



# Contents

## Boost Productivity with **Ultrasonic** Machine Tools

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## Quartz Glass Showerhead Drilling



### Challenges

- Low machining efficiency
- Vulnerable to hole edge chipping

### Conprofe Solution

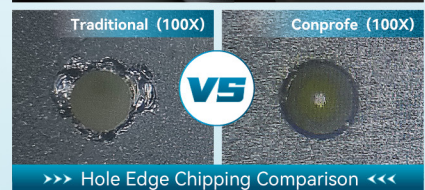
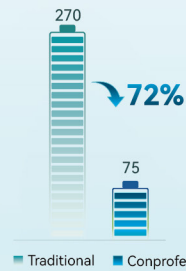
- **Ultrasonic Precision Engraving and Milling Center**

ULM-600

+ **Ultrasonic** Machining System

+ **Solid PCD** Drill

»» Cycle Time (s/hole)



### Conprofe Benefits

- Continuous drilling of **1,200** D0.5x5mm holes
- Cycle time reduced by **72%**, from 270s to 75s per hole
- Hole edge chipping decreased by **68%**, from 0.4mm to 0.13mm

## Carbon Silicon Showerhead Drilling



### Challenges

- High hardness
- Demanding depth-diameter ratio

### Conprofe Solution

- **Ultrasonic Precision Engraving and Milling Center**

ULM-500

+ **Ultrasonic** Machining System

+ **Solid PCD** Drill

### Conprofe Benefits

- Continuously machining over 100 D0.5×6.5mm holes (Depth-Diameter Ratio 13:1)
- Smooth hole wall and good hole quality (Hole chipping size < 0.02mm)



>>> Showerhead <<<

Material: Silicon Carbide (HV2,700)

## Single Crystal Silicon Curved Electrode Hole Drilling



### Challenges

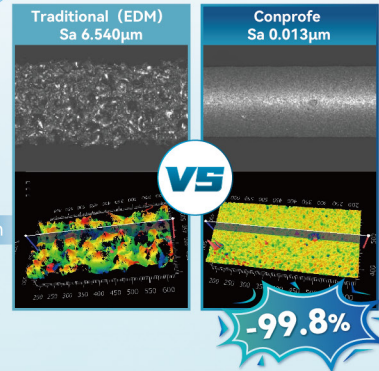
- Immature machining solution
- Hard to control hole perpendicularity
- Hole wall roughness  $\geq Sa\ 6.54\mu m$
- Hole roundness  $\geq 0.025mm$

### Conprofe Solution

- **Ultrasonic Precision Engraving and Milling Center ULM-600**
- + Ultrasonic Machining System
- + Solid PCD Micro Drill



Material: Single-Crystal Silicon



### Conprofe Benefits

- Continuous machining of over **2,000** D0.45x24.75mm ultra-deep holes
- With ultra-deep micro-hole drilling, no obvious chipping around hole edges
- Hole roundness **0.003mm**
- Hole wall roughness down by **99.8%**, from Ra 6.540 $\mu m$  to Ra **0.013 $\mu m$**

## AlSiC Threaded Hole Machining



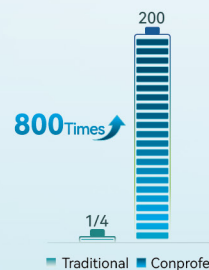
### Challenges

- Cycle time >180s/hole
- Unstable workpiece quality
- Vulnerable to hole edge chipping
- Low precision
- High cost (Tool life <1 hole)

### Conprofe Solution

- **Ultrasonic Precision Engraving and Milling Center ULM-400**
- + Ultrasonic Machining System
- + Solid PCD Drill     + Solid PCD Thread Mill

### »» Tool Life (Hole)



Material: AlSiC

### Conprofe Benefits

- Tool life improved by **800 times**, from 1/4 hole to 200 holes
- Wall thickness of 0.5mm, without any cracks or chippings

## Polysilicon Slotted Confinement Ring



### Challenges

- Low efficiency
- Recurring cracking issues leading to high scrap rate

### Conprofe Solution

- **Ultrasonic Precision Engraving and Milling Center**

ULM-600

- + **Ultrasonic** Machining System
- + Smartguy Vertical DDR High-Speed Rotary Table

