REPORT: Diamond Cutting by Laser-MicroJet®

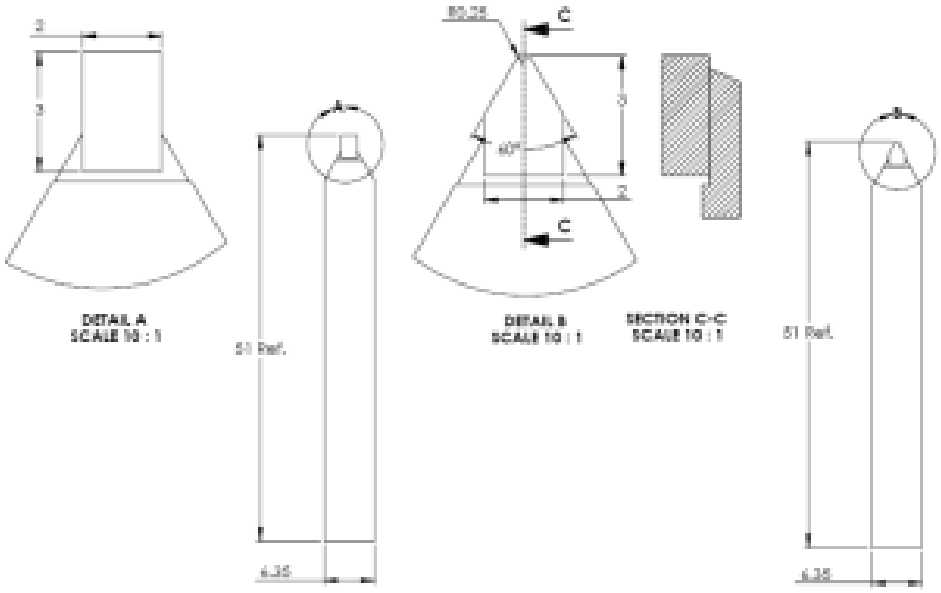
for Anonymous

by Michael Pavius; Synova SA

TASK

The Laser-MicroJet® technology has been tested for cutting five natural diamonds.

Each diamond was the diamond insert of a tooling tip made of metal (See Picture 1).



PICTURE 1: Drawing of tooling tip

Release of application report			
Project Leader		Responsible Application Group	
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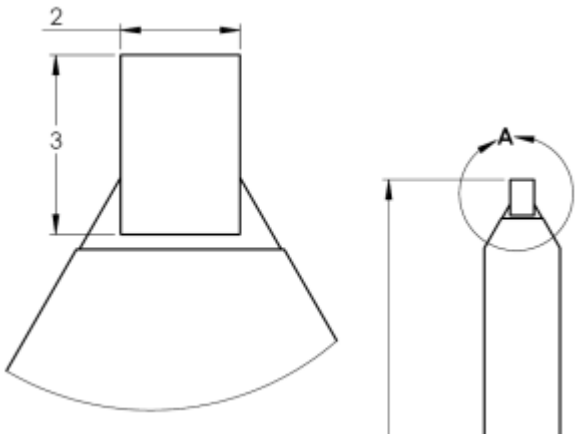
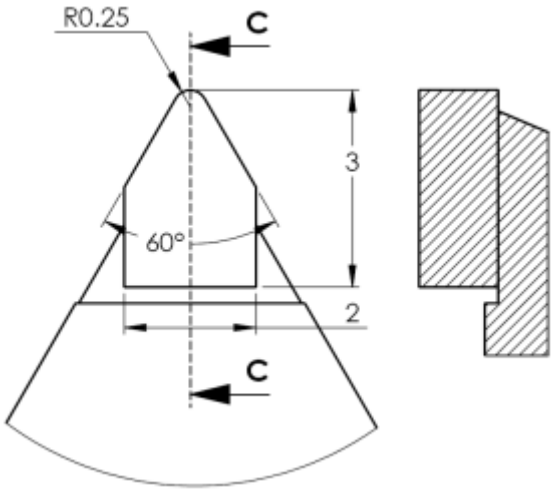
Date:	31.01.2012	Date:	07.02.2012
Visum:		Visum:	

The two pictures (See Pictures 2 and 3) below explain the exact shape we had to cut.

Basically, the work consisted in rounding the diamond inserts.



PICTURE 2: diamond insert: original shape



PICTURE 3: diamond insert: after cut shape

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Natural diamond
	Thickness	1000 *µm*
	Quantity	5 *pcs*

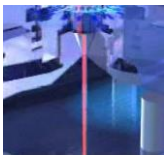
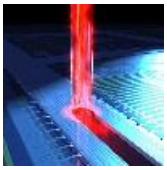
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LCS300 equipped with a frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab.
It is a manually loaded clean-room compatible machine, allowing to cut, drill, groove, scribe, trench, mark, or grind different kinds of materials.

