

## REPORT: PCD/WC Cutting by Laser-MicroJet®

for Anonymous

by Andrew Chung; Synova SA

### TASK

The Laser-MicroJet® technology has been tested for cutting of PCD/WC. The main goal is to demonstrate the feasibility of cutting such elements and to get a speed cutting estimation for this sample as well as a good surface quality. In addition, a requirement of less than 10 µm chipping size and shape edged must be achieved. Materials should not be laser damaged.

### SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	PCD / WC
	Dimension	3.6X6 mm
	Thickness	1.6 mm
	Quantity	2 pcs



Figure 1. CAD drawing for processing shape.

### SAMPLE DESCRIPTION AND PREPARATION



Picture 2: The digital camera image of the sample.

Release of application report			
Project Leader		Responsible Application Group	
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Date:	04.07.14	Date:	04.07.14
Visum:	ACH	Visum:	BC

## PROCESS: INSTRUMENT & TEST PARAMETERS

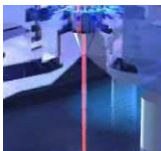

For these experiments, the LDS300 equipped with a frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab.

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<sup>®</sup> technology with regards to your application are:

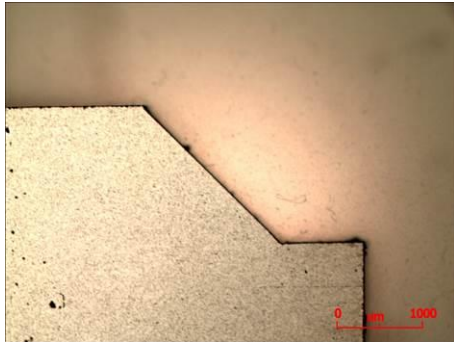
- Cutting of arbitrary shapes
- No chipping on front side, minimal chipping on backside
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation

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

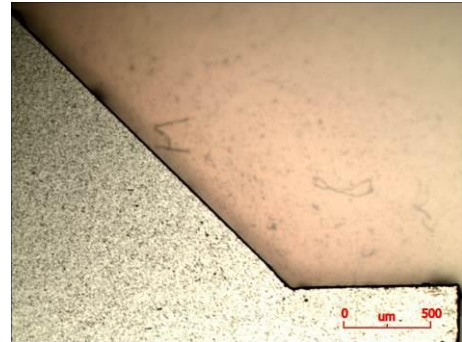
SYSTEM		Machine type	LDS300M
	MICROJET® PARAMETER	Nozzle diameter	50 μm
		MicroJet® diameter	42 μm
		Water pressure	300 bar
		Assist gas	He
	LASER PARAMETER	Laser type	L51G
		Wavelength	532 nm
		Pulse frequency	14 kHz
		Average power	27.1 W
		Pulse width	138.7 ns
		RF off-time	1.2 μs
		Scanning speed	10 mm/s
		Sample fixation	Clamp
		Number of passes	160
		Overall speed	3.76 mm/min

## PROCESS: INSTRUMENT & TEST PARAMETERS

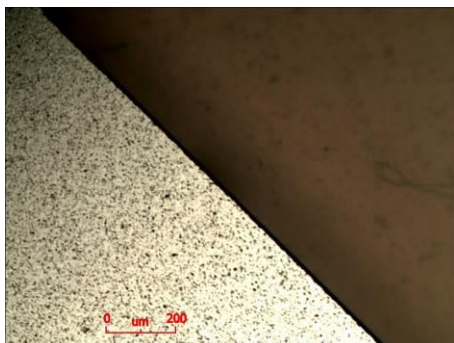
The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.



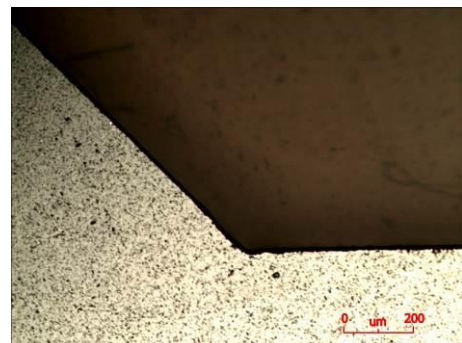
**PICTURE 3:** Microscope image of the sample.  
(bright field illumination; front side view)



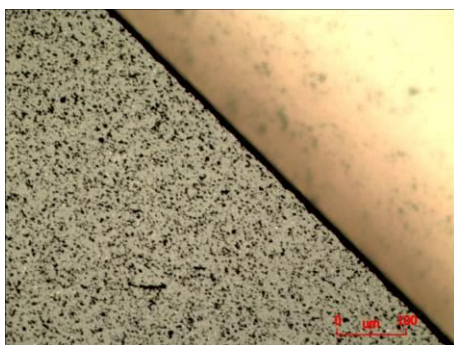
**PICTURE 4:** Microscope image of the sample.  
(bright field illumination; front side view)



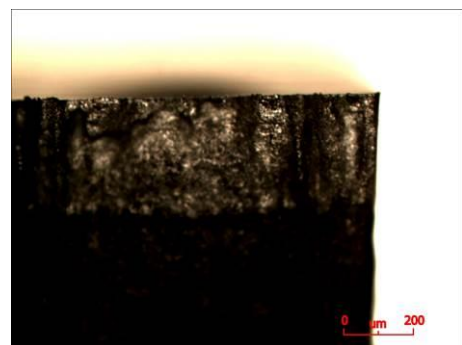
**PICTURE 5:** Microscope image of the sample.  
(bright field illumination; front side view)



**PICTURE 6:** Microscope image of the sample.  
(bright field illumination; front side view)



**PICTURE 7:** Microscope image of the sample.  
(bright field illumination; front side view)



**PICTURE 8:** Microscope image of the sample  
(bright field illumination; cross-section view)

 <div><b>SYNOVA</b> Ch. Dent-d'Oche CH-1024 Ecublens Switzerland <a href="http://www.synova.ch">www.synova.ch</a></div>	APPLICATION REPORT	Report No: 147-1
		Sample No:
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	Customer's requirements	Results obtained
• Speed/throughput	Max speed.	Needs an additional test with a high power laser in Japan.
• Edge Roughness	Very sharp edge	Analysed by the customer
• Burr-free	No burrs	No burrs
• Chipping/Cracks	Less than 10 $\mu\text{m}$	about 10 $\mu\text{m}$
• Heat-damage free	No HAZ	No HAZ

## CONCLUSION

The cutting of tooling diamond was investigated on SYNOVA LDS300M. This machine is based on the MicroJet<sup>®</sup> 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.

Our results are:

- Used PCD sample with 2mm-thickness for the trial version. In this case, it was difficult to establish the processing condition and quality that the customer wants. Chipping size was about 20 $\mu\text{m}$  and the shape of the edge was not sharp. Needed an additional grinding process.
- In case of a real sample, we gained better result with the same processing condition, up to the quality that they wanted (chipping size & edge shape). They will do the final test by actual tooling test.
- About this test, we cannot calculate the exact tact time because this machine is specialized for the semiconductor field. Low output of the laser. So I want you to focus only on the feasibility this time. More high power laser could be used for better process time. If the customer wants an additional test, we will do our best.

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