REPORT: Silicon wafer cutting by Laser-MicroJet®

for Anonymous

by Mr Stéphane Delahaye; Synova SA

TASK

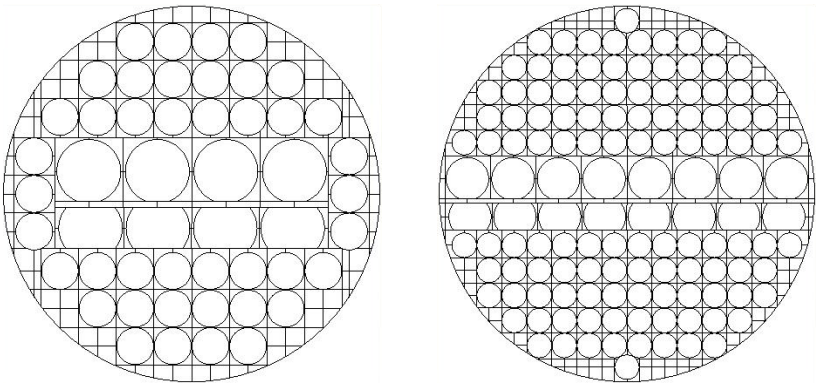
The Laser-MicroJet® technology has been tested for cutting silicon wafers.

SAMPLE DESCRIPTION AND PREPARATION

2 wafers were available for the tests.

SAMPLE 1	Material	Silicon and oxide layer
	Dimension	Ø 4 *inch*
	Thickness	435 *µm*
	Quantity	1 *pcs*
SAMPLE 2	Material	Silicon and oxide layer
	Dimension	Ø 6 *inch*
	Thickness	~480 *µm*
	Quantity	1 *pcs*

Release of application report			
Project Leader		Responsible Application Group	
Name:	Mr Stéphane Delahaye	Name:	Dr Benjamin Carron
Date:	04.04.2012	Date:	04.04.2012
Visum:		Visum:	



Picture 1: Drawings used for the cut

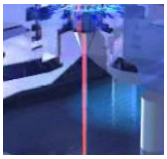
PROCESS: INSTRUMENT & TEST PARAMETERS

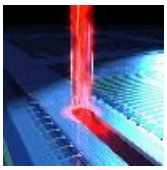
For these experiments, the LDS 200M equipped with a single cavity Nd:YAG laser has been used as the machine configuration in our lab.
It is a clean-room compatible machine, allowing to cut, drill, groove, scribe, trench, mark, or grind wafers of any kind of semiconductor material.

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

- Cutting of arbitrary shapes
- Minimal chipping on both sides
- Negligible heat damage to the material
- Negligible contamination / re-deposition
- Excellent wall surface quality

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

	**SYSTEM**	Machine type	LDS 200M
	**MICROJET® PARAMETER**	Nozzle diameter	50 *µm*
		MicroJet® diameter	40 *µm*
		Water pressure	300 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L51G
		Wavelength	532 *nm*
		Pulse frequency	15 *kHz*
		Average power	~23 *W*



