REPORT: Drilling holes in aluminum by Laser-MicroJet®

for Anonymous

by Hyuk Kim; Synova JAPAN

TASK

The Laser-MicroJet® technology has been tested for drilling holes of aluminum samples.
The goal was to drill several holes with a size ranging from the smallest possible up to 100*µm* in diameter in any pattern that is convenient.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Aluminum G55-H38-MF
	Dimension	50X50 *mm*
	Thickness	430 *µm*
	Quantity	2 *pcs*

Release of application report			
Project Leader		Responsible Application Group	
Name:	Hyuk Kim	Name:	Dr Benjamin Carron
Date:	1/6/2012	Date:	15/6/2012
Visum:	HK	Visum:	BC

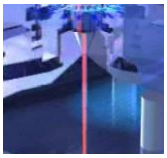
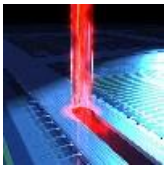
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LCS150 equipped with a frequency double Q-switch Nd:YAG laser has been used as the machine configuration in our lab.

Major advantages of Laser-MicroJet® technology with regards to hole drilling in aluminum are:

- Cutting of arbitrary shapes
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation
- Low surface contamination

In the table below, the optimized processing parameters used in the experiments are summarized:

	**SYSTEM**	Machine type	LCS150
	**MICROJET® PARAMETER**	Nozzle diameter	40 *µm*
		MicroJet® diameter	32 *µm*
		Water pressure	200 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L101G
		Wavelength	532 *nm*
		Pulse frequency	14 *kHz*
		Average power	15 *W*
	**CUTTING PARAMETER**	Cutting speed	5 *mm/s*
		Number of passes	15
		Overall speed	~21 *mm/min*
		Tape	Clamps

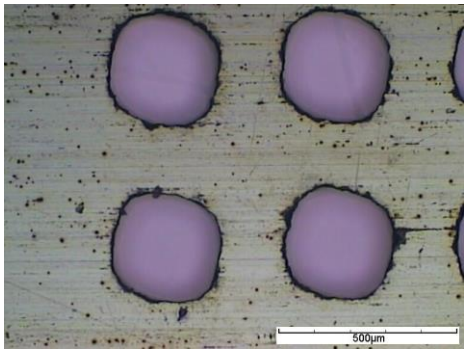
RESULTS

The different holes have been processed with the same cutting parameters.

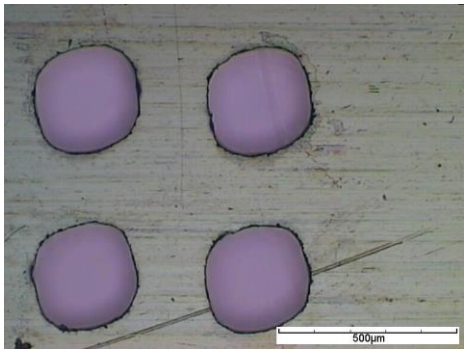
It was impossible to drill 100*µm* holes in diameter and the smallest hole was 300*µm* in diameter.

3 sets of 9 holes with diameters varying from 300*µm* to 500*µm* have been performed.

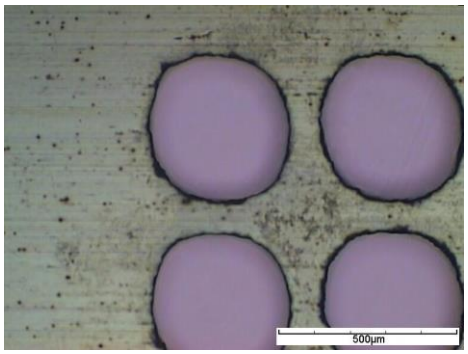
The following microscope picture give an overview on the quality obtained with the Laser-Microjet® technology.



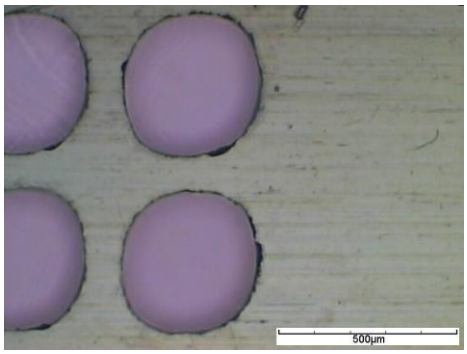
PICTURE 1: Microscope image of ϕ 300*µm*
(bright field illumination; front side view)



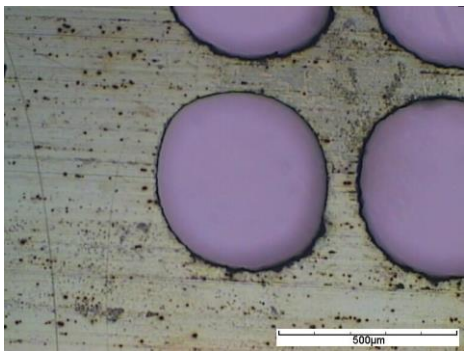
PICTURE 2: Microscope image of ϕ 300*µm*
(bright field illumination; back side view)



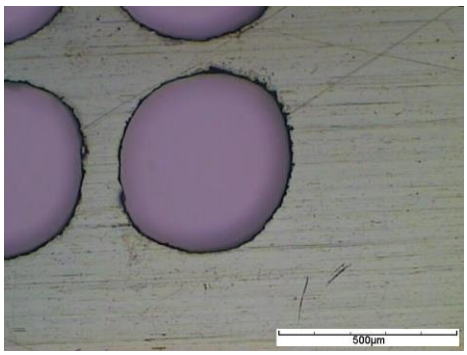
PICTURE ~~2~~3: Microscope image of ϕ 400*µm*
(bright field illumination; front side view)



PICTURE 4: Microscope image of ϕ 400*µm*
(bright field illumination; back side view)



PICTURE 5: Microscope image of ϕ 500*µm*
(bright field illumination; front side view)



PICTURE 6: Microscope image of ϕ 500*µm*
(bright field illumination; back side view)

The front side shows a good quality with limited chipping and heat-damage.
The back side quality is good as well.

- The table below summarizes the result.

	What are your priorities? (please put a cross)	Quantified expectations or improvements
• Speed / throughput:	2	2.7sec/hole(ϕ 300μm) 3.8sec/hole(ϕ 400μm) 4.8sec/hole(ϕ 500μm)
• Kerf-width:	1	The shapes of drilling holes were not good. Because this machine needs to be the axes tuning.
• Burr-free:	1	Yes
• Contamination/Particles:	1	No particle contamination has been observed
• Heat-damage free:	1	Negligible heat damage
• Chipping/Cracks:	1	Minimal chipping on both sides
• Edge Roughness:	1	The shapes of drilling holes were not good. Because this machine needs to be the axes tuning.
• Tolerances:	1	The shapes of drilling holes were not good. Because this machine needs to be the axes tuning.

- About the shapes of drilling holes

This machine that we used in this time for drilling holes needs to be the axes tuning.
That is the reason why the shapes of drilling holes were not good to compare with conventional holes.
The shape of drilling holes will be definitely improved after the axes tuning.

CONCLUSION

The Aluminum G55-H38-MF was investigated on SYNOVA LCS150. 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 drilling alumina with high quality.

These tests show that:

- Drilling ϕ 300μm diameter holes on 430μm thickness Aluminum sample is possible.
- The front side and back side quality is good with limited chipping and negligible heat damage.

- Shapes of the holes can also be improved with further tests by adjusting acceleration and speed parameters and also conducting the axes tuning of the machine.

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