Major advantages of Laser-MicroJet® technology with regards to your application are:

- Cutting of arbitrary shapes
- No chipping on front side, minimal chipping on backside
- Negligible heat damage to the material
- Parallel and smooth cut walls

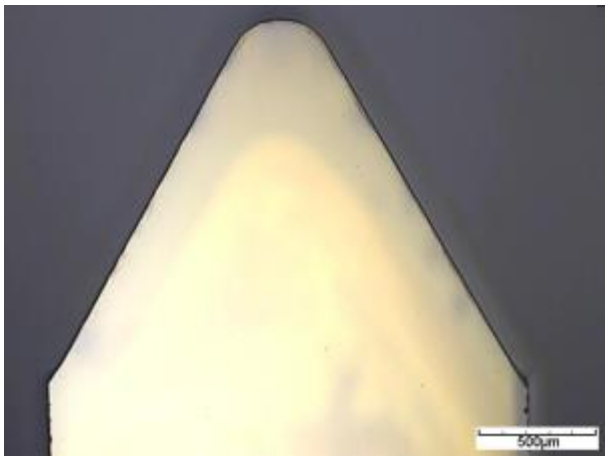
In the table below, the optimised processing parameters used in the experiments are summarised:

	**SYSTEM**	Machine type	LCS300
	**MICROJET® PARAMETER**	Nozzle diameter	60 *µm*
		MicroJet® diameter	50 *µm*
		Water pressure	250 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L51G
		Wavelength	532 *nm*
		Pulse frequency	10 *kHz*
		Average power	35 *W*
	**CUTTING PARAMETER**	Scanning speed	10 *mm/s*
		Time	70 *s*
		Fixture	clamped

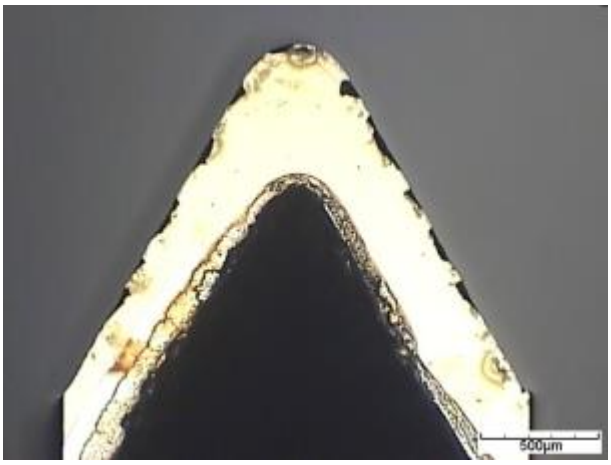
RESULTS

The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.

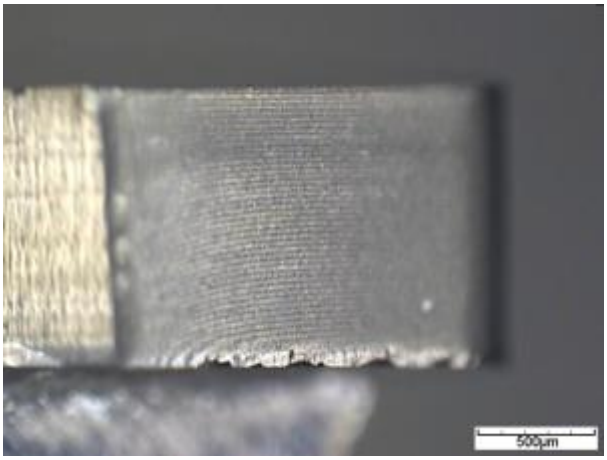
PICTURE 1: Digital pictures of a tooling tip with a diamond insert at its extremity



PICTURE 2: Microscope image of cut diamond insert (bright field; frontside view)



PICTURE 3: Microscope image of cut diamond insert (bright field illumination; backside view)



PICTURE 4: Microscope image of cut diamond insert (dark field illumination; side view)

Concerning the frontside of the diamond inserts, the quality is very high: neither crack nor chipping can be observed under our optical microscope (See Picture 2).

On the backside, limited chipping can be observed (See Picture 3).

The sidewall is also very smooth (See Picture 4).

The table below summarizes customer expectations and our results:

	What are your priorities? (please put a cross)	Quantified expectations or improvements
• Speed / throughput:	2 (currently 10-20 min)	70s
• Kerf-width:	3	60±5 µm
• Burr-free:	3	Yes
• Depth control:	3	±20 µm
• Contamination/Particles:	3	No particles
• Heat-damage free:	2	No heat damage
• Chipping/Cracks:	1	Chipping and cracks smaller than 10 µm on frontside
• Edge Roughness:	1	Smooth
• Tolerances:	2	Less than 25 µm
• Fracture strength:	1	Not possible to measure
• Other:		

CONCLUSION

The cutting of diamond insert was investigated on SYNOVA LCS300. This machine is based on the MicroJet® technology and combines the advantages of the high energy pulsed laser with a hair-thin water jet. While the laser is used for material ablation, the water jet is used for guiding the laser light, cooling the edges and preventing the sample from particle contamination, advantages that are essential for cutting diamond with high quality.

We successfully cut diamond inserts on top of five tooling tips:

- The cutting time is about 70s per cut, which is a tremendous improvement compared to the 10-20 minutes with Anonymous current grinding process.
- The frontside quality is excellent: neither chipping nor cracks can be observed under our optical microscope
- On the backside, minimal chipping can be observed. Process optimisation may help reducing this phenomenon.

We thank you for your interest in our technology and we hope our results meet your requirements. Our sales agent will contact you soon to obtain a feedback about the analysis of these results and to discuss with you the further steps.