REPORT: Wafer dicing by Laser-MicroJet®

for Anonymous

by Stephane Delahaye, Synova SA

TASK

The goal was to give a first overview of the Laser-MicroJet® capabilities with a "short pulse laser".

The expectations were:

- Process different wafers
  - Thickness between 60 and 70 µm
  - Transparent oxide layer on the top
  - Without or with epoxy (~20 µm) in the street
  - 2 different die size
  - Remove the Taiko rim around the wafer
- Reach the dicing saw performances on these wafers
  - 100mm/s – this could be reduced if the quality is better than the saw, especially on very thin wafers (30 to 50 µm)
  - Maximum 20 µm chips on frontside
  - Maximum 10 µm chips on backside

Release of application report			
Project Leader		Responsible Application Group	
Name:	Stephane Delahaye	Name:	Benjamin Carron
Date:	2014.07.21	Date:	2014.07.21
Visum:	SDE	Visum:	BC

SAMPLE DESCRIPTION AND PREPARATION

4 wafers were available for the tests.

SAMPLE	Material	Silicon with transparent oxide and epoxy on the top
	Dimension	200 *mm*
	Thickness	~60-70 *µm*
	Quantity	4 *pcs*

PROCESS: INSTRUMENT & TEST PARAMETERS

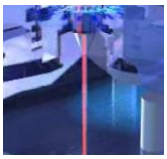
For these experiments, the LCS300 equipped with a short pulse laser has been used as the machine configuration in our lab.

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:

- Minimal chipping on front side
- Negligible heat damage to the material
- Negligible contamination / re-deposition

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

	**SYSTEM**	Machine type	LCS300
	**MICROJET® PARAMETER**	Nozzle diameter	40 *µm*
		MicroJet® diameter	~32 *µm*
		Water pressure	180 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	SP31G
		Wavelength	532 *nm*

RESULTS

1. Wafers without epoxy in the streets

First we focused on wafers without epoxy in the streets and investigate the following parameters (see excel data sheet already forwarded for more details):

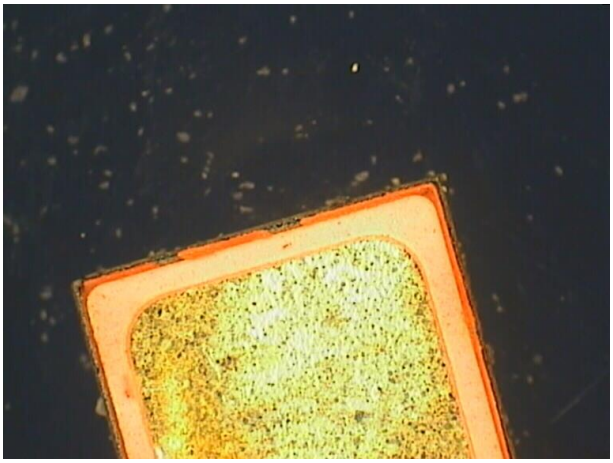
- Water pressure
- Nozzle size
- Laser parameters
- Process speed

to get the best cutting quality.

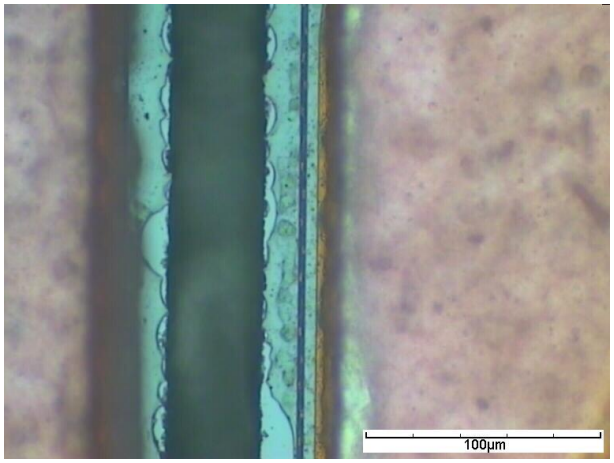
The following parameters have used for processing the samples

Pulse frequency	180	*kHz*
Average power	15	*W*
Pulse width	~30	*ns*
Cutting speed	100	*mm/s*
Number of passes	1	
Overall speed	100	*mm/s*

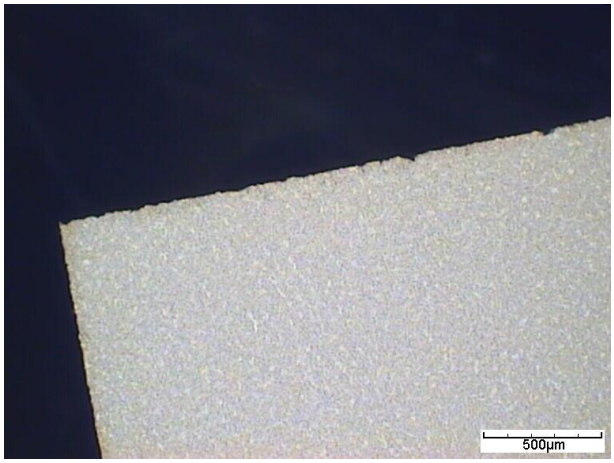
The following picture gives an overview on the quality obtained with the Laser MicroJet technology.



PICTURE 1: Die top. Some chipping is visible on the epoxy.



PICTURE 2: Microscope image of the frontside (dark field illumination)



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

The results we reached are similar to the saw, but not on the back side where the chipping is up to 30µm. The transparent oxide layer and the process speed are limiting our parameter's range.

2. Wafers with epoxy in the streets

Then wafers covered with epoxy even in the street were processed.

The following parameters have used for processing the samples

Pulse frequency	180	*kHz*
Average power	15	*W*
Pulse width	~30	*ns*
Cutting speed	100	*mm/s*
Number of passes	2	
Overall speed	50	*mm/s*

The epoxy did have some impact on the cutting process. We suspect it absorbs a big part of the laser energy before being effectively cut. Therefore 2 passes were now needed to cut clearly through it. The second pass, however necessary, affected the silicon edges, reducing the cut quality.

3. TAIKO rim removal

The following parameters have used for processing the samples

Pulse frequency	180	*kHz*
Average power	15	*W*
Pulse width	~30	*ns*
Cutting speed	100	*mm/s*
Number of passes	5	
Overall speed	20	*mm/s*

CONCLUSION

The dicing of silicon wafers was investigated on SYNOVA LCS 300 machine. This machine is based on the Laser-MicroJet® technology and combines the advantages the high energy pulsed laser with a hair-thin water jet.

These tests show that:

- Excellent front side cut quality through silicon (chipping typically 2 – 3 µm)
- Silicon oxide layer in the streets is transparent to the laser and chips away. Nevertheless it stops at the 'crack' stop ring in the street
- Some chipping is visible on the back side. Further development are required to improve cutting quality

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.