JUNE 2004 / VOLUME 56 / NUMBER 6

FOCUS: SUPERABRASIVES

▶ BY DAVID NOVAK,
ST&F PRECISION TECHNOLOGIES & TOOLS INC.

A BETTER BRAZE

A comparison of two processes for brazing PCBN onto carbide.

Polycrystalline cubic boron nitride has improved machining of ferrous materials, such as cast iron and steel. PCBN allows higher cutting speeds and feeds, extends tool life and, perhaps most importantly, eliminates the expense and hazard of using coolants because it can effectively run dry.

The process of manufacturing a PCBN cutting tool starts with cutting the expensive PCBN into small pieces with a laser or wire electrical discharge machine. (PCBN costs 30 cents per square millimeter, or $840 for a disc 58mm in diameter.) These pieces are then brazed onto a carbide insert or a shank-type holder, after which they are finish-ground to exact specifications.

Induction brazing is the process most commonly used to attach PCBN to carbide. It is a nonchemical process whereby tools placed inside a rapidly changing magnetic field, typically a copper coil, are heated by the current "induced" into the tools. A silver solder is placed between the PCBN and the carbide, the two-piece tool is heated to the melting point of the solder and then cools as one piece.

Because this process is performed manually at high temperatures, it requires a skilled hand and experienced eye to do it effectively. Ceramic sticks must be used to position the PCBN centrally on the carbide. Furthermore, because the tools are heated and cool quickly under normal atmospheric conditions, they must be coated in flux to avoid oxidation burn and discoloration. This makes the process even more difficult for the operator. In addition, the flux somewhat compromises the integrity of the induction braze.

The strength of any brazed tool is a result of the type of braze alloy used and the integrity of the brazing process. The most common braze alloys for induction brazing are comprised of a relatively impure mixture of silver, copper and zinc. The melting—or failing—point of these alloys remains at a constant level, so if they initially melt at 1,150° F, they will always melt at 1,150° F. Although the melting point is usually around 1,150° F, some braze alloys melt at a temperature as high as 1,700° F and as low as 600° F.

PBCN Doesn't Abhor a Vacuum

Unlike induction brazing, vacuum brazing is a chemical process in which a special braze alloy made of titanium hydride and a silver-copper eutectic chemically bonds to the

Thermal Technology

The 1100-4080 Labmaster furnace is one of the furnaces ST&F Precision uses for vacuum brazing PCBN onto carbide.

PCBN and carbide workpiece at 1,500° F. Conventional solders cannot be used in a vacuum furnace because they are not pure enough.

During vacuum brazing, the braze melts at the melting point of the silver, which is about 1,500° F. After cooling, the braze takes on the chemical properties of the copper, which must be heated to over 2,000° F to reach its melting point. Compared to an induction-brazed PCBN tool, this higher melting point allows vacuum-brazed PCBN tools to run faster and hotter, which is an advantage when dry machining.

In contrast to induction brazing, the operator can take his time positioning the PCBN on the carbide with vacuum brazing. Because the tool and PCBN are not being heated, there is no need to rush the process or worry about burning the PCBN. This allows the operator to make a higher precision cutting tool.

In addition, it is not necessary to coat the PCBN and carbide in flux while vacuum brazing to prevent burning.

The process takes, on average, 5 hours to complete, depending on furnace load size. All aspects concerning heat, pressure and pollutants are electronically controlled.

Although most PCBN comes with carbide backing so it can be induction-brazed to a cutter, vacuum brazing allows pure PCBN and polycrystalline diamond, including thick-film diamond, to be brazed directly to a carbide tool.

About the Author

David Novak is president of ST&F Precision Technologies & Tools Inc., Arden, N.C. For more information about the company's superabrasive cutting tools, call (828) 687-3686 or visit www.stfprecision.com.