

Carbide Cutters

Are Here to Stay

Lyle Jamieson

John English wrote about the manufacturers that produce carbide cutters in the December 2010 issue of *American Woodturner* (vol 25, no 6). Many woodturners use their own shopmade versions. This article will move the discussion of carbide cutters to another level to discuss how we use them for woodturning.

During my lifetime of working with wood, I've acquired information from others—reading books, attending demonstrations, and one-on-one conversations—as well as from personal experience. I had a learning curve to go through with carbide cutters, and this time much of my research came from the Internet, as well as from my own experience. There are conflicting viewpoints expressed on the Internet, but there is consensus enough to support my conclusions.

History

A few years ago, Mike Hunter asked me to consider using carbide cutters on my boring-bar system. In spite of my initial comment, “No thanks, carbide does not get sharp enough for turning,” Mike began my education. He described the new technology of

nanograin carbide. “Okay,” I said, “prove it.” And he did—my assumption was wrong.

Carbide cutters have been in use for decades: metal machining, military, sports, plastics, wood-production duplicators, and in flat wood-working for tablesaw-blade tips. The earliest mention I found for carbide was in the 1860s, but the woodturning tool market did not accept carbide until recently.

The first commercially produced use of carbide for turning that I know of was when Dennis Stewart put a carbide tip on his slicer tool, sometime in the early 1990s. It was the precursor of the coring systems used today. While it had wear resistance better than HSS or carbon steel, it would not get as sharp. For the use Dennis intended, however, it was perfect. Then why didn't other uses of carbide take off with Dennis's example? The answer is: *That carbide did not get as sharp as high-speed steel, and a diamond hone was required to sharpen it.*

Metallurgy

There are many different carbides and grades of carbide. Carbide is not just carbide. The quality of the manufacturing varies greatly, and the particles that make up the carbides are different sizes. A microscope is needed to see the difference. Let's break down carbide cutters into two categories. First is *tungsten carbide*. It is formulated from a gray powder and the result is three times stiffer than steel.

The second category is the new *nanograin tungsten carbide*, sometimes referred to as *micro-grain carbide*. The nanograin, as you might guess, is made of much smaller particulate than for tungsten carbide—the difference in grain size is that of BBs to beach balls. Nanograin carbide grains are cemented with another metal, usually cobalt (*Figure 1*). Generally, there is 6% to 12% binder in the carbide. With optimum grade selection, submicron-grain-size particles of tungsten carbide are manufactured to have a razor edge. What does this have to do with us in the turning world? ►



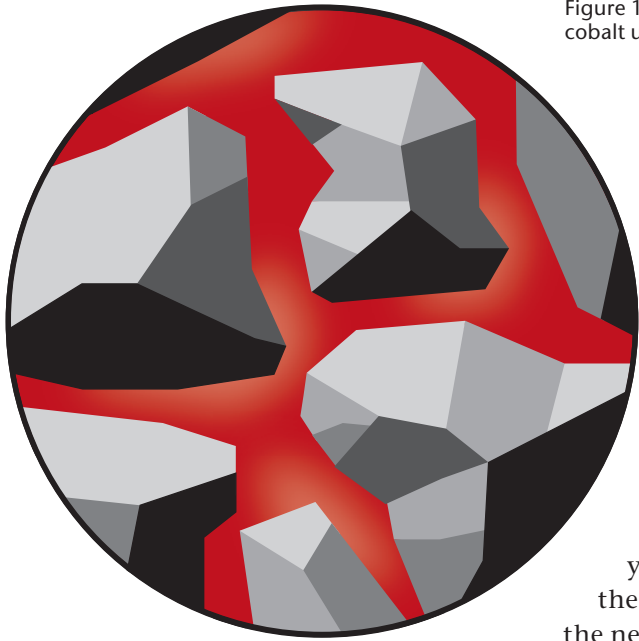


Figure 1. Magnification of carbide: Illustration of (gray) carbide cemented with (red) cobalt under high magnification.

Start with a sharp edge

In woodturning, we begin with a sharp edge on our tools, and the instant we start turning, the sharpness of the edge degrades. Let's do some math. Take a 10"-diameter bowl and calculate the circumference: $10 \times 3.14 = 31.4$ ". Thirty inches of wood are passing the cutter every rotation. Let's say we are turning at 1,000 rpm. In one minute we have just cut 30,000" of wood—almost one-half mile or 500" per second. Will any tool retain its sharp edge very long?

