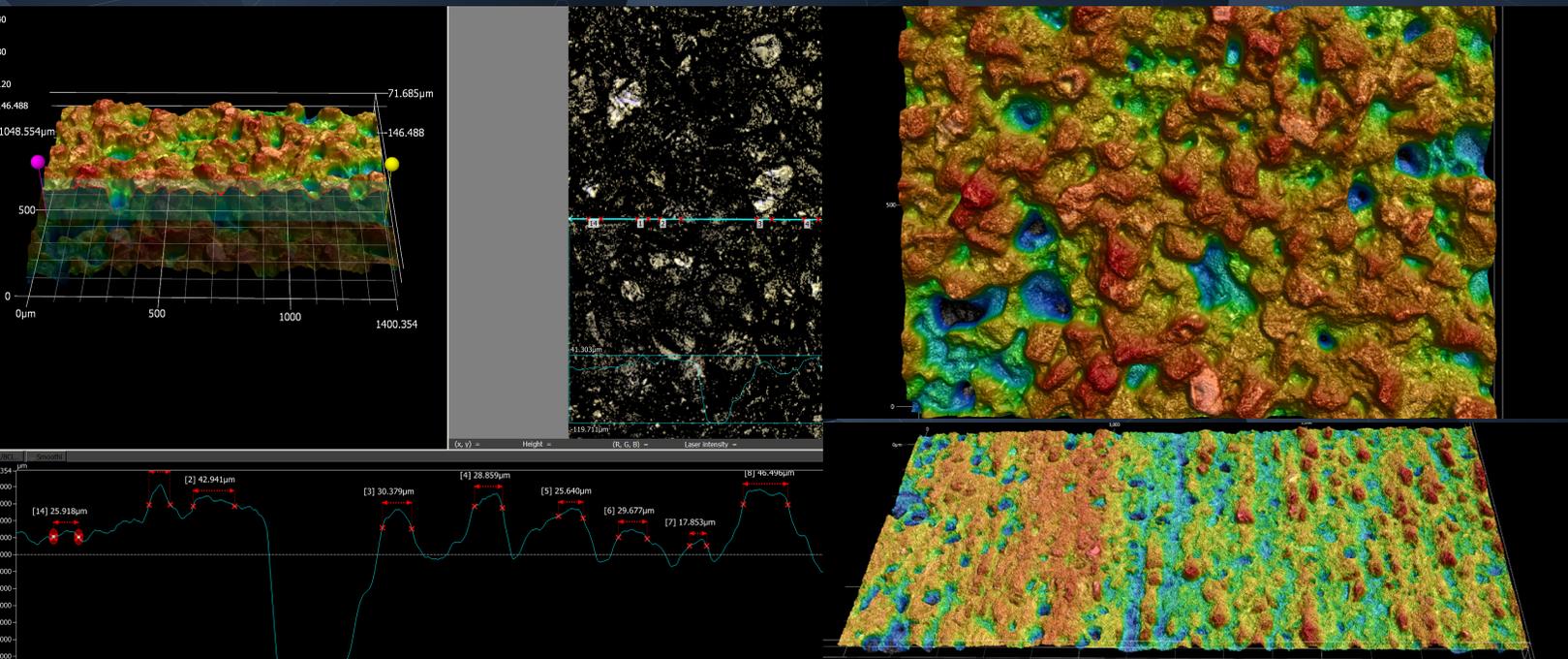
# KEYENCE

## KEYENCE VK-X100 3D LASER SCANNING MICROSCOPE

The Keyence VK-X Series Laser Scanning Microscope is able to perform non-contact profile, roughness, and film thickness measurements on any material, regardless of the complexity of the surface. It also has the ability to capture various surface information with nanometer-level resolution.



The VK-X Series is a laser scanning confocal microscope capable of ultra-fine, non-contact profile measurements. Laser scanning microscopes use He-Ne gas lasers or semiconductor lasers as a light source for microscopic inspection.



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Worldwide  
**SOLIDS**



**SPOC**  
Superabrasives Process  
Optimization Center

## THE WORLDWIDE GROUP

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