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		Sample No:
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REPORT: 70 μm hole drilling in stainless steel using by Laser-MicroJet[®]

for Anonymous

By Andrew Chung, SYNOVA KOREA

TASK

The Laser-MicroJet[®] technology has been tested for 70 μm hole drilling of stainless steel materials. The target of the drilling test of a tolerance 70 $\mu\text{m} \pm 1 \mu\text{m}$ with edge roundness. Also, we have to minimized chipping and burrs for around the processed hole.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Stainless steel(STS304)
	Dimension	20 mm X20 mm
	Thickness	70 μm
	Quantity	7ea

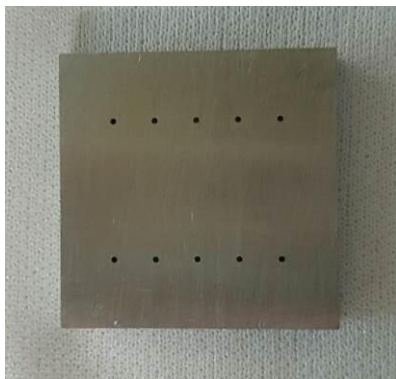


PHOTO 1: Digital camera image of the sample before processing.

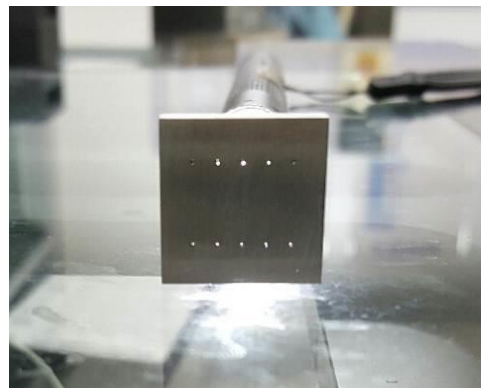


PHOTO 2: Digital camera image of the sample after processing.

The picture #1 is before the process and total samples thickness is 3.8mm as you see the picture. This sample was processed first as the type of a 400 μm holes by using a diamond tool to the depth of 3.73mm. Our job is to process a 70 μm hole on the center of a 400 μm hole.

Release of application report			
Project Leader		Responsible Application Group	
Name:	Andrew Chung	Name:	Benjamin Carron
Date:	22.12.2015	Date:	22.12.2015
Visum:	ACH	Visum:	BC

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PROCESS: INSTRUMENT & TEST PARAMETERS


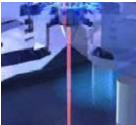

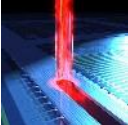
For these experiments, the LDS300 equipped with a frequency-double Q-switched Nd:YAG laser has been used as the machine configuration in our lab.

It is a manually clean-room compatible machine, allowing to cut, drill, groove, scribe, trench, mark, or grind wafers of any kind of semiconductor material.

Major advantages of Laser- Microjet[®] technology with regards to your application are:

- Cutting of arbitrary shapes
- No chipping on front side, minimal chipping on backside
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation

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

	SYSTEM	Machine type	LDS300
		Material	
	MICROJET[®] PARAMETER	Nozzle diameter	30 μm
		MicroJet [®] diameter	25 μm
		Water pressure	500 <i>bar</i>
		Assist gas	He
		working distance	20 <i>mm</i>
	LASER PARAMETER	Laser type	L51G
		Wavelength	532 <i>nm</i>
		Pulse frequency	13 <i>kHz</i>
		Pulse width	136 <i>ns</i>
		Average power	1.9 <i>W</i>
	CUTTING PARAMETER	Cutting speed	0.29 <i>mm/s</i>
		Number of passes	Depend on the sample thickness
		Overall speed	Depend on the sample thickness
		Sample fixation	clamped

In case of less than 100 μm holes processing, little bit stage movement. And water-jet could disturb the laser emission path. So large size hole could be easy.



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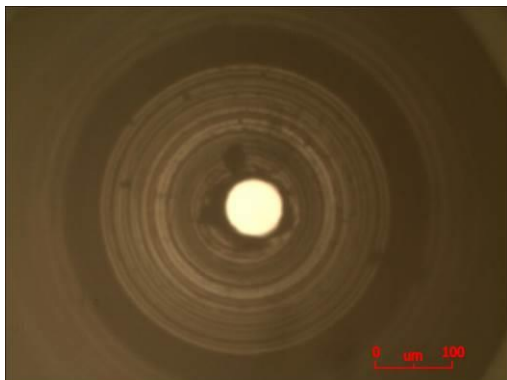
Report No: 1512-9

