REPORT: Ceramic and Tungsten cutting by Laser-MicroJet®

For Anonymous

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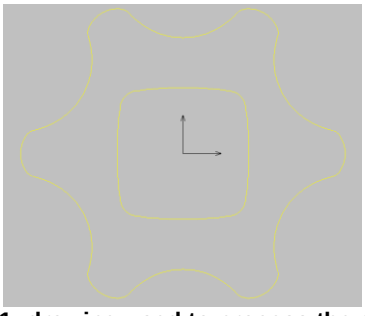
TASK

The Laser-MicroJet® technology has been tested for cutting ceramic and Tungsten samples. The main goal was to determine the feasibility of the process in order to give an overview of the technology.



Picture 1: drawing used to process the samples

Release of application report			
Project Leader		Responsible Application Group	
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Date:	01.04.2015	Date:	01.04.2015
Visum:	SDE	Visum:	BC

SAMPLE DESCRIPTION AND PREPARATION

The different samples were fixed with two clamps .

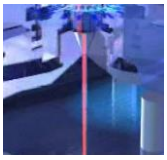
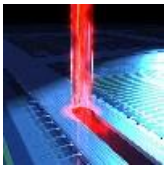
SAMPLE 1	Material	Ceramic
	Thickness	~2000 *µm*
	Quantity	3 *pcs*
SAMPLE 2	Material	Ceramic
	Thickness	~4000 *µm*
	Quantity	2 *pcs*
SAMPLE 3	Material	Hard metal (W)
	Thickness	~4000 *µm*
	Quantity	2 *pcs*

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.

In the table below, the machine configuration is summarized:

	**SYSTEM**	Machine type	DCS 300
		Helium flow (MFC)	*0.9 L/min*
		Working distance	*10 mm*
		Laser fiber	150 *µm*
		Collimator	200 *mm*
		Transmission	*~60 %*
	**MICROJET® PARAMETER**	Nozzle diameter	60 *µm*
		MicroJet® diameter	48 *µm*
		Water pressure	350 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L101G
		Wavelength	532 *nm*
		Pulse frequency	14 (sample 1) *kHz* 8 (sample 2&3)
		Average power	25 (sample 1&2) *W* 33 (sample 3)
		Pulse width	<200 *ns*
	**CUTTING PARAMETER**	Cutting speed	5 (sample 1&2) *mm/s* 3 (sample 3)
		Number of passes	30 (sample1) 50 (sample 2&3)

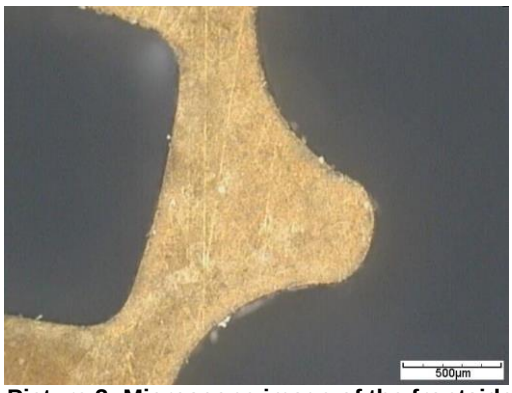
Process time	~2 (sample1) ~3 (sample2) ~5 (sample3)	*min*
Fixing system	Clamps	

RESULTS

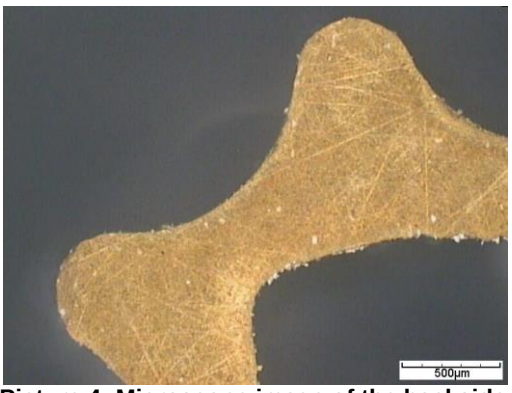
The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.

