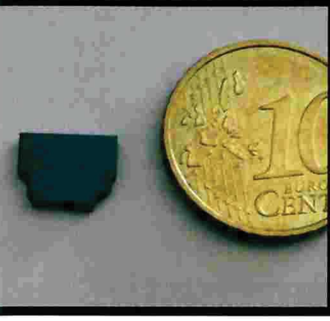
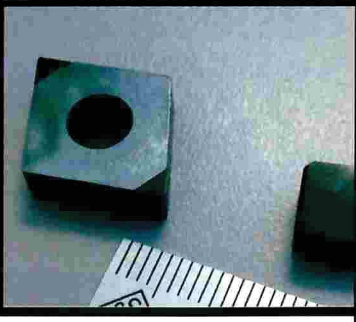
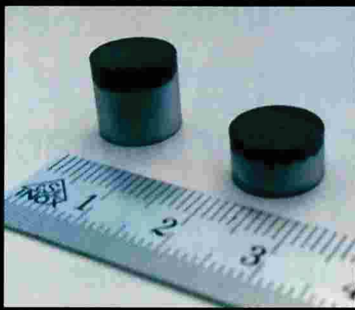






Cutting Diamond Tools By Laser MicroJet®

New developments in the wet laser machining of industrial diamond tools

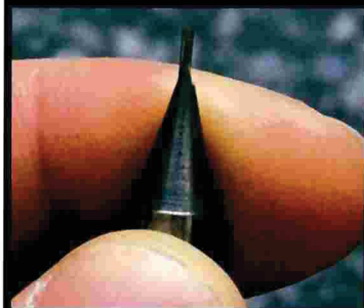
SÉBASTIEN KURZEN, NITIN SHANKAR

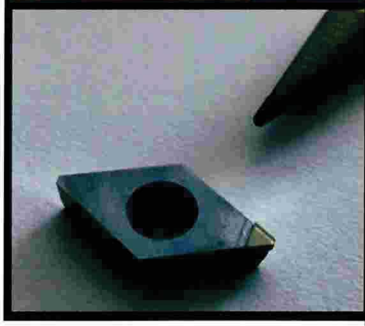
INTRODUCTION

Artificial diamond materials are replacing tungsten carbide and ceramic composites in cutting tools where high surface finish quality is required. The choice of materials ranges from lower end polycrystalline diamond (PCD) to high-end single crystalline diamond (SCD). SCD tools have proven their capability in the super-finishing of ultra-precision optical grade surfaces. In many cases, the use of SCD tool inserts can eliminate grinding operations and cut process times. They also benefit from a longer tool life. Only laser technologies are capable of machining such materials, which are just as hard as natural diamonds. Synova•s patented Laser MicroJet® (LMJ) technology delivers better results than traditional dry lasers and is especially suited for the machining of diamond materials. This paper shows the results achieved in using Synova•s Laser MicroJet process for cutting PCD and SCD tool inserts.

LMJ PROCESS

In the Laser MicroJet system, a laser beam, passing through a pressurized water chamber, is focused into a nozzle. The low-pressure water jet emitted from the nozzle guides the laser beam by means of total internal reflection at the water/air interface. The water jet diameter is usually 50 microns and the laser power required is between 25 and 30 watts. While the principle looks simple, years of experimentation and optimization were required to fine-tune the process. The LMJ process works in two stages. The energy of the laser pulses vaporizes the workpiece material by heating while the water cools and cleans the surface in the interval between the pulses. Through a scanning process, a trench is formed that becomes deeper with each pass. As compared to traditional dry lasers, the LMJ "wet laser" technology has many advantages. The most important advantage is that Laser MicroJet cuts with a parallel beam and the cutting depth can extend up to several centimetres. This is not the case with conventional lasers where the focused laser beam has a limited working distance of just a few millimetres due to beam divergence. The beam converges at a focal point and then diverges. Therefore, a focus distance control is required and the working distance is short. The technology behind the Laser MicroJet is based on creating a laser beam that is completely reflected at the air-water interface, using the difference in the refractive indices of air and water. The laser is, therefore, entirely contained within the water jet as a cylindrical beam, similar in principle to an optical fibre. The LMJ process offers several advantages. There is no need for focal adjustment and one obtains parallel kerf sides. There is a minimum heat affected zone thanks to the cooling effect of the water. Finally, there is a high removal rate with debris washed from the kerf. Synova LCS 50-5 Laser Cutting System The Synova LCS 50-5 laser cutting system can cut extremely hard materials with high precision. It is a compact





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