PCD Tools Specification and Application

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Definition of PCD

Polycrystalline Diamond (PCD) refers to the polycrystalline which is obtained by mixing diamond micropowder (micron size) with a small amount of metal powder (such as Co, etc.) and sintering it at high temperature (1400°C) under high pressure.

The PCD composite sheet is a superhard composite material which is firmly bonded to a cemented carbide substrate at a high temperature and high pressure by a polycrystalline diamond layer having a thickness of 0.5 to 0.7 mm. It not only has high hardness, high wear resistance of PCD, but also has good strength and toughness of Tungsten carbide. PCD composite sheet is used to make PCD Insert through cut, brazed and sharpened process.
The characteristics of PCD Insert Materials

① The hardness of PCD can be HV8000, about 80~120 times of tungsten carbide insert;
② The Thermal Conductivity of PCD is about 700W/mk, is about 1.5~9 times tungsten carbide, even higher than PCBN and Copper;
③ The Coefficient of friction of PCD usually is about 01~0.3, so pcd tools can reduce the cutting force obviously;
④ The thermal expansion coefficient of PCD is about PCD $0.9 \times 10^{-6} \sim 1.18 \times 10^{-6}$, only about 20% of tungsten carbide, so the deformation will be small, and will have high precision;
⑤ The affinity between PCD cutting tools and non-ferrous metals and non-metallic materials is very small. Chips will not easily stick on the tip of the cutting edge during processing to form a built-up edge
<table>
<thead>
<tr>
<th>Grade</th>
<th>Granularity (μm)</th>
<th>Characteristics</th>
<th>Application</th>
<th>Microstructure</th>
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</thead>
<tbody>
<tr>
<td>CDW850 (CDW20-1)</td>
<td>Submicron</td>
<td>Ultra--fine grain structure, strong edge sharpness and edge durability</td>
<td>High precision machining, mirror surface machining, suite for aluminum alloy that required high on the chipping performance, mainly used for machining Ti alloy and other composites</td>
<td></td>
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<tr>
<td>CDW002</td>
<td>2μm</td>
<td>High cobalt content, Good electrical machine performance, excellent toughness, Good roughness machining, more convinent for complec tool processing</td>
<td>Mainly used for engrave milling cutter and thread cutting tool, and also cutting tools for wear--resistant parts, used in woodworking saws, particleboard and the tools for machining silicon aluminum alloy</td>
<td></td>
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<tr>
<td>CDW005</td>
<td>5μm</td>
<td>Excellent electric spark and machinability, good toughness, wear resistance and edge quality</td>
<td>It suits for good surface quality processing, mainly used for machining PMMA, Silicion alloy and metal cell phone shell outlin and used in the wood cutting tools, saws industry</td>
<td></td>
</tr>
<tr>
<td>CDW010</td>
<td>10μm</td>
<td>Universal PCD Grade, good toughness and high abrasive resistanse</td>
<td>Suit for single tool for rough machining, especially for wood molding, medium and low silicon aluminum alloy parts (such as piston).</td>
<td></td>
</tr>
<tr>
<td>CDW025</td>
<td>25μm</td>
<td>High wear resistance and edge quality</td>
<td>Suit for high Silicion Aluminum alloy, MMC, Tungsten carbide and ceramic, graphite,wear resistant parts, mainly used in wood Wood finishing insert and saws</td>
<td></td>
</tr>
<tr>
<td>CDW302</td>
<td>2–30μm</td>
<td>Mixed 2 μm and 25 μm,good wear resistance and edge quality and edges strength</td>
<td>It mainly used for machining MMC, high Silicion Aluminum calloy, high strength cast iron and other application.</td>
<td></td>
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ISO PCD Indexable Insert
Non-Standard PCD Insert
PCD Milling Insert/PCD End Mills
PCD Boring Tools
PCD Drill Bits
PCD Forming Insert

Classification
ISO PCD Indexable Insert

PART 01
ISO PCD Indexable Insert

ISO PCD Indexable Insert usually is used for cnc turning lathe or machine center. PCD indexable insert usually for turning, boring, milling process. Comparing with tradtional tungsten carbide insert, pcd insert can be used with higher cutting speed and feed rates. The tool life also will be improved obviously. Also it can help obtain excellent roughness.

Customized PCD Insert: You may need to offer the following details:
(1) Component Materials,
(2) Process Condition(Continuous/interrupt),
(3) Present used pcd insert model
(4) Customers' requirements (most important), such as roughness.
PCD Chipbreaker Insert
The application range of PCD Insert

（1）Non-ferrous metal materials

When machining Copper, Zinc, Aluminum and their alloy, the materials will be easily stick the cutting tools, and difficult to machine. With low coefficient of friction and Low affinity with the non-ferrous metal. PCD Tools can reduce the sticking phenomenon. And PCD tools have small deformation, can obtain good dimension.

