REPORT: PCD cutting by Laser MicroJet®

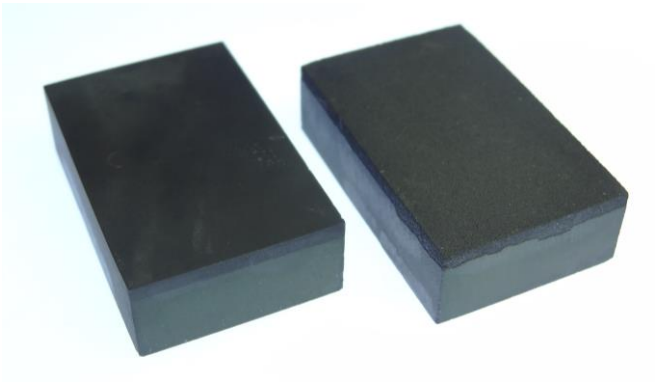
for attention of Anonymous

by Ronan Martin, Synova SA

TASK

The Laser MicroJet® technology has been tested for cutting squares in PCD on ceramic substrate. These squares would then undergo grinding to create the final parts.

SAMPLE DESCRIPTION AND PREPARATION



PICTURE 1: As-received material

PCD PLATES	Material	PCD on ceramic substrate
	Thickness	12 *mm*
	Quantity	2 (1 rough + 1 smooth)

Release of application report			
Project Leader		Responsible Application Group	
Name:	Ronan Martin	Name:	Dr Benjamin Carron
Date:	14.07.2015	Date:	17.07.2015
Visum:	ROM	Visum:	BC

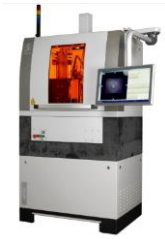
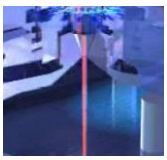
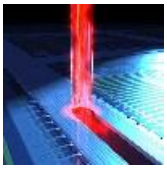
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, an LCS 150 equipped with a dual-cavity frequency-doubled Nd:YAG laser has been used as the machine configuration in our lab. This machine allows cutting diamond, most ceramics any kind of metal.

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

- Negligible heat damage to the material
- Excellent wall surface quality
- Limited chipping

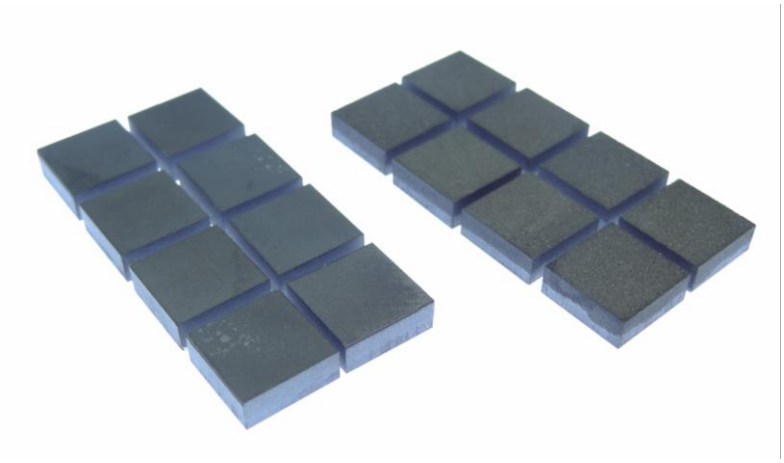
The table below summarizes the optimized processing parameters used in the experiments. Because the parts have to be grinded afterwards, we did not focus on quality but used parameters that provide a good speed.

	**SYSTEM**	Machine type	LCS 150
	**MICROJET® PARAMETERS**	Nozzle diameter	80 *µm*
		MicroJet® diameter	66 *µm*
		Water pressure	100 *bar*
		Assist gas	He
	**LASER PARAMETERS**	Laser type	L202G
		Wavelength	532 *nm*
		Pulse frequency	10 *kHz*
		Internal power	90 (2x45) *W*
		Pulse widths	200 *ns*
		Pulse delay	300 *ns*
	**CUTTING PARAMETERS**	Motion speed	10 *mm/s*
		Mean time per square	22 *min*
		Fixation	waxed