### Conprofe Benefits

- Reduced cutting force and improved efficiency with ultrasonic machining
- Lower surface roughness
- Reduced chipping or crack
- Improved hole roundness



>>> Confinement Ring<<<

Material: Polysilicon

## Alumina Ceramic Disc Grinding



### Challenges

- Low efficiency
- Poor tool life
- Micro grinding cracks giving rise to scrap of the workpiece

### Conprofe Solution

- **Ultrasonic Precision Engraving and Milling Center**

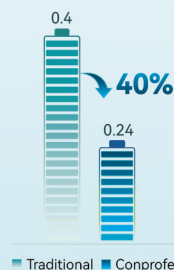
ULM-600

- + **Ultrasonic** Machining System

### Conprofe Benefits

- Better chip evacuation
- Improved machining efficiency
- Reduced micro cracks on the surface of hard-brittle material
- **40%** workpiece surface roughness reduction

>>> Workpiece Surface Roughness ( $\mu\text{m}$ )



>>> Ceramic Disc<<<

Material: Alumina Ceramic

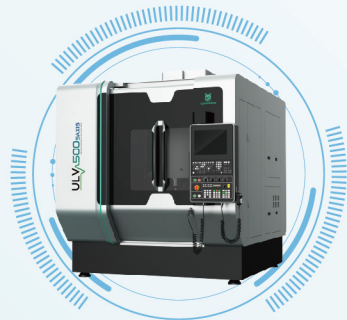
## Ultrasonic Engraving and Milling Center

- Intelligent **Ultrasonic Machining System** developed by Conprofe to tackle the challenges in machining hard-to-cut materials
- Various kinds of screw guide protection available to meet machining needs of hard-brittle materials and metals
- Single tool magazine / extended tool magazine available
- Optional spindle speed with max. speed of 40,000rpm
- Full closed loop control with high-precision linear encoders, positioning accuracy of **5 $\mu$ m**, repeatability of **3 $\mu$ m**
- High precision probe for on-machine measurement function
- With centrifugal filtration, bag and other multi-stage filtration system



## Ultrasonic Vertical 5-Axis Machining Center

- Intelligent **Ultrasonic Machining System** developed by Conprofe to tackle the challenges in machining hard-to-cut materials
- Bridge gantry structure, low center of gravity, short overhang and super high rigidity for lower thermal strain
- Full closed loop control with linear encoders
- Equipped with high power, torque and speed ultrasonic spindle
- Various chain-type tool magazine capacity options: 24~120 tools
- Automatic fire suppression system configured to reduce the risk of machining flammable and explosive materials
- Siemens 840D sl and SINUMERIK ONE 5-axis simultaneous control systems available



## Ultrasonic Graphite Machining Center

- Intelligent **Ultrasonic Machining System** developed by Conprofe to tackle the challenges in machining hard-to-cut materials
- Multi-layered protection with labyrinth design, positive pressure sealing and special dust collector design
- Superior performance in vibration damping, accuracy retention, dynamic characteristics and thermal stability due to its high-rigidity bed casting and symmetrical gantry structure
- Full closed loop control with high-precision linear encoders to ensure repeatability accuracy of **2 $\mu$ m**
- Equipped with high-volume, high-power stand-alone filter cartridge dust collector
- Optional handheld vacuum cleaner with mobile operation for more thorough vacuuming



## Solid PCD Micro Drill

- Suitable for drilling hard-brittle materials, effectively reducing chipping
- Hole quality **up by 3 times** vs. conventional cutters in machining **CFRP**
- Successful breakthrough in machining ultra-deep micro-hole with Depth-Diameter **Ratio of 55:1** in single crystal silicon workpiece



## Solid PCD Thread Mill

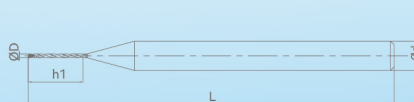
- Conprofe Solid PCD Drill - best fit for hard-brittle materials threading
- Thread milling efficiency **up by 100%** vs. traditional thread mills, with machining cost per hole reduced by more than **2 times**
- Tool life **up by 50~100 times** vs. traditional thread mills
- Customized specifications of micro-diameter thread mills available



