REPORT: Sapphire wafer grooving by Laser-MicroJet®

for Anonymous

by Andrew Chung, Synova Korea

TASK

The Laser-MicroJet® technology has been tested for grooving ~140 µm thick sapphire wafer. Only half of a wafer has been processed to check the cutting quality. The next wafer can be scribed upon request.

SAMPLE DESCRIPTION AND PREPARATION

Release of application report			
Project Leader		Responsible Application Group	
Name:	Andrew Chung	Name:	Benjamin Carron
Date:	2015.04.10	Date:	2015.04.10
Visum:	ACH	Visum:	BC

SAMPLE	Material	Sapphire
	Dimension	50*25 *mm*
	Thickness	~140 *µm*
	Quantity	4 *pcs*

PROCESS: INSTRUMENT & TEST PARAMETERS

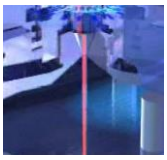
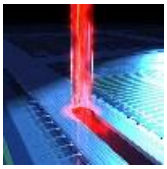
For these experiments, the LDS300 equipped with a with a frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab.

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

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

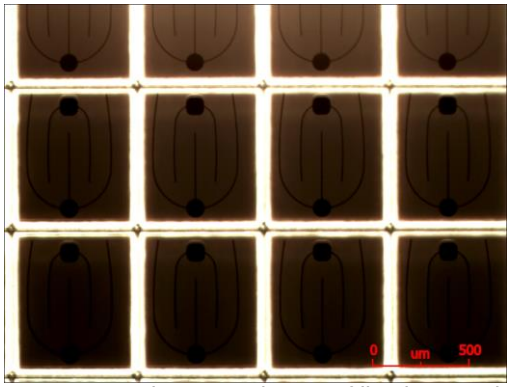
- Cutting of arbitrary shapes
- No chipping on front side, minimal chipping on backside
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation

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

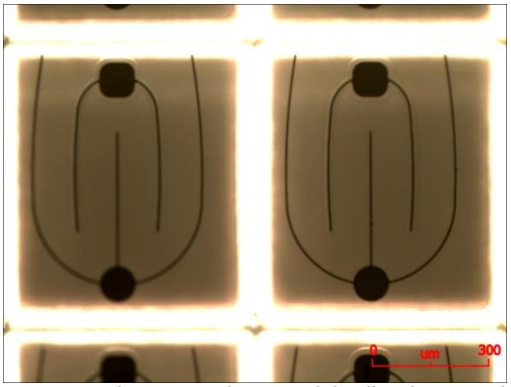
	**SYSTEM**	Machine type	LDS300
	**MICROJET® PARAMETER**	Nozzle diameter	30 *µm*
		MicroJet® diameter	24 *µm*
		Water pressure	250 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L51G
		Wavelength	532 *nm*
		Pulse frequency	6 *kHz*
		Average power	5.3 *W*
		Pulse width	~104 *ns*
	**CUTTING PARAMETER**	Cutting speed	10 *mm/s*
		Number of passes	4 *passes*
		Overall speed	2.5 *mm/s*
		Fixing system	clamps

Results

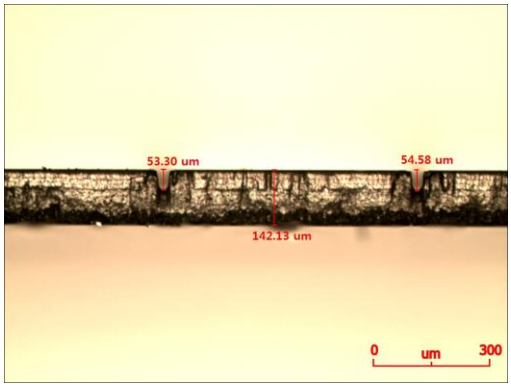
The following microscope pictures give an overview on the quality obtained with the laser micro-jet technology.



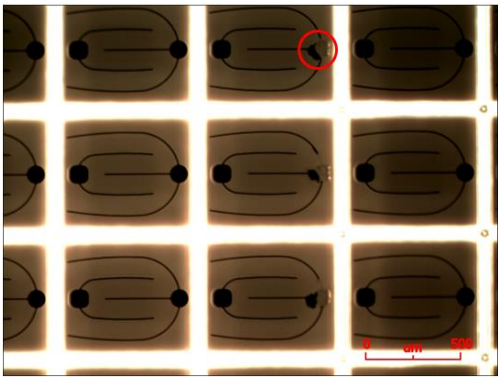
PICTURE 1: Microscope image of line intersection (dark field illumination)



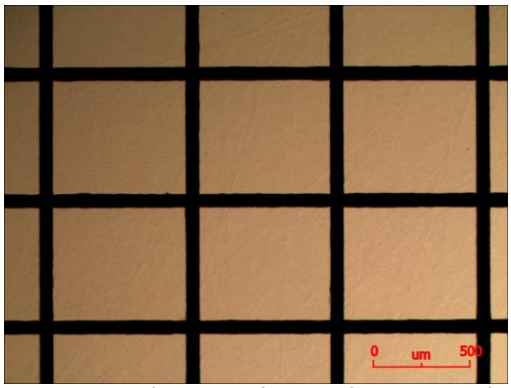
PICTURE 2: Microscope image of the line intersection at higher magnification. No chipping is visible. (dark field illumination).



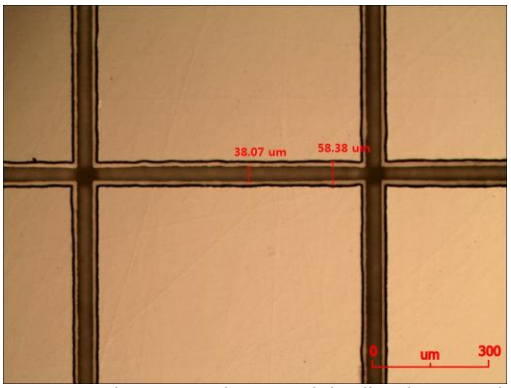
PICTURE 3: Microscope image of a cross section. (bright field illumination)



PICTURE 4: Microscope image of the front side. Some delamination is visible due to the processing. (dark field illumination)



PICTURE 3: Microscope image of a cross section. (bright field illumination)



PICTURE 4: Microscope image of the line intersection at higher magnification. The upper layer of the back side was composed of metal. (bright field illumination).

The table below summarizes Anonymous expectations and our results

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Speed / throughput:	X	2.5 mm/s
Kerf-width:	X	~60 µm
Heat-damage free:	X	No damaged
Chipping/Cracks:	X	No chipping on the frontside
Tolerances	X	Cutting depth ~50-60 µm according to our optical measurements
Other	V-groove capability	U-groove achievable (see cross section picture)

CONCLUSION

The grooving of sapphire wafer was investigated on SYNOVA LDS 300 machine. This machine is based on the MicroJet® technology and combines the advantages the high energy pulsed laser with a hair-thin water jet.

1. Excellent cut quality is achievable with no chipping on the backside and front side.

2. Kerf depth is deeper than requested even with the smallest nozzle currently available (60 µm instead of 50 µm)

3. Delamination on the pattern of the front-side happens partly.

4. The absorption factor of a green laser on the metal layer of the back side is high. So the processing kerf-width increases compare to sapphire. In case of sapphire, this one is 40 µm.

5. As process depth increases, more delamination occurs. Guessing that adhesive strength should improve.

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.