（2）Non-metallic materials

When machining glass fiber plastics, silicon filling materials, and hard carbon fiber/epoxy resin composite materials, tungsten carbide inserts will have serious wear and are difficult to process, while PCD tools have high hardness, good wear resistance, and high processing efficiency. PCD Tools will be the right cutting tools for machining Non-metallic Materials.
Application industry of PCD Insert

- CFRP Composite
- Non-ferrous metals and their alloys
- Aluminum Alloy
- Other Materials

Metalworking, Aerospace, 3C Industry, Composite Non-ferrous metals and their alloys.
In order to improve the performance of the engine, the manufacturers have changed low-silicion aluminum alloy to mid-silicon aluminum alloy, also high-silicon aluminum alloy because of its high hardness ang good abrasive resistance. PCD Tools have been widely used in automotive pistons industry.
Aluminum alloy have been widely used in wheel hub industry because of its light weight, saving energy and many other advantages. PCD Tools are the right cutting tools for machining Aluminum alloy.
Non-Standard PCD Insert
Non-Standard PCD Insert

Non-standard PCD Insert, normally refer to some insert have complex structure, strict tolerance and complex process condition. Usually it will improve the efficiency obviously and lower the tool costs with indexable Non-standard PCD Insert.
PCD Milling Insert

PCD Milling Insert, compared with traditional tungsten carbide insert, PCD can be used for higher speed. With wiper milling insert, it also improve the precision, and the roughness can be within Ra0.2.
PCD End Mills

PCD End Mills can be divided into 2 types: (1) Over Center (2) Not over center
Both of them can be made with single tips or multi-tips. The tips diameter can be made with 2mm and above.
PCD End Mill--- for machining automotive aluminum alloy component

Component: Transmission top cover
Materials: ZL104（含Si6.5%）
Cutting Condition: Dry Cutting
Roughness requirement: Ra3.2 μm
Insert: PCD End Mills and Tungsten Carbide End Mills

Testing Performance: The durability with tungsten carbide end mills will be about 300 pieces, however it will reach 6000 pieces with PCD Endmills. And the roughness can be improved obviously.

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<thead>
<tr>
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<th>Durability</th>
<th>10</th>
<th>300</th>
<th>6000</th>
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<tbody>
<tr>
<td><strong>PCD End Mills</strong></td>
<td>Flatness</td>
<td>0.02</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Roughness Ra ( μm )</td>
<td>2.3</td>
<td>2.5</td>
<td>3.2</td>
</tr>
<tr>
<td><strong>Tungsten Carbide End Mills</strong></td>
<td>Flatness</td>
<td>0.06</td>
<td>0.09</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Roughness Ra ( μm )</td>
<td>2.8</td>
<td>3.2</td>
<td>-</td>
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</table>
PCD Milling Inserts---For machining Aluminum alloy engine block

Component: Aluminum alloy engine block
Machining Materials: AlSi9Cu3 (Fe)
Tool clamping method: flanged installation
Cutting Condition: Interrupt turning
Cutting Depth: 0.5~0.7mm
Tool life: 30000 pieces
Processing beat: 7.74S

PCD Milling Inserts will have much better performance than tungsten carbide insert and ceramic insert. And the tool life and efficiency will be much higher with high cutting speed.
Advantages:

PCD Ball nose end mill-- rough and finish machining aluminum pistons. Double blade pcd end mills improve the processing efficiency with double times. And it also can achieve good roughness and Good Roundness. With PCD Ball Nose Endmill, the tool life also improved a lot, and help the customers improve the efficiency and lower the costs.
PCD thread milling cutter---for machining Automotive steering gear housing

Advantages:

PCD thread Milling Cutter--Special design improve the feeds and the metal improved rates. With this type pcd thread milling cutters, it improve the tool life and obtain good roughness and precision. Also the design of the inside collant can help improve the roughness and the tool life.

PCD Forming Tools--Also can help the customers save some process, so that improve the efficiency.
PART 04

PCD Boring Tools
PCD Boring Tools

PCD Boring Tools can be divided into 2 types depending on the shank diameter:
(1) Tungsten Carbide Base (for the small diameter)
(2) Steel Base (for large diameter)
This type tools usually used for the hole process which required high on the roughness, tolerance. For the brazed structure tools, the diameter usually should be above φ4.
PART 05

PCD Drill Bits
PCD Drill Bits

PCD Drill Bits usually use tungsten carbide and steel as the base. The pcd blade can be made with 2 or more. This type tools usually required high on the machining tolerance, roughness, can machine the hole (including thorough hole and blind hole). The roughness can reach within Ra0.1.
PART 06

PCD Forming Tools
PCD Forming Tools

PCD Forming Tools, belong to Rotary tools. The advantages are high processing efficiency, high precision, excellent tolerance guarantee, and can milling several Step hole at the same time.

For this type pcd tools, it belong to customized tools, the customers need to offe the drawings or component drawing details, then we can offer that.
Thanks!

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