After the initial sharpened edge is gone, the structure of the base material the cutter is made from is left. This remaining cutting edge is called the *land*. With carbide, the base material is very wear resistant and the tool will cut reasonably well for a long time on the land before the edge deteriorates enough to become unusable.

With nanograin carbide, the finer particulate will allow the edge to be even sharper to begin with than with the old carbides—manufacturers are able to produce a razor-sharp

edge. The land edge left after the initial nanograin razor-sharp factory edge has been used to cut wood will still be sharp because the fine grain structure is resistant to wear.

How can you tell if your tools are made from the old-style carbide or the new nanograin carbide?

The nanograin carbide is manufactured under high heat and high pressure. The surface ends up with a mirror or glossy finish. The old carbide will have a dull, flat-gray appearance. To confuse the distinction, some carbide manufacturers apply coatings to enhance sharpness. These coatings are usually yellow or gold in color and they are intended to mask the dull gray. The coating wears off quickly and the tool is now cutting with the land made of the same base metal structure.

Grain sizes and sharpness

I spoke with Tom Walz, President of Carbide Processors Inc. in Tacoma, WA, to compare nanograin carbide to HSS. He said, "Consider that the sharpness level of HSS is in the range of 1 to 20, with 1 being the sharpest possible for HSS starting out. Nanograin carbide, on the other hand, starts out at 2 or 3 sharpness. Turning with both for the same amount of time, HSS is dull and has reached a 20 while nanograin carbide is still sharp at a 4 or 5 in the 1 to 20 range." My conclusion is that the finer structure of

nanograin carbide will begin with and hold a sharper edge than the old carbide and stay sharper longer than HSS. This is demonstrated to me in daily use of the Hunter nanograin carbide tools on my boring-bar system.

With HSS tools, the sharpened edge will degrade rapidly, but we can go quickly to the grinder and constantly renew the sharp edge to optimal performance. The sharpened edge of HSS tools will be sharper than the old-style carbide ever gets. You also can use a burr on HSS tools that is not present on carbide. Other steels like stainless and composites have the same trade-off. The knife industry has been struggling with this issue for centuries. The old carbon-steel knives would get sharper and last reasonably well for culinary needs, but they rust and their appearance was a problem. Flat woodworkers have been arguing forever about the best tool steel for router bits and carving tools.

Why use carbide?

Nanograin carbide tools cannot be resharpened to their original razor-sharp factory edge; they are designed to be disposable. They are, however, economical because they last so long. I believe they will wear up to 100 times longer than HSS.

Nanograin carbide cutters leave a much better surface on the wood than the old carbide. Why? Because it begins and remains sharper, and we can use a slicing cut that leaves a cleaner surface on the wood.

How woodturners use carbide tools

There are two types of cuts we can make while turning wood: a scraping cut or a slicing cut. It does not matter whether the tool is HSS or a carbide. The rule for scraping is the cutting edge must touch the wood at a 90° angle or less. Cutting at the centerline with the scraper held flat on the toolrest, the 90° angle is achieved by having the handle slightly up from horizontal (nose of the tool pointing slightly down). As the wood passes by the cutting edge, it scrapes some wood off. If we touch the wood with any sharp edge at more than a 90° angle, handle down with a scraper, the tool will dig in, starting a catch.

The rule for a slicing cut is the bevel behind the cutting edge must be supported against the wood. If you are

slicing on an angle without bevel support, the cutting edge will grab, dig in, and skate across the wood's surface until you get a catch. This is a critical concept to understand and when you understand it, tool catches will become a thing of the past (see *Figure 2*).

The two different carbides are used for different cuts for different reasons. The old carbide is used in the scraping mode. Carbide cutters are especially useful for beginners. Learning to use a scraper is easy, and they can scrape for hours and their tool will still be sharp enough.

Old-style carbide cutters are also great for what they were originally made for—roughing out. The turner just presents the tool to the wood in a scraping mode and just pushes it into the spinning wood and scrapes away, keeping the handle slightly up, never

violating the 90°-angle rule. The old carbide cutters are wear resistant, so going through dirty bark and miles and miles of waste wood, they will hold their edge for a long time, longer than HSS scrapers. The trade-off is that the old carbide cutters are not as sharp as HSS scrapers or bowl gouges, which is okay—we are using them as roughing tools.