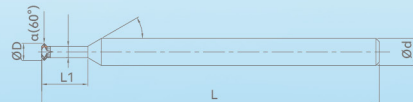
Solid PCD Micro Drill

Solid PCD Thread Mill

Cutting Edge Diameter (D)	Cutting Edge Length (h1)	Overall Length (L)	Shank Diameter (d)	Spec.	Cutting Edge Diameter (D)	Thread Angle (α)	Reference Pitch	Neck Diameter (d2)	Neck Length (L1)	Neck Angle (r)	No. of Cutting Edges	Overall Length (L)	Shank Diameter (d)
0.45	7.5	40	4	M2.5	1.95	60°	0.45	1.28	6.5	15°	4	45	4
0.5	7.5	40	4	M3.0	2.36	60°	0.5	1.63	7.5	15°	4	45	4
0.6	9	40	4	M4.0	3.19	60°	0.7	2.15	9.5	15°	4	50	4
0.8	12	40	4	M5.0	3.97	60°	0.8	2.86	10	15°	4	50	6
1.0	15	45	4	M6.0	4.9	60°	1.0	3.38	15	15°	3	60	6
1.1	16.5	45	4	M8.0	6.0	60°	1.75	4	15	15°	4	50	8
1.2	18	45	4	M10	7.95	60°	1.75	5.63	15	15°	4	60	10
1.3	19.5	45	4	M12	9.95	60°	1.75	7.3	15	15°	4	65	10
1.4	21	50	4										
1.5	22.5	50	4										
1.8	27	60	4										
2.0	30	60	4										



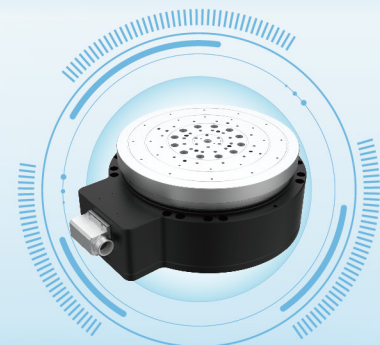
Solid PCD Micro Drill



Solid PCD Thread Mill

## Vertical DDR Rotary Table

- **High Speed: Max. 1,500rpm**
- High Precision: **No backlash**, standard 26-bit encoder
- Mill-Turn: for both **milling** and **high-speed turning**
- High Load Capacity: Max. load of **80KG**
- Built-in Air Path: **Built-in positive labyrinth, fixture positive pressure** and **vacuum air paths**, with aesthetic look that avoids tube folding or air holding during high-speed rotation
- Compatible with Fanuc, Siemens, Mitsubishi, Brother and other CNC controllers



# Ultrasonic Machining Technology



## ▲ Intelligent Sensor Ultrasonic Generator

### Five Highlight Technologies

- Max. Power: 350W
- Patent Sine Wave Drive Technology
- Amplitude Closed-Loop Linear Control
- Adaptive Control Technology
- CNC System Communication Function



### Integrated Structure

- Patent Technology
- Gap:  $0.5 \pm 0.1$  mm
- Effective Interference Resistance

### Ultrasonic Vibration

- Max. Amplitude: 20  $\mu$ m
- Frequency: 15-70 kHz
- Controllable 3D Vibration

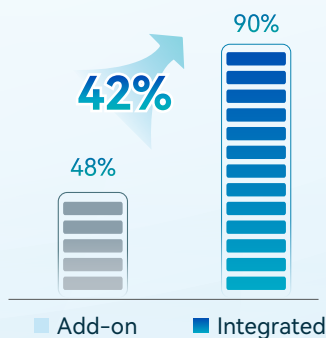
## Advantages of Integrated Ultrasonic System over Add-on System

