REPORT: Wafer dicing by Laser-MicroJet®

for Anonymous

by Stephane Delahaye, Synova SA

TASK

The Laser-MicroJet® technology has been tested for cutting ~250 µm thick silicon wafer with aluminum pads and silicon oxide on the top.
The goal of this iteration is to demonstrate the Laser-MicroJet® technology capabilities with a "short pulse" laser.

SAMPLE DESCRIPTION AND PREPARATION

Two wafers were available for the tests.

SAMPLE	Material	Silicon with Al Pads on the top
	Dimension	200 *mm*
	Thickness	~250 *µm*
	Quantity	2 *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:

Release of application report			
Project Leader		Responsible Application Group	
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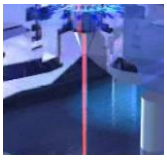
Date:	2014.07.21	Date:	2014.07.21
Visum:	SDE	Visum:	BC

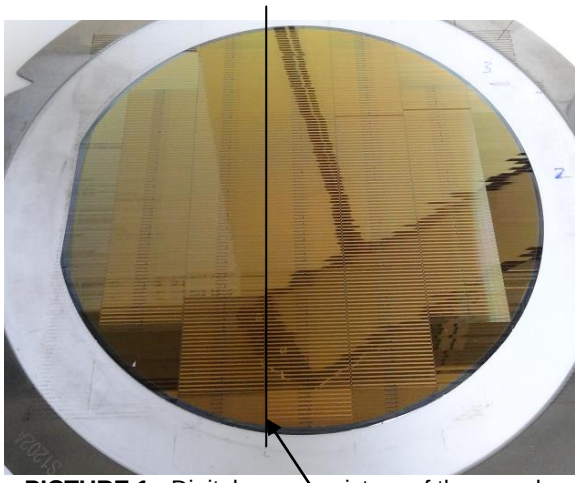
- Cutting of arbitrary shapes
- Minimal chipping on front side
- Negligible heat damage to the material
- Negligible contamination / re-deposition

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	260 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	SP31G
		Wavelength	532 *nm*

Results

Two wafers were available for the tests.



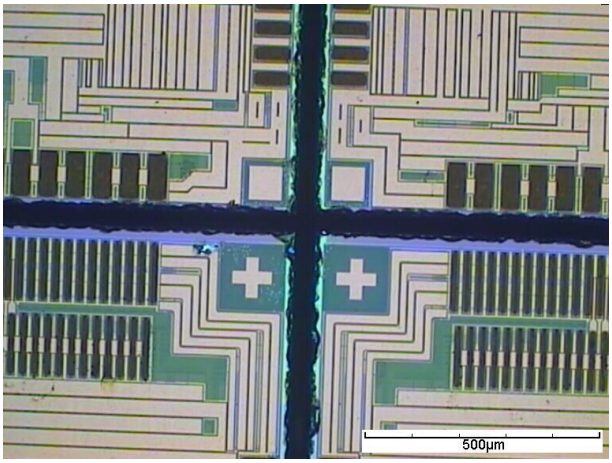
PICTURE 1: Digital camera picture of the sample

1. Wafer A

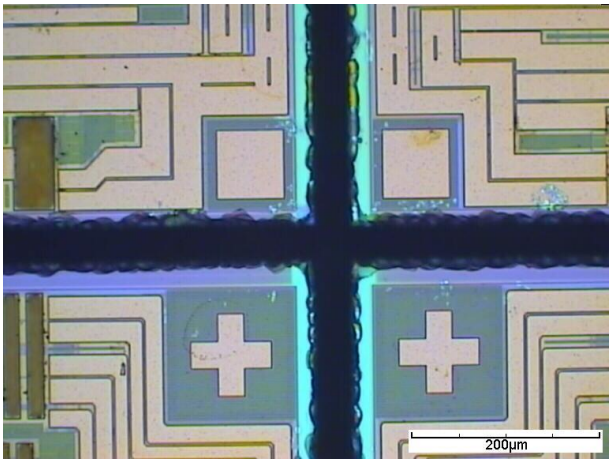
A few lines were scribed in order to optimize the cutting quality then the firs full wafer has been cut.

