REPORT: Ceramic cutting by Laser-MicroJet®

For Anonymous

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1. TASK

The Laser-MicroJet® technology has been tested for cutting lines and drilling small holes in ceramic materials. The main goal was to show the process capabilities and to give a first overview of the technology.

2. TASK DESCRIPTION

SAMPLE	Material	Ceramic (Al2O3)
	Thickness	635 *µm*
	Quantity	10 *pcs*

Release of application report			
Project Leader		Director of Applications Engineering	
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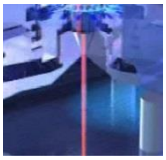
3. PROCESS: INSTRUMENT & TEST PARAMETERS

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 machine, allowing cutting and drilling any kind of materials.

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

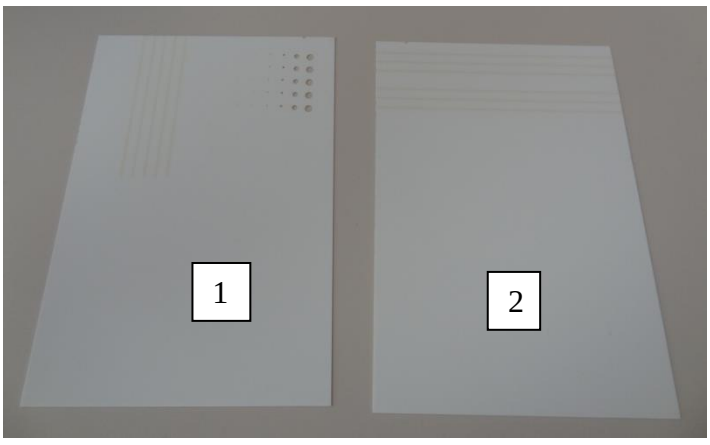
- Cutting of arbitrary shapes
- Low heat damage to the material

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

	**SYSTEM**	Machine type	LCS300
	**MICROJET PARAMETERS**	Nozzle diameter	40 *µm*
		MicroJet diameter	~32 *mm/s*
		Water pressure	350 *bar*
		Assist gas	He (0.9 *L/min*)

4. RESULTS

Two types of geometry (hole/line) were used to show the process capabilities. The following pictures give an overview on the quality obtained with the Laser-MicroJet technology.



PICTURE 1: Macroscopic view of the 2 samples

- **Holes**

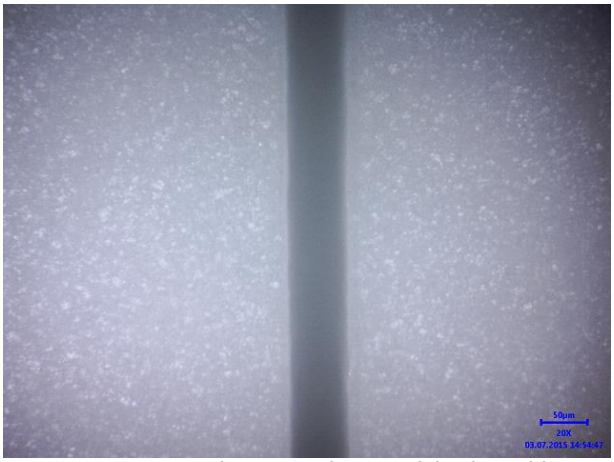
GEOMETRY DIAMETER		Hole ~3.5	Hole ~2.5	Hole ~1	Hole ~0.5	Hole ~0.3	Hole ~0.2	*mm*
LASER PARAMETERS	Frequency	10	10	*6*	*6*	*6*	*6*	*kHz*
	Pulse width	~140	~140	~140	~140	~140	~140	*ns*
	Power	13	13	*18*	*18*	*18*	*18*	*W*
	Power in jet	~6	~6	~6	~8	~8	~8	*W*
CUTTING PARAMETERS	Working distance	12	12	*12*	12	12	12	*mm*
	Motion speed	10	10	*10*	*10*	*8*	*8*	*mm/s*
	Pass numbers	110	110	*60*	*100*	*400*	*1200*	
	Process time	~120	~100	~60	*~25*	*~40*	*~100*	*s*

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

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

- **Lines**

GEOMETRY		Scribing 1st sample	Scribing 1st sample	Scribing 1st sample	Scribing 2nd sample	Scribing 2nd sample	*mm*
LASER PARAMETERS	Frequency	6	6	*6*	*6*	*6*	*kHz*
	Pulse width	~140	~140	~140	~140	~140	*ns*
	Power	19	19	*19*	*19*	*19*	*W*
	Power in jet	~8	~8	~8	~8	~8	*W*
CUTTING PARAMETERS	Working distance	12	12	*12*	12	12	*mm*
	Motion speed	20	20	*20*	*20*	*20*	*mm/s*
	Pass numbers	20	30	*40*	*40*	*60*	
	Process time	~90s	~132s	~180s	~5min	*~7min40*	



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

5. CONCLUSION

The cutting of Alumina material has been performed with a SYNOVA LCS 300. 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 cutting alumina with a high quality.

These tests show that:

- The quality of the cut is very good with limited heat affected zone
- Cutting speed can be improved by using more average power but the quality may suffer

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