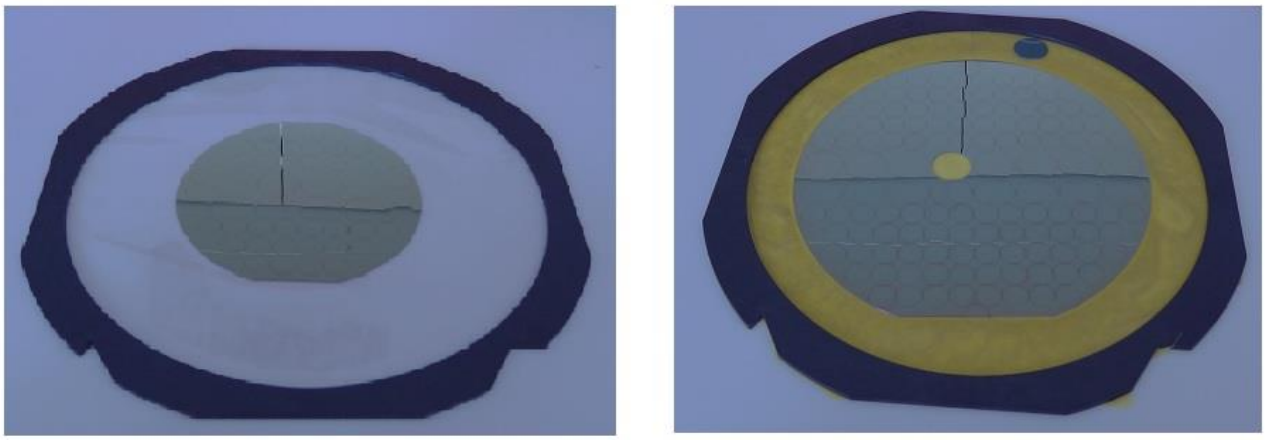
CUTTING PARAMETER

Cutting speed	100 *mm/s*
Number of passes	14 for 4 inch wafer 16 for 6 inch wafer
Overall speed	~7 *mm/s*
Tape	UV Tape: ADWILLD-611 and LaserTape®

Note: I voluntary increased the number of passes to avoid any bridges on the backside.

RESULTS

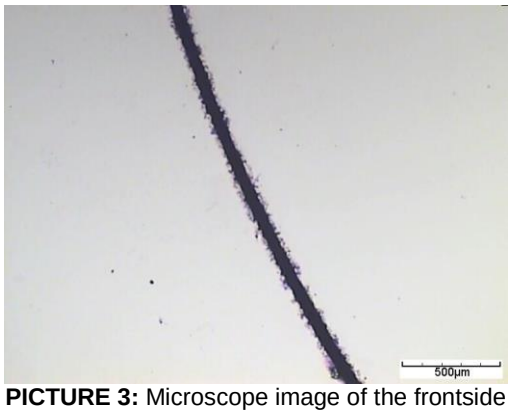
The two wafers have been processed with the same cutting parameters but different laser tapes. The goal was to avoid cracks (using porous laser tape) observed on the first wafer due to the accumulation of water between the laser tape and the silicon wafer during the cut.



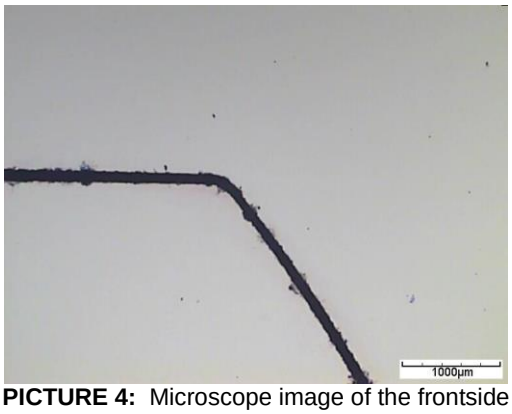
PICTURE 2: Digital camera image of the 2 wafers after cutting

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

- Sample 1: 4 inch wafer



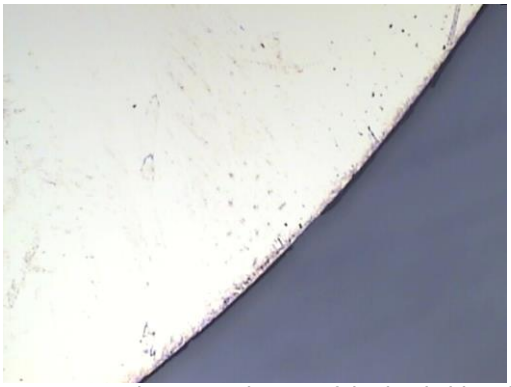
PICTURE 3: Microscope image of the frontside (bright field illumination)



PICTURE 4: Microscope image of the frontside (bright field illumination)

- Sample 2: 6 inch wafer

PICTURE 5: Microscope image of the frontside (bright field illumination)



PICTURE 6: Microscope image of the backside edge (bright field illumination)

The table below summarized Anonymous expectations and our results:

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Contamination/Particles:	X	Minimal contamination
Heat-damage free:	X	No heat affected zone
Chipping/Cracks:	X	Minimal chipping on both sides
Tolerances:	X	+/-10 um
Other:	X	Wafers have not been exposed to UV

CONCLUSION

The cutting of silicon wafers was investigated on SYNOVA LDS 200M. 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 silicon wafers with high quality.

These tests show:

- Various geometries can be cut and the overall quality is good with minimal chipping on both sides.
- Laser tape has been damaged but this issue can be fixed by reducing the number of passes.

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