REPORT: Silicon wafer cutting by Laser-MicroJet®

for Anonymous

by Stephane Delahaye; Synova SA

TASK

The Laser-MicroJet® technology has been tested for cutting silicon wafers.
The aim of this iteration is to give a first overview of the cutting quality and the process time according to the last drawings received.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE 1	Material	Silicon
	Dimension	Ø 300 *mm*
	Thickness	~800 *µm*
	Quantity	3 *pc*

Release of application report			
	Project Leader		Responsible Application Group
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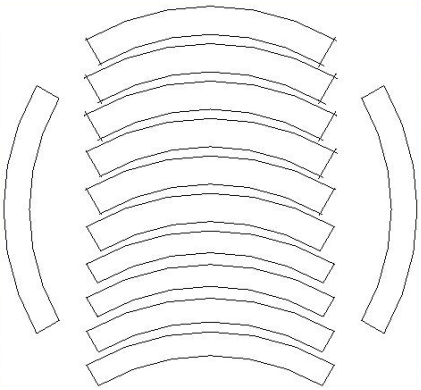
Date:	20.02.2013	Date:	20.02.2013
Visum:	SDE	Visum:	BC



Picture 1: Drawing representing the cutting path

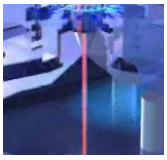
PROCESS: INSTRUMENT & TEST PARAMETERS

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	40 *µm*
		MicroJet® diameter	~32 *µm*
		Water pressure	400 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L51G
		Wavelength	532 *nm*
		Pulse frequency	20/40 *kHz*
		Average power	25/16 *W*

Please note that the wafers have been cleaned with acetone and ethanol after processing.

RESULTS

A two-step strategy was used to process the three wafers.

1. Grooving at high frequency and low average power to minimize pulse energy and limit chipping size and heat affected zone.
2. Cutting with standard parameters (higher pulse energy)

The tables below summarized the different cutting parameters.

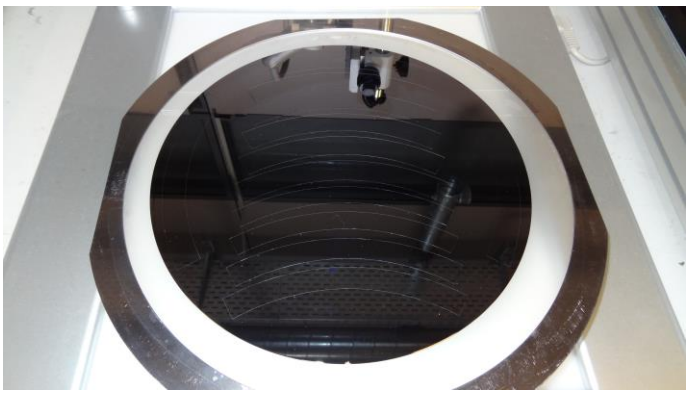
- **Wafer 1**

Laser type	L101G		
	Grooving	Cutting	
Nozzle diameter	40	40	
Pulse frequency	40	20	*kHz*
Average power	~14	~25	*W*
Cutting speed	100	80	*mm/s*
Number of passes	2	35	
Overall speed		*~2.3*	*mm/s*

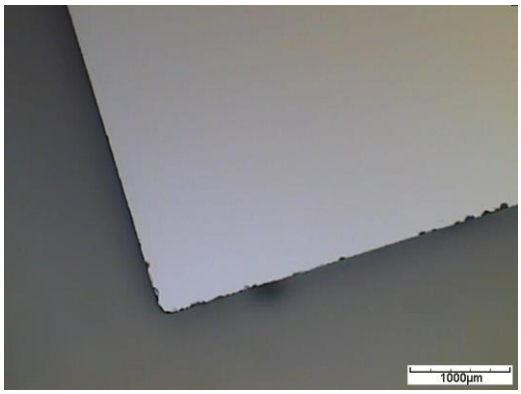
- **Wafer 2&3**

Laser type	L101G		
	Grooving	Cutting	
Nozzle diameter	40	40	
Pulse frequency	40	20	*kHz*
Average power	~14	~25	*W*
Cutting speed	100	100	*mm/s*
Number of passes	2	35	
Overall speed		*~2.7*	*mm/s*

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



Picture 1: Digital camera image of the sample



PICTURE 2: Microscope image of the front side magnification (dark field illumination)

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

Three wafers were shipped:
Wafer 1 (bare wafer) which can be used as spare. Indeed some bridges are visible on the backside. We suspect that the cutting speed parameters of the second step are not suitable for the geometry of the samples
Wafer 2 (bare wafer): fully cut.
Wafer 3 (whose the front side was already grooved with the previous drawing): fully cut

Finally as the loading/unloading of the wafers is manual on our available equipment stronger effort will be made to avoid any cracks on the wafers due to the handling.

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 that:

- Good quality is achievable on both sides with limited chipping size.
- Once produced wafers become very fragile. UV tape was used to prevent any breakage but handling/packaging require particular attention.

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