✓ High Intelligence

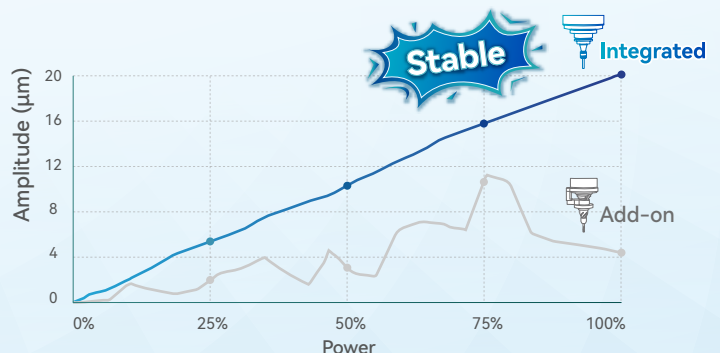
✓ Stable Structure

✓ Superior Ultrasonic Performance

### » Transmission Efficiency Comparison



### » Amplitude Linearity Comparison



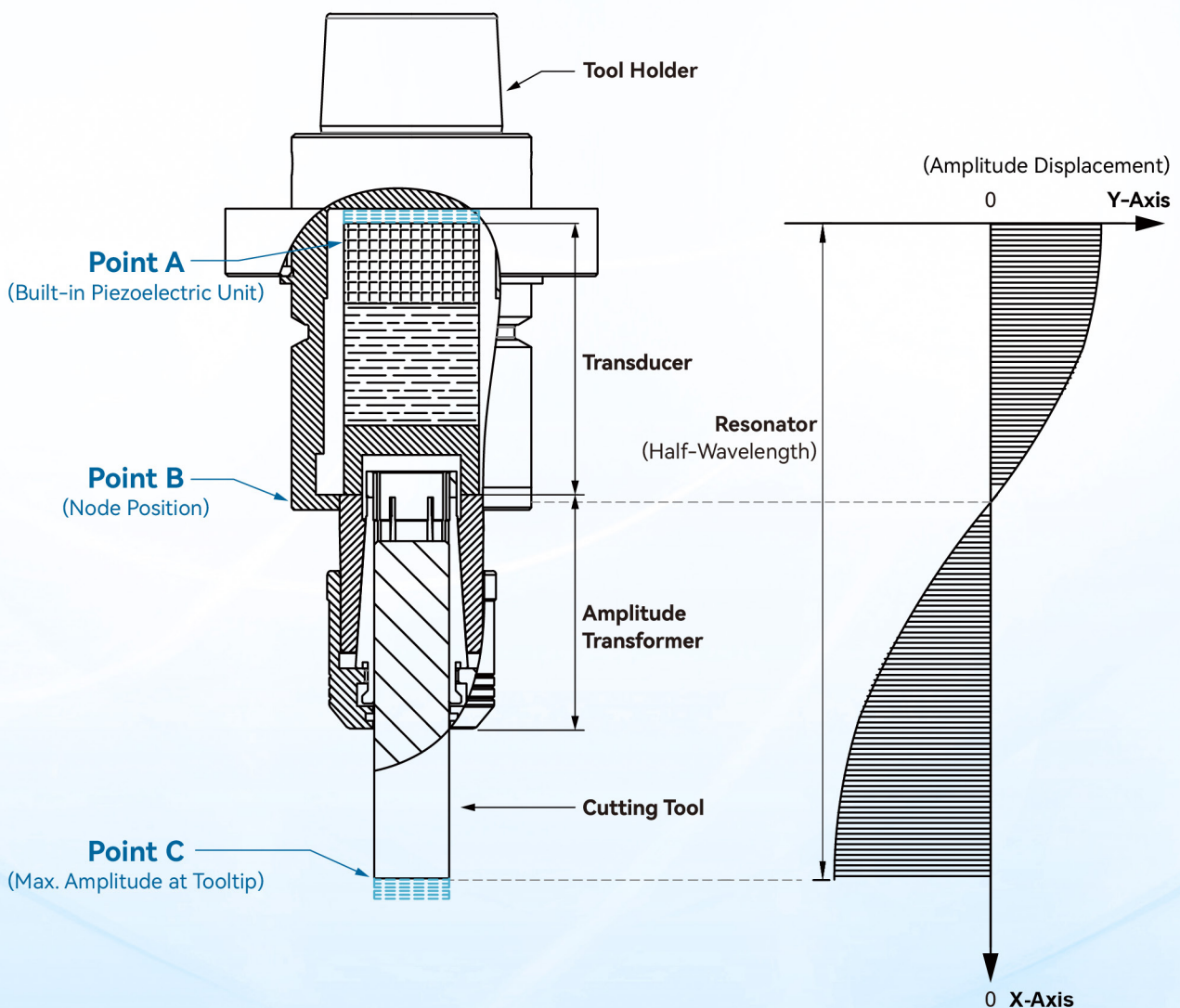


# Principle of Ultrasonic Machining

Ultrasonic machining technology converts ultrasonic electrical oscillations into mechanical vibrations. While the tool rotates, it applies vibrations at tens of thousands of times per second, creating periodic separation between the tool and the workpiece during the machining process. This results in smoother chip removal, better cooling, and improved consistency of the processed surface, significantly enhancing machining efficiency, extending tool life, and improving the surface quality of the workpiece.

1. In ultrasonic-assisted machining, the ultrasonic generator is activated by high-frequency alternating electrical energy, driving the transducer and amplitude transformer to resonate as a whole. Energy is transmitted in the form of longitudinal waves from point A through point B to point C.

