Machining

How Sumitomo's Binderless CBN and PCD Are Setting New Standards for Cutting Tools

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With challenging machining jobs sometimes requiring multiple tool changes, a durable tool that extends tool life is highly desirable. Here's how Sumitomo's binderless CBN and binderless PCD tools are offering long-lasting, hard-cutting options for working with difficult-to-cut materials.

Sumitomo has always been committed to modernizing its product lines.

The latest product of its research and development efforts is a set of cutting tools that give the end user greater versatility when machining hard-to-cut materials, such as titanium alloys.

Sumitomo's engineers have succeeded in creating ***binderless CBN*** (cubic boron nitride) and ***binderless PCD*** (polycrystalline diamond) tools.

These products directly bind nanometer- or submicron-level particles without using metallic binder materials. This "binderless" technology is harder and has better thermal conductivity than conventional CBN/PCD, allowing for higher efficiency and offering a big benefit for machinists who value productivity, tool life and versatility.

> **"By not using a binder, we make the bond between the grains stronger than the grain itself, so it improves the properties of the cutting material."**
> George Schendel
> Sumitomo

"The customer is always asking for a tool that's going to last longer, leave a better finish and cost less," says George Schendel, an applications engineer at Sumitomo Electric Carbide.

"So it has always been a goal of the developers to produce a product with no binder because they felt that there would be benefits," he adds. "The binder is a weak link in the cutting tool material, but nobody has ever been able to do it until our scientists came up with the current solution."

The Science of Binderless CBN and PCD

Under a newly developed process, Sumitomo engineers have developed small crystal grains of carbon that can be laid out compactly and are 100 times smaller than prior grain sizes. These grains are bound to one another directly, without any binder material in between them, offering a very high degree of hardness.

“The traditional method of using a metallic binder material introduces an impurity into the cutting edge. So when the product is made without a binder, you have a very pure cutting edge, and it lasts longer, and so it can be very cost-effective for the user,” Schendel says.

When we sinter the material, the cubic lattices between these tiny grains interlace to each other and the grain size actually grows; they grow into larger grains that are still much smaller than what we provide in our other conventional products, but those grains bond to each other and the cubic lattice interlace becomes very strong,” Schendel says.

He explains that the ultimate objective for this type of cutting tool is for it to be hard. So when a binder is used in conventional tools to synthesize material, it weakens the bond between the grains of material, meaning there’s a place where the tool insert can fail and the cutting edge can lose its shape, which also means it can’t perform anymore.

