REPORT: Cutting of PCD cylinders by Laser-MicroJet®

For Anonymous

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1. TASK

The Laser MicroJet® technology has been tested for cutting PCD on tungsten carbide cylinders. The aim of this application was to optimize the laser parameters as well as the cutting strategy in order to:

- remove the circumferential material on the whole cylinder thickness;
- optimize the effective cutting speed.

The Laser MicroJet® technology gives precise cuts and no HAZ on the work-piece cut faces, thanks to the water jet. The latter enables to reach cutting speeds higher than other cutting processes like electric discharge machining, as well as competitive roughness.

2. SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	PCD/WC	PCD/WC	
	Diameter	15	14	*mm*
	Thickness	5.2	9.3	*mm*
	Quantity	30	30	*pcs*

Release of application report			
Project Leader		Industry BU Responsible	
Name:	Mr Sébastien Kurzen	Name:	Dr Benjamin Carron
Date:	14.01.2015	Date:	16.01.2015
Visum:	SEK	Visum:	

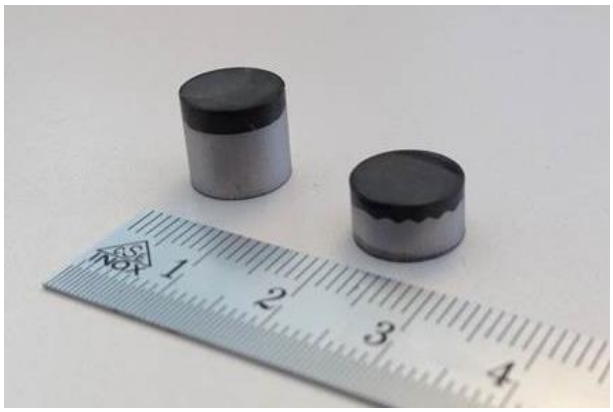
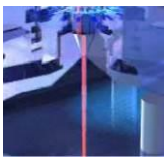
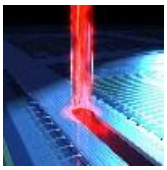


Figure 1: Macroscopic view of the final samples.

3. PROCESS: INSTRUMENT & TEST PARAMETERS

A Synova LCS300, equipped with a 200 W diode-pumped solid state laser source, has been used as the machine configuration the most appropriated for your application.

The table below summarizes the optimized processing parameters used for the tests:

			PCD/WC 5.3 mm	PCD/WC 9.2 mm	
	**MICROJET® PARAMETER**	Nozzle diameter	80		*µm*
	**LASER PARAMETER**	Laser type	L202G		
		Wavelength	532		*nm*
		Pulse frequency	10		*kHz*
		Power in jet	70		*W*
		Pulse width	190 & 190 + Δ		*ns*
	**CUTTING PARAMETER**	Cutting speed	30		*mm/s*
		Process duration	4.3	8.0	*min*
		Fixation	Clamp		

4. RESULTS

The following measurements were made with an Alicona microscope, 20 x magnification, on 10 mm diameter cylinders. Each value is an average performed on a 50 profiles analysis.

4.1. Sample thickness 5.3 mm

Figure 2: PCD surface

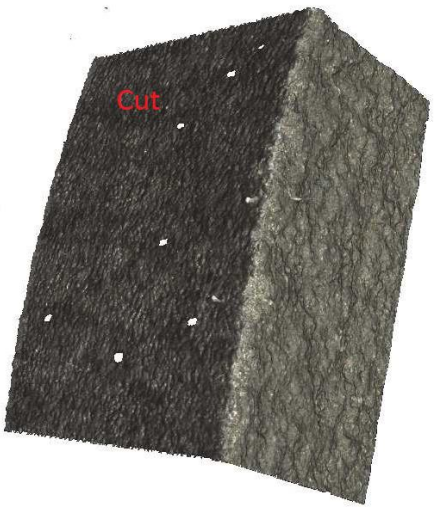


Figure 3: PCD edge

Cut duration	**Effective cutting speed**	*Ra*	*Rz*	Edge radius
4.3 min	**7.3 mm/min**	0.21 µm	0.94 µm	15 µm

4.2. Sample thickness 9.2 mm

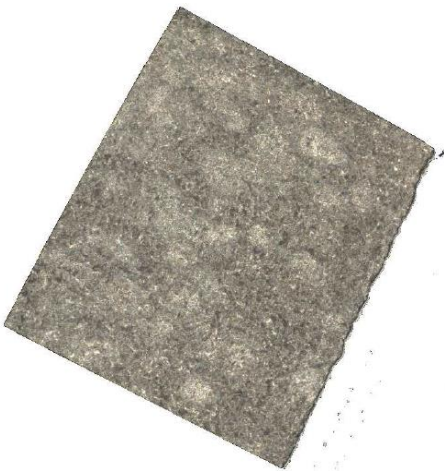


Figure 4: PCD surface.

Figure 5: PCD edge.

Cut duration	**Effective cutting speed**	*Ra*	*Rz*	Edge radius
8.0 min	**3.9 mm/min**	0.23 µm	0.95 µm	17 µm

5. CONCLUSION

The cutting of PCD on tungsten carbide cylinders has been performed with a 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 processing all kinds of tools with high quality.

These feasibility tests showed:

- The possibility to cut 5.2 and 9.3 mm thick PCD/WC samples;
- The cut quality even when the main purpose of the application was an optimization of the effective cutting speed;
- A process time of 4 minutes for the 4.3mm sample and 8 minutes for the 9.2mm sample.

With a 300W Trumpf green laser, we should be able to reduce the cutting time by a factor of two or three so that we should be able to achieve 1.0 to 1.3 minutes for the 5.2 mm thick parts, or 3.1 to 4.0 minutes for the 9.3 mm thick parts. This tool should be available soon in our application lab.

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