2. Once activated, the resonator vibrates with minimal elongation and contraction. Points A and C move away from or approach the node of the resonator (point B) simultaneously, while point B remains stationary throughout the vibration process.

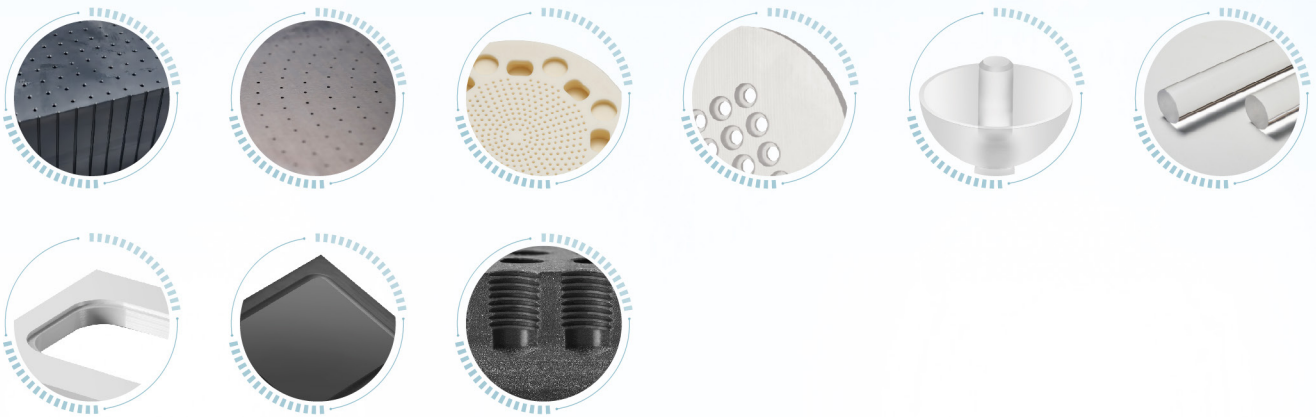


# Applicable Materials

## Hard-Brittle Materials

**Materials:** Single-Crystal Silicon, Silicon Carbide (SiC), Alumina (Al<sub>2</sub>O<sub>3</sub>), Sapphire, Quartz Glass, Silicon Nitride (Si<sub>3</sub>N<sub>4</sub>), Aluminum-Based Silicon Carbide (AlSiC), etc.

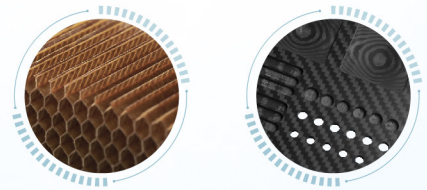
**Workpieces:** Semiconductor Showerheads, Optical Reflectors, Optical Fiber Preforms, Smartphone and Watch Enclosures, Graphite Molds, Dentures, etc.



## Composites

**Materials:** Nomex Honeycomb Cores, Carbon Fiber Prepreg, Carbon Fiber Preform, Carbon Fiber Composites, etc.

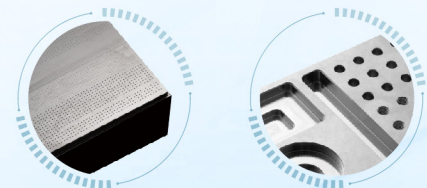
**Workpieces:** Structural Parts for Aviation, Automotive, Rail Transit Vehicles, etc.