Picture 2: digital camera image of the 2 types of sample

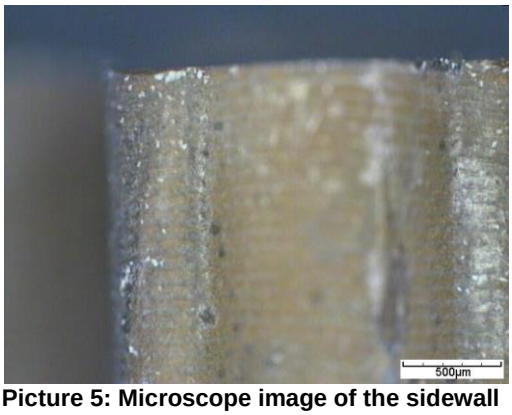
Sample 1



Picture 3: Microscope image of the frontside



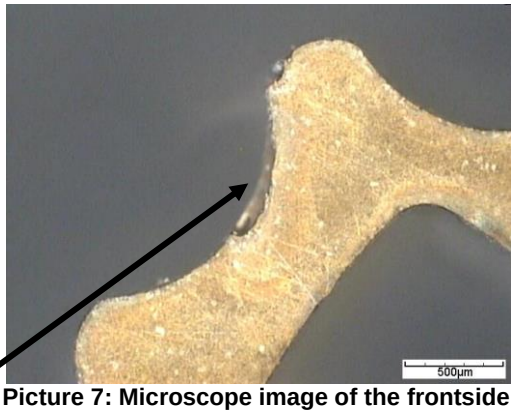
Picture 4: Microscope image of the backside



Picture 5: Microscope image of the sidewall

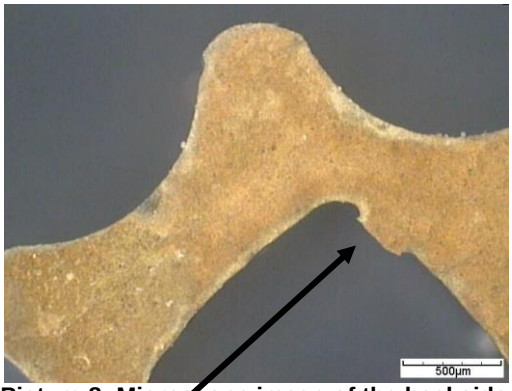
Sample 2

Picture 6: Microscope image of the frontside



Picture 7: Microscope image of the frontside

Sample is moving at the end of the process which leads to laser marks on the surface

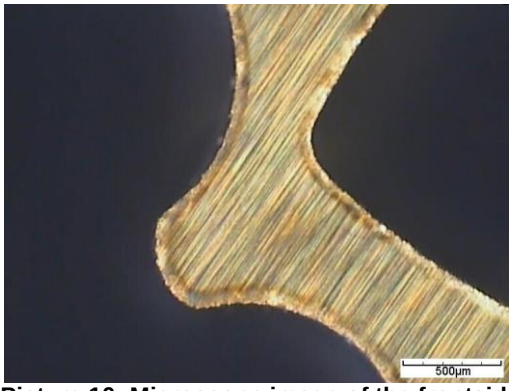


Picture 8: Microscope image of the backside

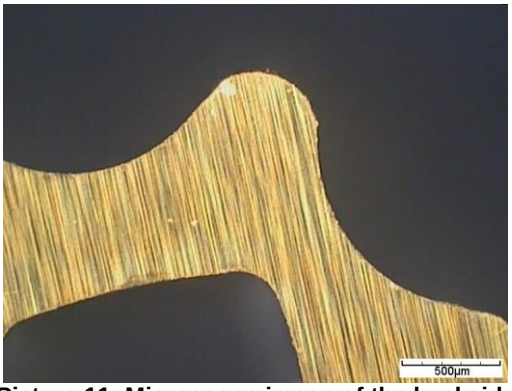
Picture 9: Microscope image of the sidewall

A small bridge is visible on backside. This can be avoided with a suitable holding system.

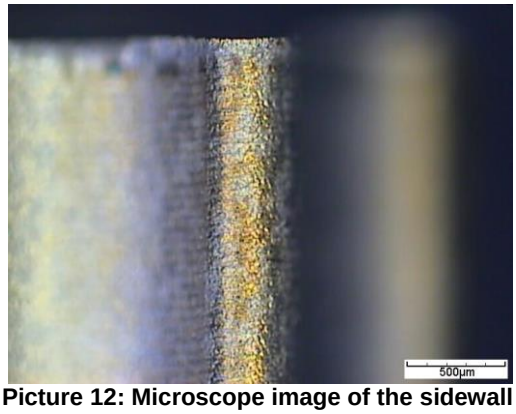
Sample 3



Picture 10: Microscope image of the frontside (some HAZ is visible)



Picture 11: Microscope image of the backside



Picture 12: Microscope image of the sidewall

CONCLUSION

The cutting of ceramic and Tungsten 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 allowing an excellent accuracy, advantages that are essential for cutting ceramic and Tungsten with high quality.

Preliminary tests show that it is possible to cut such materials with an excellent quality.
However some more developments are required to fine tune the results, in terms of quality to avoid laser marks and bridges (this will require to develop a suitable fixing system) and time of process.

We thank you for your interest in our technology and we hope 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.