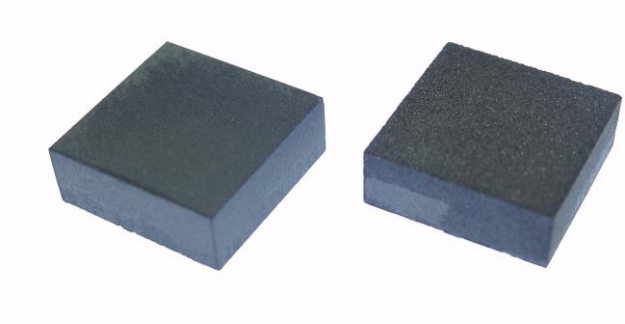
The parts were waxed on an alumina plate, in order to prevent the squares from falling after being cut through, and thus possibly getting some damage on the edge when falling. The wax made it a bit difficult to see when the plate was cut through, so that we had to make extra passes to be sure. Waxing was actually done because we had initially planned to cut rounded squares, but in this case of simple dicing, it would also be possible to just clamp the parts, and get a slightly faster process.

RESULTS

Following the customer's recommendations, we cut, in each plate, eight squares with a side of about 9.75mm, and then cut these squares to decrease their thickness to about 3.5mm. The pictures below present the processed squares.



PICTURE 2A: General view of all the cut squares



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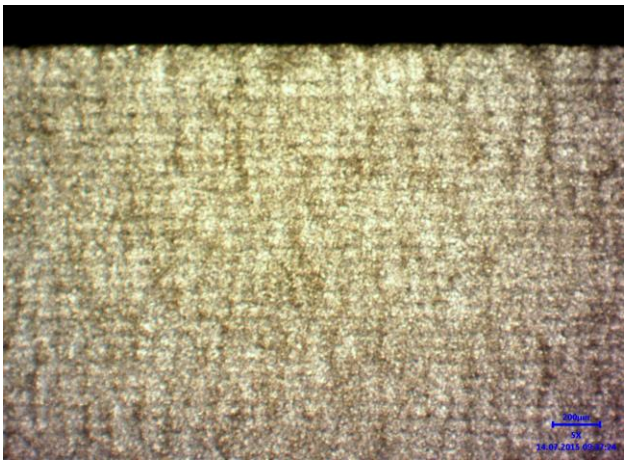
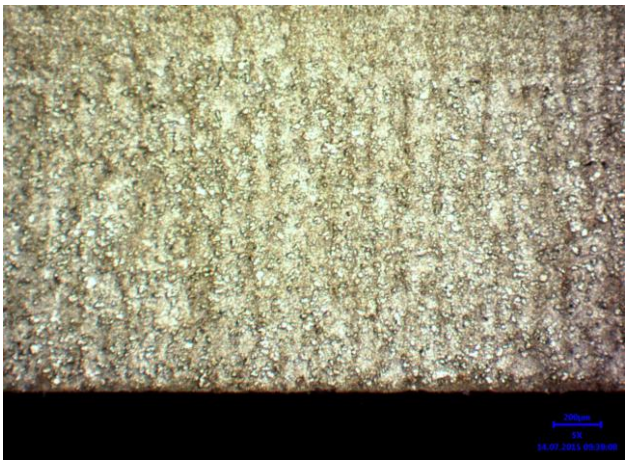
PICTURE 2B: Close-up on two squares (smooth on the left, rough on the right)

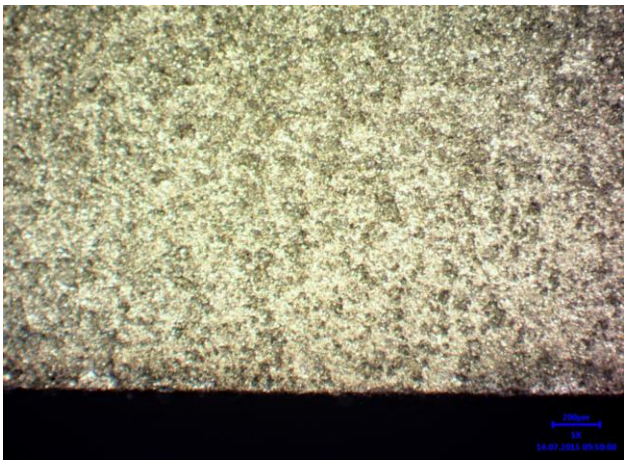
The following microscope pictures give an overview on the quality obtained with the Laser MicroJet® technology. The cut walls are smooth, without visible cracks or heat damage. Due to the cutting strategy we used (and to handling), there may be some chipping in the corners, but it should not matter since these parts will eventually be grinded.

It should be noted that some of the samples with smooth PCD have a defect on one side of the top edge, due to a few passes that were done with a small offset compared to the final cut wall. These defects are fortunately small enough to be grinded off eventually.