The new nanograin carbide can be used for either a scraping cut or a slicing cut. Professional turner Mike Jackofsky has set up the nanograin cutters to work only in the scraping mode with a tip angle dedicated to scraping across the bottom, inside a hollow form. Mike Hunter developed his new Hercules tool to scrape in this manner, which works better than the old carbide because it is sharper. ▶

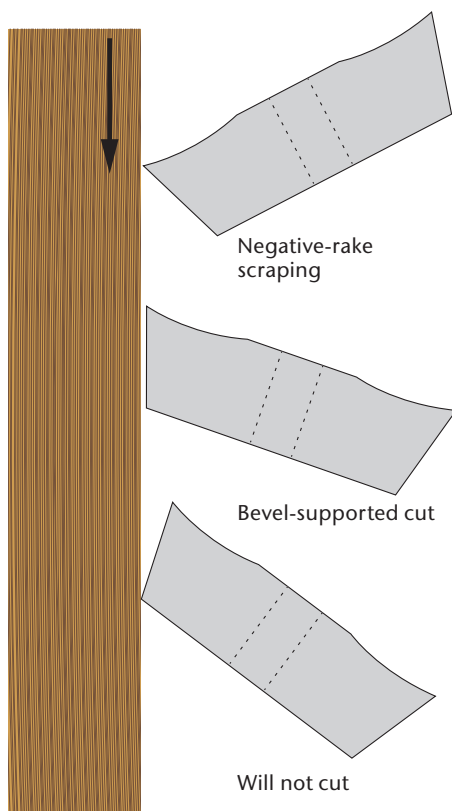
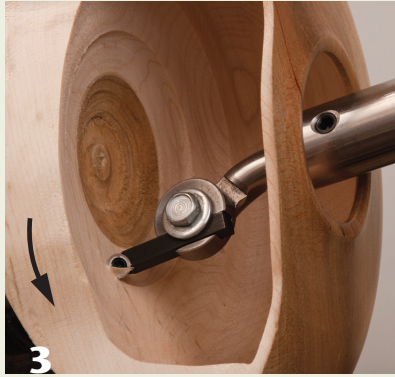
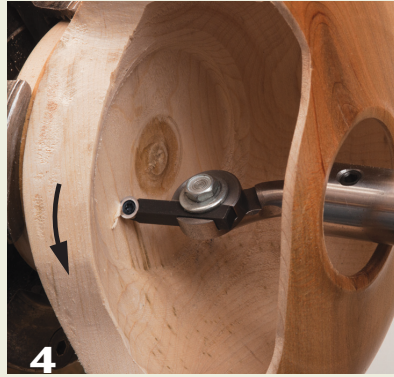


Figure 2. Nanograin carbide cutter in three positions tilted to cut wood (or not).





3
The direction of cut is to the left when the carbide-cutter insert is angled to the left. The ring visible in the photo shows the transition shoulder between the surface of the wood just cut and the wood ahead of the cutter. Notice the large thickness of the shaving. The cutting motion is slightly pulling away from the tip, on a taper, across the bottom of this vessel. This hogging-off cut is aggressive and removes large quantities of wood quickly.



4
This bevel-supported cut in the bottom of the vessel is made with the cutter at the 12:00 position, angled to the left, and the direction of the cut is to the left. Note the fine shavings as a light cut is taken.



5
A light cut, riding the bevel, and slicing part way up the side of the hollow form produces a smooth surface. The cutter is cutting at the 12:00 position and the cut is to the left.



6
This is the correct way to undercut a shoulder by removing the waste wood from behind the cutter before working on the underside of the shoulder. The cutter is at the 12:00 position, riding the bevel, and slicing up the side wall to the left.

Mike Hunter, Trent Bosch, Eliminator, or Jamieson tools have set up the nanograin carbide inserts so the bevel can be used in a slicing action to get a smoother, cleaner surface on the wood. It acts as a hook tool or ring tool to slice through the endgrain fibers of a hollow form or lidded box. Mike Hunter has great tutorials on using nanograin carbide for slicing and scraping in bowls and hollow forms on his website, hunterwoodturningtool.com.