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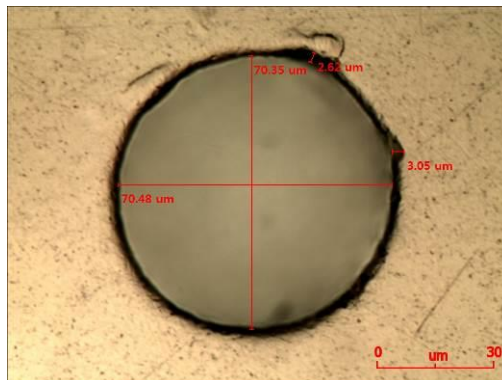
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• RESULTS

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



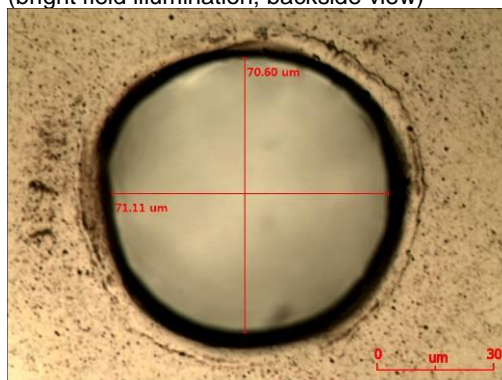
PICTURE 1: Microscope image of the drilling sample.
(bright field illumination; top view)



PICTURE 2: Microscope image of the drilling sample.
(bright field illumination; backside view)



PICTURE 3: Microscope image of the drilling sample.
(bright field illumination; top view)



PICTURE 4: Microscope image of the drilling sample.
(bright field illumination; backside view)



PICTURE 5: Microscope image of the drilling sample.
(bright field illumination; top view)



PICTURE 6: Microscope image of the drilling sample.
(bright field illumination; backside view)



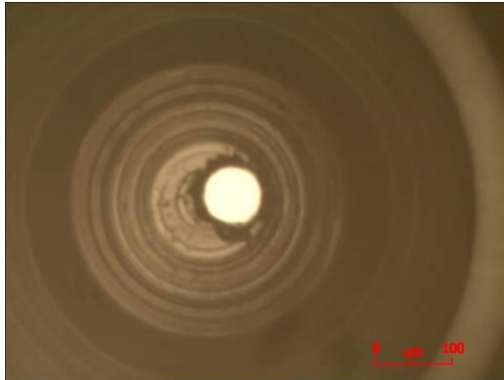
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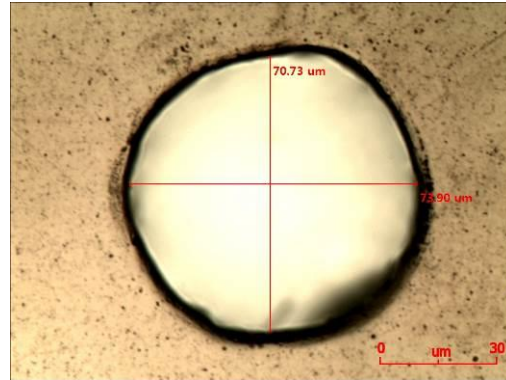
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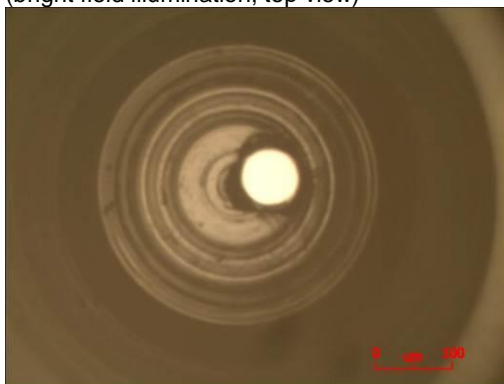
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PICTURE 7: Microscope image of the drilling sample.
(bright field illumination; top view)



PICTURE 8: Microscope image of the drilling sample.
(bright field illumination; backside view)



PICTURE 9: Microscope image of the drilling sample.
(bright field illumination; top view)



PICTURE 10: Microscope image of the drilling sample.
(bright field illumination; backside view)

The above pictures shows five holes straight processing after the alignment job. But a little off-center. Also, There are differences from the processing scan times. Maybe not regular thickness. This could make the difference of the processing form because we have to adjust the power and scan speed for the small hole processing.

CONCLUSION

The cutting of stainless steel samples were investigated on SYNOVA LDS300. 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 70 μm hole drilling of stainless steel with high quality.

The test results, we have the trouble finding the same processing conditions. And this made different hole size and shape quality of the holes. No reproducibility. High speed makes the rectangular hole, not round one. High power makes many chippings around the processed hole and could not meet 70 $\mu\text{m} \pm 1 \mu\text{m}$ hole size. This would be improved if the first processing from the customer makes better regular thickness.

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