

What Woodturners Need to Know about CBN (Cubic Boron Nitride).

What is CBN?

CBN (Cubic boron nitride) is a synthetic chemical compound made up of boron and nitrogen atoms in a one-to-one ratio. It has a cubic crystal lattice, with its atoms arranged in a symmetrical, cube-shaped structure, very much like the crystalline structure of diamond. Its material properties include extreme hardness, stability under heat, and superior chemical resistance.

Cubic boron nitride is the second-hardest known material after diamond. For woodturners, it is the best *grinding-wheel* abrasive known to man.

The biggest advantage of CBN over diamond is its chemical stability in the presence of nickel, iron, and related metals at elevated temperature. Diamond is soluble in these metals at elevated temperatures, meaning that it reacts with them chemically and dissolves. This makes it useless as a tool for high speed grinding of iron or steel. CBN, on the other hand, does not react and can therefore be used to cut these materials. (Note: Diamond *hones* work great on steel because the speed of honing is so slow; if you raised the speed to where sparks were flying, you'd be into the chemically reactive temperatures.)

The heat resistance of CBN is quite high. Diamond begins to decompose to carbon dioxide in air at around 1,470°F, whereas cubic boron nitride is stable in air up to about 2,550°F. In metal-grinding applications where intense heat is generated, CBN is far superior to diamond.

(above material excerpted and expanded from wisegeek.com)

What Other Properties of CBN Make it Superior for Sharpening Woodturning Tools?

One of the objectives of metallurgists as they are developing better HSS (high-speed steels) is to get a more uniform distribution of fine microcrystalline carbides throughout the HSS. This makes the steel far more wear resistant, so the time between tool sharpening is greatly extended. But it is not without its attendant difficulties, namely the sharpening of the carbide grains distributed throughout the HSS.

Most woodturners prefer aluminum-oxide sharpening wheels, which wear away faster than silicon carbide wheels, but don't heat the steel as badly. But, when the aluminum-oxide wheel encounters the microcrystalline grains of carbide in the HSS, the carbide isn't sharpened per se, it is worn down slightly, but definitely not sharpened. At some point, the micro-grain of carbide is sticking out of the steel matrix enough that the grinding wheel simply tears it out of the steel matrix. So, one can say that an aluminum-oxide wheel exposes new carbide grains, dulls them, and then tears them out! Perhaps an oversimplification, but close enough for everyone to understand. And it isn't optimal sharpening of HSS.

If you have ever ground a pure carbide cutter on a green wheel (silicon carbide) you will think CBN is the best thing since sliced bread. CBN wheels are far harder than carbide, and readily sharpen carbide. So, unlike with aluminum-oxide or silicon carbide grinding wheels, when grinding a HSS woodturning tool with a CBN wheel, as the microcrystalline carbide grains are exposed they don't get worn down, they get sharpened to the shape of the edge, and they don't get torn out of the matrix so much. Because CBN actually sharpens carbide microcrystals, on HSS the CBN wheel is a far superior abrasive than aluminum oxide or silicon carbide.

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CBN wheels will even sharpen pure carbide bits and tools, although the life of the wheel will be compromised enough to probably not make it economically worthwhile. A wet CBN cutoff wheel will slice through carbide at the same speed as a diamond wheel, it just wears faster. Diamond is still the best abrasive for cutting pure carbide.

If you are a fan of the newer powdered-metal woodturning tools (I know I am!) a CBN wheel is a must. My first Crown Bowl Gouge of powdered-metal design seemed scarcely worth \$5.00 extra UNTIL I bought my first CBN wheel! Wow, those sharpened microcrystalline carbides really do perform better than did the dulled or removed ones when the tool was sharpened on an aluminum-oxide wheel.

Everyone talks about having to buy a slow speed grinder to successfully use CBN wheels. I say it just ain't so; that is, if you're willing to be less aggressive with your grinding. I read up on industrial abrasives for cutting metal, and CBN is superior to all others at very high speeds, and also at higher temperatures, so speed (and attendant heat) is not deleterious to these wheels. I contacted Cindy Drozda, who sells fine CBN wheels, and she says she uses her wheels on high-speed grinders. I also contacted some other vendors and got the same report. The big issue seems to be that the CBN wheels CUT SO MUCH FASTER at the higher speeds; so for neophyte sharpeners it has been recommended to go with slow-speed grinders in order to extend their tool life. Well, if you can slow down your aggressions, and grind a bit more gently, you can save yourself the price of a slow-speed grinder. I've had no problems with CBN wheels at 3600 rpm. They cut beautifully, and the grind is superb.

Ohh, you shouldn't throw away your old aluminum-oxide or silicon-carbide wheels. You'll still need them if you do any grinding of mild steel. **CBN is for HSS only, not for mild steel.** Don't forget this, lest you have to buy yourself a new CBN wheel. I keep one CBN wheel on one arbor of my grinder and an aluminum-oxide wheel on the other arbor of the same grinder, and it works out fine for me.

The Arizona Woodturners Association does occasional group buys of CBN wheels, and we get a nice discount, which we pass on to our members who participate in the buy. If dull tools is one of the banes of your turning -- like sanding is for me -- you can cure the problem with the purchase of a CBN wheel.

-- Marvin Fretwell
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