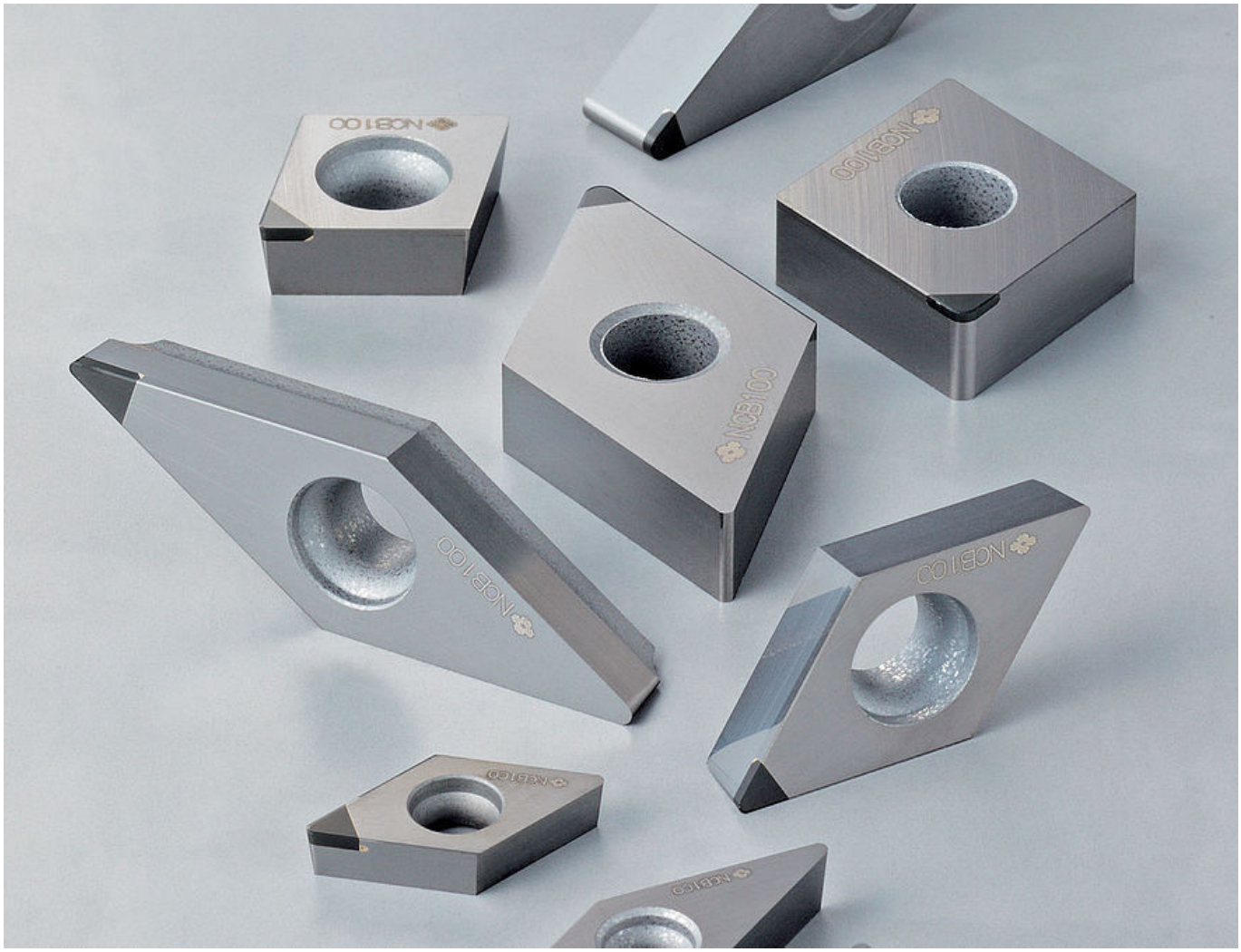
“By not using a binder, we make the bond between the grains stronger than the grain itself, so it improves the properties of the cutting material,” Schendel says.

Binderless Material Applications

Sumitomo’s two binderless products are:

Binderless CBN (NCB100):

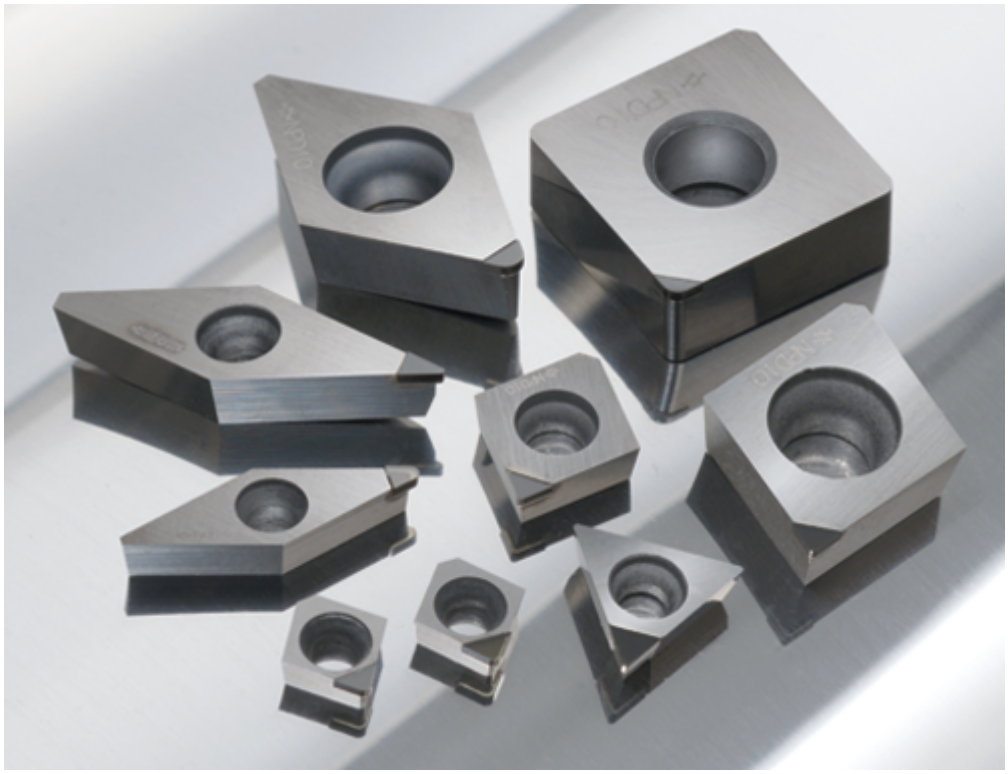
- Ideal for high-efficiency finishing of titanium alloys, cobalt chrome alloys, cemented carbide, and other difficult-to-cut materials.
- The tool also offers unsurpassed dimensional accuracy and reduced surface roughness, and drastically improved tool life that results in optimal cost efficiency.



