

New laser system for cutting and shaping industrial diamond

It is widely assumed that the real obstacle for the growth of the market for diamond based products and applications is not only a relatively high cost of the material itself, but foremost the costly process of shaping of the manufactured objects. The latter is due to the need to polish away often relatively large volumes of the diamond material until the final shape is reached. This polishing is very slow, requires the use of expensive equipment and makes the manufacturing process dependent on expensive specialists with today rare skills.

Bettonville NV, based in Antwerp, Belgium, has come up with a solution to this problem with the launch of its new laser system, UltraShape II, which allows for quick and safe removal of the excess diamond material, leaving only approximately 20 microns for the fine polishing.

With the UltraShape II laser, Bettonville provides diamond tool manufacturers with a system which enables:

- ◆ a considerable increase of manufacturing throughput
- ◆ a dramatic reduction of manufacturing costs as less time will be needed and less labour will be involved in the final polishing of the excessive material
- ◆ higher predictability of the manufacturing costs as always only around 20 microns overhang can be left for the final polishing

100 year history

Bettonville NV is over 100 years old and since its early days has been serving the gem-diamond industry worldwide. It is known to have exhibited its machines and tools on the World Exhibitions in Paris in 1931, in New York in 1939 and in Brussels in 1958.

One of its most successful products was diamond sawing blades and diamond sawing machines for abrasive sawing of the natural diamonds. The quality and performance of the sawing blades was unparalleled in the diamond industry and for decades Bettonville enjoyed almost full monopoly on the market.

Another product, which has revolutionised the way gem diamonds were shaped, was an automatic bruting machine (diamond round-shaping machine) traded under the name Maxicut. The concept of Maxicut using "revolving diamond to shape the other diamond" was patented worldwide and was developed further over the years into 8 consecutive generations of automatic bruting machines.

Laser systems for cutting gem diamonds

10 years ago, Bettonville introduced the first commercial laser system for very safe (less than 0.1% damaged stones) and very fast (over 300 carats of 6-grainers/day) diamond sawing. It was a real technological revolution as sawing of one-carat diamond (approximately 4 mm in diameter) was shortened from 3 hours of abrasive sawing to 4 minutes of laser sawing.

As a result of further developments, in 2003, a versatile Bettonville COMBI laser system was introduced to the gem diamond market, again setting new

A Belgian company that has specialised in the manufacture of machines for cutting and shaping gem diamonds for more than 100 years has now launched a laser system for use in the fabrication of diamond tooling. The new system is suitable for use on both natural diamond and all types of synthetic diamond: HPHT monocrystal, PCD and CVD diamond. Report by **K. Jedraszak**

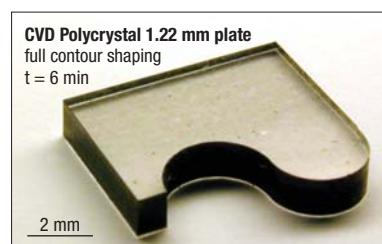


Fig 1 CVD polycrystalline diamond-laser shaped 1.22 mm plate

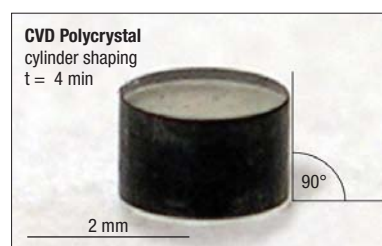


Fig 2 CVD polycrystalline diamond-laser cut out cylinder with perpendicular walls