Smooth PCD

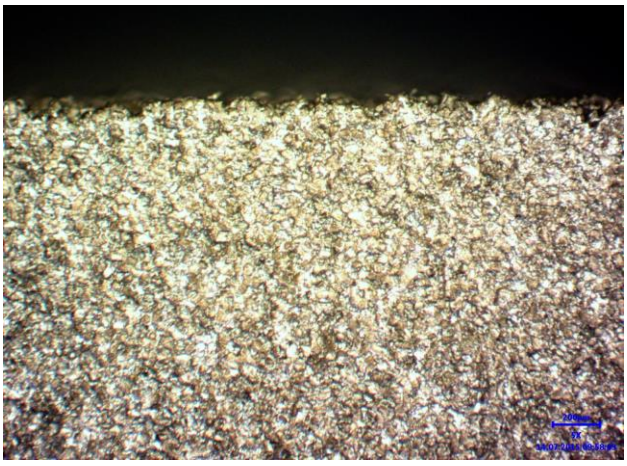
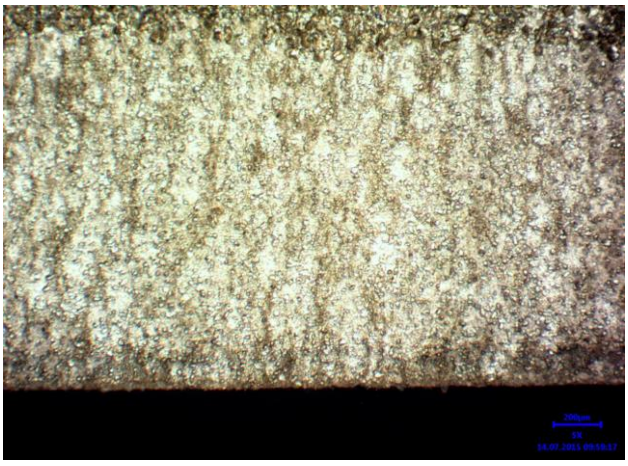



PICTURES 3A & 3B: Microscope images of the cut wall (top on the left, bottom on the right)

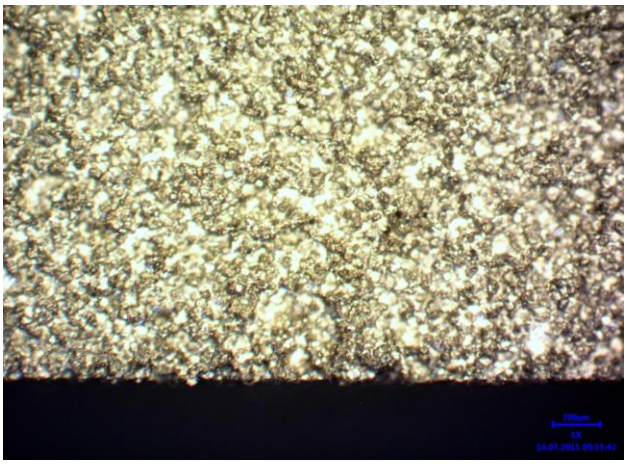
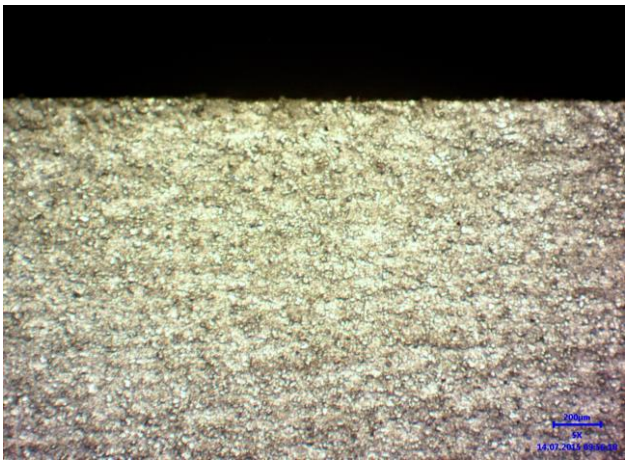



PICTURES 4A & 4B: Microscope images of the top edge (on the left) and bottom edge (on the right)

Rough PCD

PICTURES 5A & 5B: Microscope images of the cut wall (top on the left, bottom on the right)

PICTURES 6A & 6B: Microscope images of the top edge (on the left) and bottom edge (on the right)

CONCLUSION

The cutting of squares in PCD on ceramic was investigated on a Synova LCS 150. 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 metal and diamond with high quality.

We successfully cut two sets of eight squares and decreased their thickness. The process time per square was about 22min, and the quality seems more than sufficient for this type of application, due to the grinding operation that has to be performed afterwards.

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