REPORT: TS-PCD cutting by Laser MicroJet®

for attention of Anonymous

by Stéphane Delahaye, Synova SA

TASK

The Laser MicroJet® technology has been tested on TS-PCD materials.
The goal of this study is to demonstrate the feasibility and the quality of our process and to give an estimation of the cutting time and quality of the Laser MicroJet® process on PCD materials.
Two pieces of different dimensions were processed for each sample thickness as requested by the customer.

Release of application report			
Project Leader		Responsible Application Group	
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Date:	2014.03.03	Date:	2014.03.03
Visum:	SDE	Visum:	BC

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE 1	Material	TS-PCD
	Wall thickness	3.5 *mm*
	Quantity	4 *pcs*
SAMPLE 2	Material	TS-PCD
	Wall thickness	5 *mm*
	Quantity	4 *pcs*

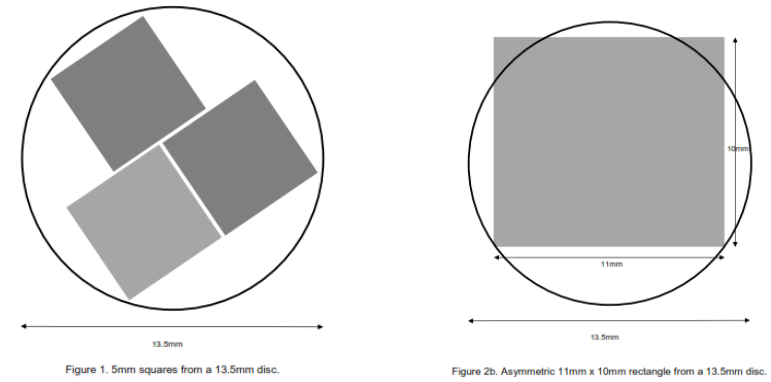


FIGURE 1: Illustration of the sample

Note: the samples were waxed on a ceramic plate and hold up with a clamp.

PROCESS: INSTRUMENT & TEST PARAMETERS

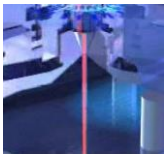
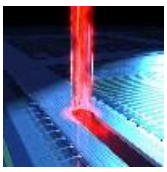
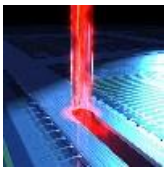
For these experiments, an LCS 300 equipped with a frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab. It is a manually loaded machine, allowing cutting and drilling any kind of materials.

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

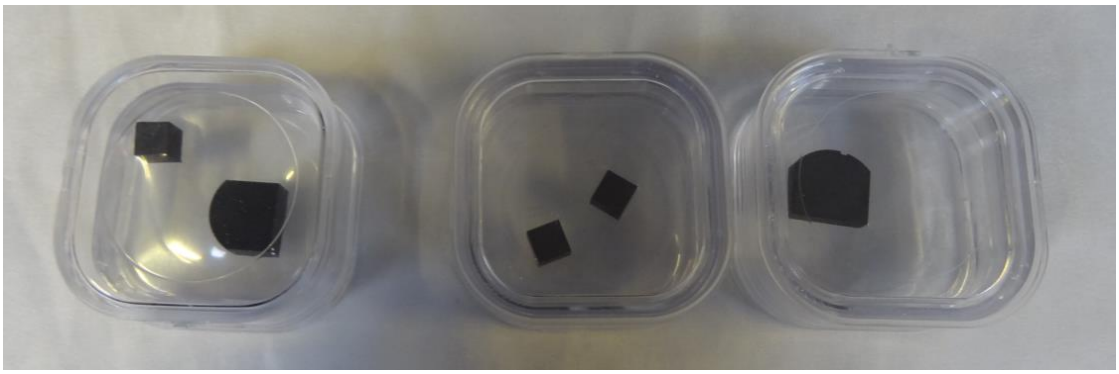
- Cutting of non-conductive materials
- Advantageous process rates
- Cutting of arbitrary shapes
- Low heat damage to the material

In the table below, the optimized processing parameters used in the experiments are summarized. Please note that the laser has one cavity, the process time could be reduced with the use of a double cavity laser.

	**SYSTEM**	Machine type	LCS300

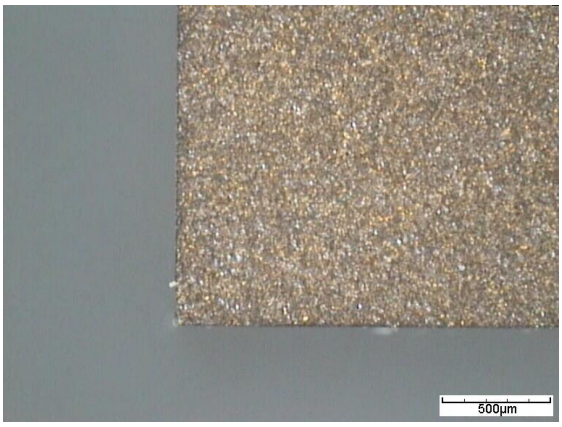
	**MICROJET PARAMETERS**	Nozzle diameter	40 *µm*
		MicroJet diameter	~32 *µm*
		Water pressure	400 *bar*
		Assist gas	He (0.9 *L/min*)
	**LASER PARAMETERS**	Laser type	L51G
		Wavelength	532 *nm*
		Frequency	6 *kHz*
		Pulse width	120 *ns*
		Power	28 *W*
		Power in jet	~11 *W*
	**CUTTING PARAMETERS Sample 1**	Working distance	12 *mm*
		Motion speed	10 *mm/s*
		Pass numbers	330
		Process speed	1.8 *mm/min*
	**CUTTING PARAMETERS Sample 2**	Working distance	12 *mm*
		Motion speed	10 *mm/s*
		Pass numbers	440
		Process speed	1.36 *mm/min*