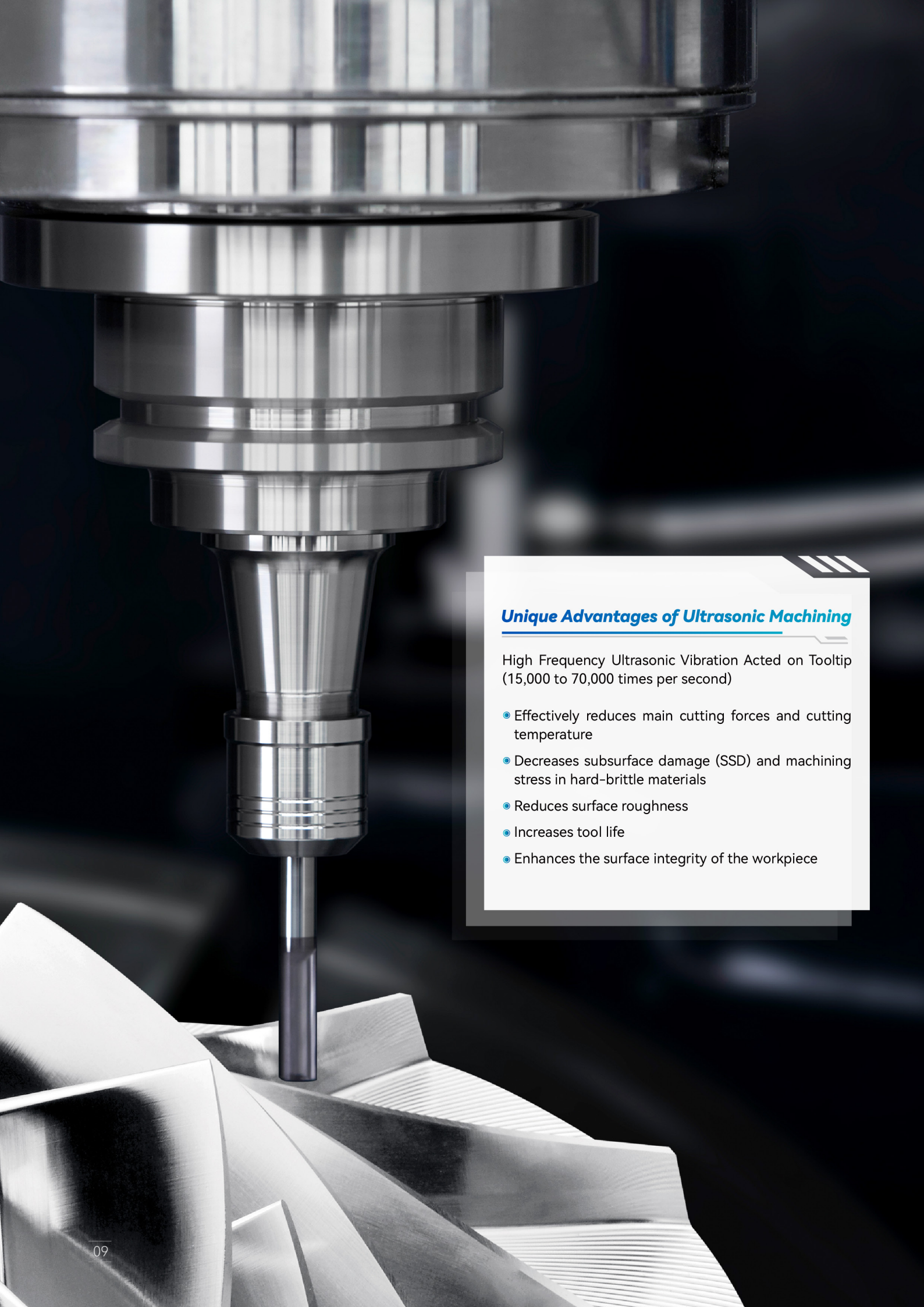


## Hard-to-Cut Metals

**Materials:** Stainless Steel, Titanium Alloy, Superalloy, etc.

**Workpieces:** Spacecraft Parts, Wear-Resistance Parts, Heat-Resistance Parts, etc.





### ***Unique Advantages of Ultrasonic Machining***

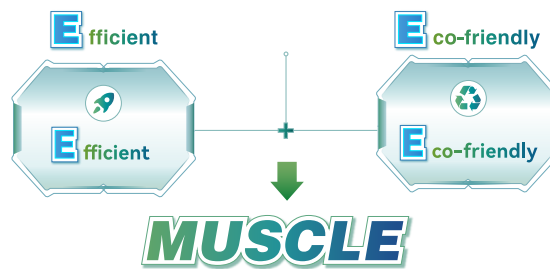
High Frequency Ultrasonic Vibration Acted on Tooltip  
(15,000 to 70,000 times per second)

- Effectively reduces main cutting forces and cutting temperature
- Decreases subsurface damage (SSD) and machining stress in hard-brittle materials
- Reduces surface roughness
- Increases tool life
- Enhances the surface integrity of the workpiece

# When Ultrasonic Meets Green Technologies



## High-End Manufacturing



## Ultrasonic CNC Machine Tool



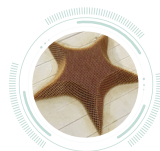
3 in 1

## Advantages in 3+A Application Scenarios

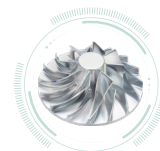
Superior Machining Performance for 3 Material Categories



Hard-Brittle Materials



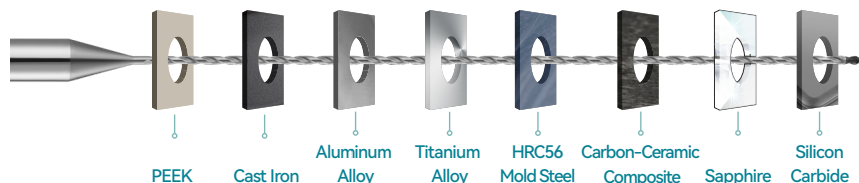
Composite Materials



Hard-to-Cut Metals

+

Superior Hole Drilling Performance in All Materials





## Definition of CONPROFE

Converging of Global Resources

Professional as Industry Leader

# CONPROFE

## Company Profile

With its roots back to 2003, Conprofe is a Provider of Efficient, Green and Intelligent Manufacturing Solutions and Key Units. It has been holding on to the idea of "Converging of Global Resources, Professional as Industry Leader" in the past two decades. Revolving around "Efficient, Green and Intelligent Manufacturing", the company has achieved a giant leap from parts, units to machines and developed a product portfolio with three major industries - Precision Tools, Key Units and CNC Machine Tools, which covers eight categories of products, including