Nanograin carbide: Three cuts possible

The new carbide tool is one complex little workhorse. The $\frac{3}{16}$ " (5 mm) nanograin carbide cutter is efficient and in this case, smaller is better. Larger cutters stress the wood and the chucking method. Using this small cutter, it is easier to hollow deeper vessels without vibration. The turner takes many smaller cuts quickly rather than slowly grinding away with a larger cutter bit.

If you set it up as I do in my captured boring-bar system, there are three different cuts possible.

Let's envision the cutter assembly locked in a boring-bar swivel assembly and positioned straight forward. Looking toward the headstock and down on the cutter, imagine a clock face (*Photo 1*). When presenting the 8:30 to 9:30 section of the cutter to the wood, the cutting action mimics that of a negative-rake scraper (*Photo 2*). The arrow indicates we can cut in both directions while scraping.

The second type of cut is to use the cutter from the 10:00 to 12:00 section. The result is an angled slicing action that is efficient and easy to cut with (*Photo 3*). In fact, this is the workhorse section of the cutter that gets most of the use

and abuse; wood can be hogged off. There is no bevel support for this cut or for the scraping cut. Note the arrow in *Photo 3*: Only cut to the left.

At the 12:00 position of the cutter, a bevel-supported cut is the result. It is a slicing action and leaves a smooth and clean surface behind. This cut is intended for removing only a small-shaving slice to clean up tool marks and prepare to sand, if needed (*Photo 4*). To make a bevel-supported cut, you must swing the handle to keep the bevel on the surface of the wood to make a curved shape inside a hollow vessel. As indicated by the arrow, the cutting action is to the left.

Even if the entry hole is small, the swivel will allow the 12:00 position to be used in any quadrant of the vessel, bottom, side, or top. This will require working in stages as you move the swivel often to position the cutter to use the bevel at the 12:00 position. The inside contour achieved from this method is really sweet because it is easy to pick up the line from a previous stage and carry it through the next stage (*Photo 5*). With a little practice, the line that the bevel and cutter follow will be superior to scraping cuts. (A laser-measuring device will help monitor the transition from stage to stage and keep a uniform wall thickness.)

The cutter will not cut in the 12:00 to 3:00 position. If you present this quadrant to the wood, it will just rub the shaft and the bottom edge of the cutter, and may even result in some chatter and/or vibration.

Learning curve

HSS cutters attached to the end of boring bars can be directed left, right, in, or out to produce

a cut. With a nanograin carbide cutter, however, there is a bit of a learning curve. For example, the cutting action of the carbide cutter will always be to the left if it is angled or facing to the left.

the tailstock. *Photo 2* shows the negative-rake scraping cut used to undercut the shoulder area.

The shearing/slicing cut of the nanograin carbide cutter produces a shaving. A scraping cut would

One caution to keep in mind:

Do not combine the ride-the-bevel and the hogging-off cuts—that combination removes too much wood, too fast, and starts some vibration going. Doing both cuts simultaneously stresses the chucking method, stresses the wood, and stresses the boring bar. The trick to hogging off fast and easy is to cut with a slight sweeping or scooping motion to pull away from the bevel slightly as you cut. This will create a slight curve to the inside surface of the vessel (see *Photo 3*).

The direction the cutter is facing dictates the direction of the cut. It will try to “climb” if you try to cut in the opposite direction. Going the wrong way will not usually produce a catch, but it will cause the cutter to skate.

When hollowing under a high shoulder, make sure to get the waste wood out of the middle behind the shoulder of the vessel (*Photo 6*). *Photo 2* shows the incorrect way to hollow by leaving the waste wood in the way behind the cut. Removing the waste wood will prevent an inadvertent skate should you bump the wood behind the cut with the back side of the tool.

Photo 4 shows the correct direction for cutting the endgrain on the bottom of a hollow form. *Photo 6* shows the correct direction of a cut coming up the side of a hollow-form vessel. The cutter needs to cut pulling toward the shoulder of the vessel when the cutter is swiveled to the left. And in *Photo 6*, “left” is actually pulling the cut toward

produce sawdust. Try one of these little cutters on the nastiest wood you can find and you will be a believer. These nanograin carbide cutters excel in wet wood, dry wood, hard wood, and soft wood. There is no sharpening and they are economical. I find them to be easy and fast for hollowing, and I like it that there is less sanding required. It takes making a few vessels to master the cuts, but it is worth the effort. ■

Photos by David Speckman Photography.

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