

New Solutions for Machining Hard Brittle Materials

With the application of state-of-the-art laser technology, 6C Tools AG, a company based in Switzerland, fabricates tools from solid PCD that meet requirements for machining brittle and hard materials (cemented carbides, technical ceramics, glass). These tools can be used in conventional production machines and enable unparalleled precision and manufacturing reliability, especially for small feature sizes.



Fig. 1
6C Tools produces PCD cutters and drill bits with high geometric flexibility (images not to scale)

Introduction

Sintered ceramics and cemented carbides are constant companions in our everyday life. In some places, they are in plain view, whereas in others they do their job while hidden from sight. However, it has so far not

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been possible to exploit the full potential of these materials. While being the primary property for their use, the high hardness of these materials is both a curse and a blessing, as it causes their machining to be associated with technical challenges and high cost. As a result, its use on a wider scale is not always economically feasible.

Nowadays, these materials are machined primarily by grinding with diamond tools. However, grinding is slow, especially

for small-size structures, requires high operator skill as well as maximum spindle speeds. The dressing of the grinding wheels for these applications and limited tool lifetime pose additional difficulties and cost.

To produce components in relatively large series, manufacturing companies therefore often need a large number of grinding machines operating in parallel. All in all, the grinding of small features in hard brittle materials is inefficient and often uneconomical. The application of PCD tools can increase productivity considerably and reduce overall costs.

Diamond is regarded as the hardest of all known materials. This also applies to tools made of polycrystalline diamond – PCD. With the application of state-of-the-art laser technology, 6C Tools AG, a company based in Switzerland, is able to fabricate tools with 3D-geometries from solid PCD, which meet requirements for machining brittle and hard materials. The tools fabricated in this way can be used in conventional production machines and, especially for the range of very small geometries, they enable unparalleled precision and manufacturing reliability. Additional to a wide portfolio of drills, torus mills, thread milling cutters, chamfer mills, ball mills and polishing balls, 6C Tools also supplies tailored solutions for special requirements with high geomet-

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ric flexibility. For example, form cutters, special thread mills, deep-hole drills with coolant holes in the PCD and PCD drill bits with a diameter of 0,4 mm and a length of 15 mm.

A unique feature of 6C Tools products is the number of cutting edges. These are the basis for cost-efficient process design. A cutter with a diameter of just 1 mm has seven cutting edges active in the machining process enabling high productivity as well as long tool lifetime.

Applications and challenges

The use of PCD tools enables the application of brittle and hard materials in places where they have not been used so far because their machining is too expensive or technically challenging.

Especially in high-wage countries, like for example, Switzerland, it is particularly important not only to be able to machine these materials, but also to machine them with high process reliability for a high degree of automation. To this end, 6C Tools makes a crucial contribution with its solid PCD tools, because these, in contrast to diamond-coated tools and grinding tools, allow high reproducibility of machining results.

Ceramics

Especially in medical engineering, ceramics are enjoying considerable popularity – whether as sliding bearings in cardiac pumps or in dental applications. Tolerances in the range of micrometres are not rare in this field.

Looking at a modern dental implant, it soon becomes clear which requirements must be met by the fabrication process. Besides boreholes and inner threads of all shapes and sizes, the interfaces between the different components entail very demanding fabrication on account of their dimensional and geometric tolerances. The resulting challenges can only be met with innovative fabrication solutions.

Ceramic materials are also used increasingly in the luxury goods sector. For example, in the Swiss watch industry, where more and more manufacturers are offering casings made of a wide range of ceramics or even high-purity sapphire (Al₂O₃). Here, besides the maintaining of manufacturing tolerances, the appearance of the machined surfaces is of paramount importance. For these applications, too, 6C Tools



Fig. 2
Cut demo-part made of silicon carbide (l.) and cut M3 inner thread, M6 outer thread and hexagon head screw made of zirconia (r.)

offers customised solutions to meet specifications.

Next level in carbide machining

In the die- and mould production, it is important for the companies to always be a step ahead. Besides a fleet of productive machines, this means state-of-the-art manufacturing equipment. The focus is set on meeting standards for maximised quality, flexibility and absolute dependability in meeting deadlines. The applications range from tools for injection to pressure casting and LSR mould-making.

With the use of PCD tools, new possibilities result for the design and cost structure. In comparison with conventional machining processes like grinding or spark erosion, cutting with PCD tools offers enormous ad-

vantages for machining carbides. Especially for small geometries and boreholes, maximised precision, productivity and process reliability can be achieved with tools supplied by 6C Tools.

Process times can be minimised, eroding of rough contours and cutting of eroding electrodes are no longer necessary, and it is possible to cut carbide components in a single clamping. Customers frequently marvel at the high quality of the surfaces and fabrication accuracy for narrow tolerances even with relatively long processing times.

Comments like “With the collective know-how, we are going into carbide machining straight away and can offer our customers another competitive advantage” are not uncommon.

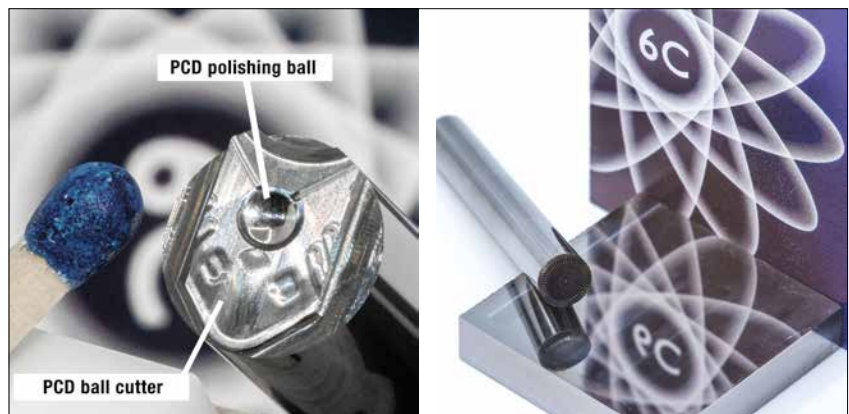


Fig. 3
Cut carbide die (l.) and cut carbide surface (K40UF) (r.) (Figs.: 6C Tools)