ULTRASONIC MACHINE TOOLS MODULE
MARKET AND TECHNOLOGY

(1) Low vibration cutting power consumption.
(2) Small amount of deformation.
(3) The processed high accuracy, low surface roughness.
(4) To processing tool lift span.
(5) Processing a wide range of material.

Ultrasonic vibration cutting after years of development, the processing technology is mature, and is now widely used in a variety of composite machining, such as ultrasonic vibration turning, ultrasonic vibration grinding, ultrasonic vibration machining deep hole, etc..
PRO Ultrasonic high-speed engraving spindle module

Applied to materials and products which it?

★ Driven by a high-speed high-precision rotary machining spindle with ultrasonic vibration tool to do the processing of application.
★ Design generic collet structure, to all kinds of tools used in conjunction.
ULTRASONICS TOOL HOLDER MODULE

▲ simple structure
▲ easy to install
▲ Automatic Tool Changer

▲ plug-ins
▲ Simple modification
▲ original machine use
Processing application example introduced
TOOTH CAVRING MACHINING PATH PLANNING

Big remove amount / High processing speed test
THE ULTRASONIC 3D FULL SINTERED CROWN ENGRAVING

<table>
<thead>
<tr>
<th>WORKERS CONT.</th>
<th>FEEDRATE</th>
<th>EACH DEPTH</th>
<th>SPINDLE SPEED</th>
<th>PROCESSING TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROUGHING</td>
<td>500 mm/min</td>
<td>0.14 mm</td>
<td>10000 RPM</td>
<td>23 minutes 33s</td>
</tr>
<tr>
<td>FINISHING</td>
<td>800 mm/min</td>
<td>0.1 mm</td>
<td>12000 RPM</td>
<td>5 minutes 12s</td>
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</tbody>
</table>
Monodentate roughing and finishing of total working hours to 28 minutes and 45 seconds (tooth length 7.6mm 2mm length, finishing plus cut set aside about 12min).

The experimental results show that ultrasound-assisted tooth carving processing in addition can effectively enhance the processing speed to the movement of machine processing and the generation of noise can directly determine the resistance is very low processing toothed precision machined through simple correction method to upgrade.
THE CERAMIC PORES PROCESSING TEST

Diameter accuracy ±5µm

<table>
<thead>
<tr>
<th>编号</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
<th>#9</th>
<th>#10</th>
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</thead>
<tbody>
<tr>
<td>孔径</td>
<td>0.200</td>
<td>0.211</td>
<td>0.200</td>
<td>0.249</td>
<td>0.249</td>
<td>0.20</td>
<td>0.25</td>
<td>0.251</td>
<td>0.254</td>
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<tr>
<td>槽间距离</td>
<td>0.005</td>
<td>0.002</td>
<td>0.005</td>
<td>0.009</td>
<td>0.009</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
<td>0.006</td>
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</tr>
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</table>

[Images of micrographs showing the ceramic pores processing test results]
THE CERAMIC PORES PROCESSING TEST

- Tungsten steel tool layers consumption phenomenon.
- Overcome the hard material a soft material.
Basin-type panel processing
ULTRASONIC CUTTING VS GENERAL HIGH-SPEED CUTTING

★ ULTRASOUND SURFACE ACCURACY BETTER

<table>
<thead>
<tr>
<th>UNIT : um</th>
<th>PERPENDICULAR TO THE MACHINING PATH</th>
<th>WITH THE LEVEL OF PROCESSING PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULTRASONIC SPINDLE</td>
<td></td>
<td></td>
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<tr>
<td>Ra ( mean )</td>
<td>0.576</td>
<td>0.568</td>
</tr>
<tr>
<td>Rmax ( maximum )</td>
<td>5.66</td>
<td>5.52</td>
</tr>
<tr>
<td>SPINDLE 60000 rpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ra ( mean )</td>
<td>1.022</td>
<td>0.924</td>
</tr>
<tr>
<td>Rmax ( maximum )</td>
<td>15.7</td>
<td>11.7</td>
</tr>
</tbody>
</table>
LINEAR CHIPPING CONDITIONS

Non-ultrasonic machining------rough

Ultrasonic machining------flat
ROUNDED CHIPPING CONDITIONS

Non-ultrasonic machining------irregular crack

Ultrasonic machining------smooth
ULTRASONIC DRILLING SUS 316

∅ 1mm stainless steel 316 drilling speed 6000 rpm.
Enhance tool life more than 40 times, the processing speed of 3 times.
(F: 60 raised to 210mm/min, number of holes: 26 holes deep x1mm increased to more than 3000 holes x1mm deep)
Poor ductility of the glass, the material will be in the high-speed processing extrusion force of grinding tools, when the compression force is greater than the glass can withstand rupture.

Basically, glass grinding process is the rupture of the application, the use of diamond abrasive tool tough the glass grinding bifida and curettage. Therefore, is that when the high-speed grinding glass, its damaged condition directly related to particle size and processing speed.
The crisp edge amount can be controlled at 20μm or less, preferably 3μm. The crisp edge amount can be controlled at 20μm or less, preferably 3μm. The processed feed speed 20μm 900mm/min, feed 0.2mm 0.2mm. 900mm/min, feed 0.2mm.
R0.3mm

Traditional high-speed grinding

7~10μm

400X
Alumina micro hole drilling

Helium cooling channels

Helium out of the wind hole

Tool $\phi 0.17\text{mm}$
Diameter $\phi 0.19\text{mm}$

400μm

High-density, high hardness aluminum oxide, ceramic aluminum oxide ceramic (18mm) drill microporous ($\phi 0.18\text{mm}$) ultrasound drilling technology development and parameter studies. Drilling Technology
CERAMIC ELECTROSTATIC CHUCK
TUNGSTEN STEEL GRINDING

Use the tool: # 120, the 3mm diameter electroforming rod mill.

Use parameters: frequency of 20kHz, speed 4400rpm, Depth of 1.5mm (a feed), feed the linear feed speed 3mm/min
OTHER PROCESSED SAMPLES
STRUCTURE OF PLUG-IN MODULE