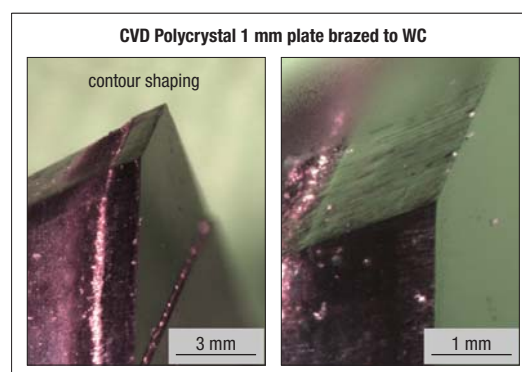


Fig 3 CVD polycrystalline diamond-laser shaped tool tip

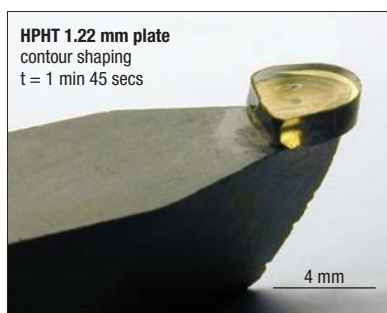


Fig 4 HPHT monocrystalline diamond-laser shaped tool-tip

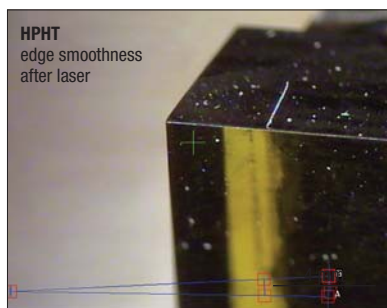


Fig 5 Smooth edge of HPHT monocrystalline diamond after being laser cut



Fig 6 Bettonville UltraShape II laser system

standards in this industry. This system was capable not only to saw diamonds, but also to shape them into any form (round, oval, heart, marquise, or any other CAD created) and to cut facets in an automatic, programmable manner.

Up to the present time, over 400 Bettonville's laser systems, including more than 200 units of COMBI laser system, have been installed worldwide.

Laser systems for industrial applications

As early as 2001, Bettonville decided to make a good use of its vast experience in diamond processing and established 'Bettonville Industrial' – a division concentrated on developing methods and equipment for laser processing of natural and synthetic diamonds for industrial applications.

In 2003, at the 'Laser World of Photonics' exhibition in Munich, Bettonville launched its first laser system for industrial applications, the UltraShape 5xs, a system that differed strongly from other laser machines on the market.

UltraShape 5xs was compact, relatively inexpensive, highly standardised and fully dedicated to processing various diamond materials: natural diamonds, HPHT monocrystal diamonds, PCD as well as mono- and polycrystalline CVD diamonds.

Its patented Optical System guaranteed high processing speed, low diamond weight-loss while cutting and high smoothness of both, sawn edge and surface, in all cutting directions. This meant that any shape, whether polygonal, round or oval, concave or convex, or any combination thereof, had the same smoothness of the edges and sawn surfaces all around.

Another feature of this Bettonville patented Optical System was the ability to correct the effects of the laser beam divergence and cut the sidewalls of the shaped object perpendicularly to the base.

Additionally, this Optical System made the laser processing very safe for the precious diamond material, as diamonds did not heat up while subjected to the laser beam, thus the heat-affected zone was minimised and so was the risk of the diamond breakage.

Because of this high performance in diamond processing, the UltraShape 5xs laser system became of a great interest to the non-gem diamond industries, particularly for the manufacture of special diamond tools, anvils, optical and heat management elements, surgery tools and ultra-microtomy.

The list of Bettonville's industrial clients now consists of respected names in the industry from Europe, USA, Canada and Far East.

Ultrashape II laser system

In 2007, Bettonville, in conjunction with Belgian investment group QAT Arkiv Investments and with the participation of the Belgian Government, established a new venture, Bettonville Integrated Solutions NV (BIS). The aim of this new venture was to specifically address the needs of those industries that relied heavily on the growing availability of synthetic diamonds (CVD and HPHT) and their derivatives.

In 2008, BIS re-designed the UltraShape 5x model and developed a laser system, which will be officially launched in the first quarter of 2009 under the trade name UltraShape II.

UltraShape II laser system comes with a new motion control, based on standard G-codes, which opens an access to the system, for standard and non-standard manipulators, in order to allow more shape related movements of the diamond object under the laser beam.

Additionally, UltraShape II laser system is equipped with Automatic System for Mirror Adjustment (ASMA) and Optical Power Regulator (OPR), which give the operator a control from the keyboard over the laser beam alignment and its optical power.

Together with it, several auxiliary modules for product preparation are available for an off-line batch programming to further enhance the throughput of the system.

The UltraShape II laser system and all other accompanying equipment are driven by Bettonville's proprietary software, known from the gem-diamond industry as being extremely user friendly and easy to learn for even an unskilled operator. ♦

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