Super-hard Tools, Tapping Tools, Precision Tool Holders, Ultrasonic Technologies, Green Technologies, Precision Units, Ultrasonic-Green CNC Machine Tools and Automation. Its customers have spread across diverse sectors, such as semiconductors, aviation & aerospace, medical field, automotive, consumable electronics, education and general precision manufacturing, etc.

Conprofe perseveres in laying a solid foundation in the domestic market while keeping its eyes open to the world. Headquartered in Guangzhou Science City, the company has established sales and service centers in seven domestic regions and forged a network of R&D, sales and service based in Hong Kong, Taiwan, the United States, South Korea, India and Vietnam, etc. With its products being exported to over 70 countries and regions across six continents, Conprofe's integrated distribution of R&D, production, sales and service around the globe has gradually come into being.

Conprofe persists in innovation-driven developing strategy and owns two National High-tech Enterprises under the Group. The company's Frontier Technology Research Institute (FTRI) and Guangdong Province Engineering Technology Center (GPETC) has developed over 850 core technology patents. Its primary product technologies have reached an internationally advanced level, as assessed and acknowledged by experts led by members of the Chinese Academy of Engineering (CAE). Furthermore, Conprofe has successively been granted the Guangdong Scientific and Technological Progress Award (First Prize 2020, Second Prize 2021), Guangdong Patent Award (Silver), China Patent Award (Excellence) and has been honored as Enterprise with Significant Contribution to Guangdong's Supplies for COVID-19 Prevention and Control, Guangzhou Pioneering Private Enterprise, etc.