RESULTS

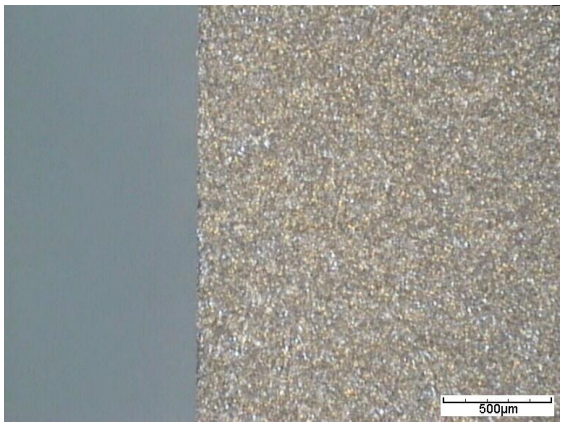


PICTURE 1: Picture of the samples

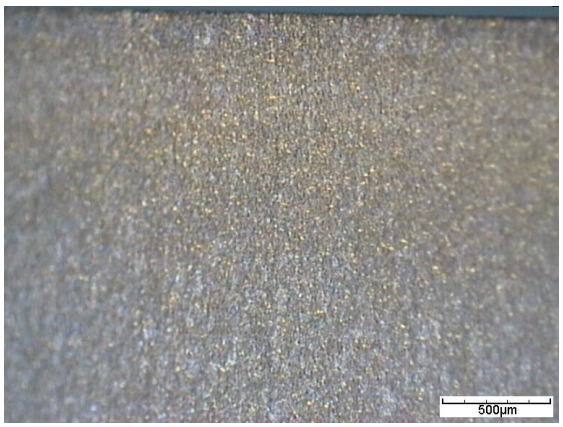
1. 3.5 mm thick samples



PICTURE 2: Microscope image of the frontside (dark field illumination)

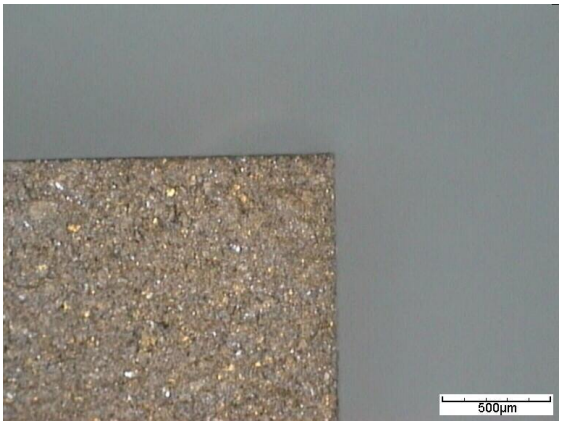


PICTURE 3: Microscope image of the backside (dark field illumination)

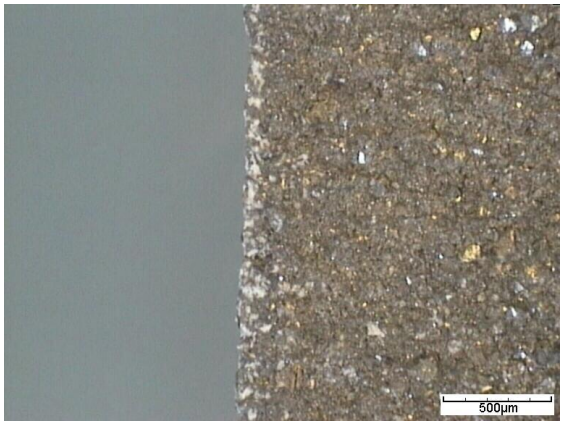


PICTURE 4: Microscope image of the side wall (dark field illumination)

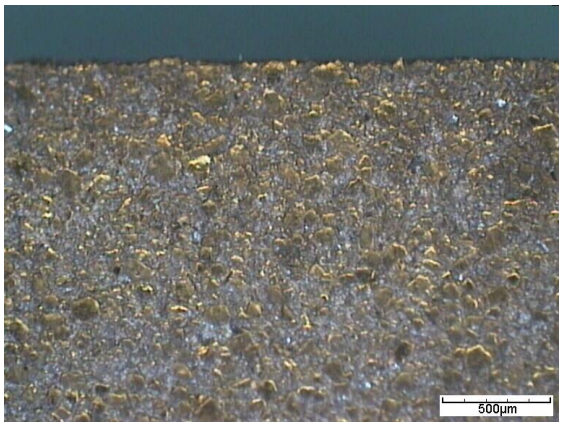
2. 5mm thick samples



PICTURE 5: Microscope image of the frontside (dark field illumination)



PICTURE 6: Microscope image of the backside (dark field illumination)



PICTURE 7: Microscope image of the side wall (dark field illumination)

CONCLUSION

Cutting TS-PCD squares was investigated on a Synova LCS 300. This machine is based on the Laser MicroJet® technology and combines the advantages of a 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 and grooving super-hard materials with high quality.

The feasibility of cutting squares of TS-PCD materials was demonstrated.
This test shows that:

- Very good cutting quality is achievable. No chipping on the frontside while some minor chipping is visible on the backside. This is mainly due to the way that we take out the samples from the ceramic plates.
- Cutting speed can still be optimised by using a double cavity green laser but cutting quality may suffer.

We thank you for your interest in our technology. We will contact you soon to receive your feedback and the analysis of these results and to discuss the further steps.