Binderless CBN (NCB100) from Sumitomo

Binderless PCD (NPD10/DA90):

- Best suited for finish machining of carbide and hard, brittle material, primarily tungsten carbide and cemented carbide.
- Maintains excellent dimensional accuracy over long periods.
- Achieves high-precision machining of carbide with nano-polycrystalline diamond, which has excellent wear resistance.
- Greatly reduces the number of times that the tool must be indexed compared to previous diamond tools, improving work efficiency and reducing total cost.



Binderless PCD (NPD10/DA90) from Sumitomo

As stated above, CBN is highly useful for titanium and titanium alloys, while PCD is used for hard brittle materials such as tungsten carbide and cemented carbide, which most people now grind.

“You could cut a carbide end mill with the NPD10 binderless PCD cutting edge, and some die-cast manufacturers use it for carbide punches, while companies that make lens cavities or lens molds use it to cut the actual cavity for the lens,” Schendel says. “Normally you would have to use grinding to manufacture that block, but now we can do direct cuts.”

Because the new binderless technology allows for much better tool life, it increases throughput for the end user, which is significant, Schendel explains.

“By shortening the cycle time, a manufacturer can run operations faster and can make more parts per day—so that increases profit,” he says. “Or a job shop can finish a smaller run of units more quickly so that the machine becomes available for the next job, so they’ll get more parts through their door every year, which is always a big plus.”

And when shops are more productive, they don’t need as many machine operators, he adds: “So if they are having trouble finding workers now, this tool helps by making it possible for them to produce more with fewer people.”

Benefits for Aerospace, Medical Industries

Binderless CBN and PCD tools have uses in specific industries.

For example, binderless CBN tools are predominantly used in the aerospace and medical industries. Aerospace uses a lot of titanium and titanium alloys. The medical industries also use titanium, and cobalt chrome for items such as knee and hip joints.

Because producing parts for these industries can be expensive, reducing the cost per part through the

tool's performance can help these customers with their overall cost savings.

Test cutting in the turning of titanium alloys with Sumitomo's NCB100 binderless CBN returned the results below:

- Consistent chip control and a long-lasting edge, making the tools great candidates to replace current stable finishing processes using carbide
- 3X longer in the cut
- 9X the amount of material removed
- Minimized downtime
- Reduced operator input
- Eliminated need for redundant tools
- Enabled unattended operation

Reduced costs are another benefit, Schendel says.

"While these items come with a higher price tag, the return has shown the customer a great value," he says.

In a lot of cases, our ***traditional PCD (DA90)*** can rough and finish a workpiece in a cost-effective way, Schendel adds. "Rough with the DA90 and finish with the NPD10 binderless, and that's the cost-effective way to do it."

"And if users are looking for a mirror finish in carbide, or they have to hold a very tight tolerance in carbide, they can control the size of the workpiece and get much better consistency, part after part, with the binderless option as opposed to traditional PCD," he adds.

"Our goal is always to increase the bottom line for the end user, to make their processes as profitable and as efficient as we possibly can," Schendel says. "We always look at the user's cost per part compared to how they're processing a part now, because our aim is to increase their productivity."

What tools have helped you make your shop more productive? What are you using to machine difficult-to-cut materials? Share your thoughts in the comments below.

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