Pulse frequency	200	*kHz*
Average power	24 (12 into the water-jet)	*W*
Pulse width	~28	*ns*
Cutting speed	300	*mm/s*
Number of passes	15	
Overall speed	20	*mm/s*
Process time		*min*

The following microscope pictures give an overview on the quality obtained with the Laser MicroJet technology.



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



PICTURE 3: Microscope image of the street intersection at higher magnification (dark field illumination).

After this first run we noticed that some bridges were visible on the backside. So the cutting strategy has been changed to improve the water-jet stability:

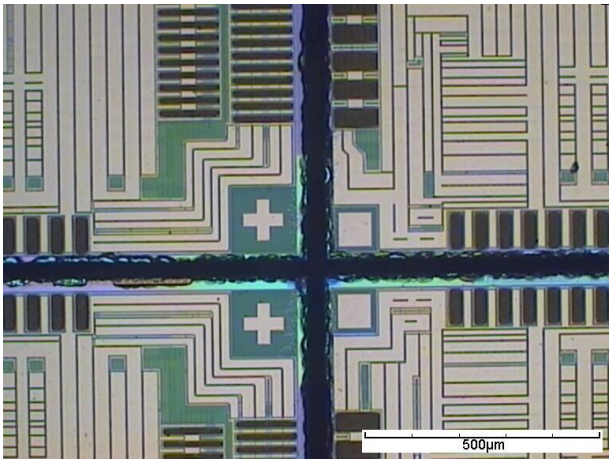
- Vertical lines were first cut
- Cutting speed was reduced

2. Wafer B

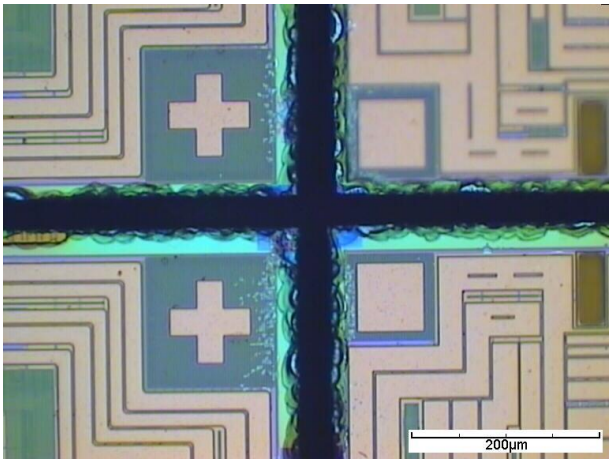
Wafer B has been split in 3 parts to work on three different sets of parameters to avoid any bridges on the backside.

Laser set	***1***	***2***	***3***	
Pulse frequency	*180*	*180*	*180*	*kHz*
Average power	*26*	*26*	*26*	*W*
Pulse width	*~28*	*~28*	*~28*	*ns*
Cutting speed	*280*	*250*	*220*	*mm/s*
Number of passes	*15*	*15*	*15*	
Overall speed	*18.7*	*16.7*	*14.7*	*mm/s*

Part 1

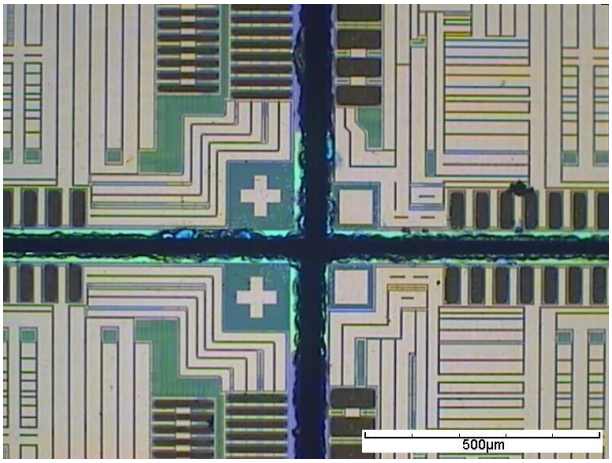


PICTURE 4: Microscope image of the street intersection (dark field illumination)

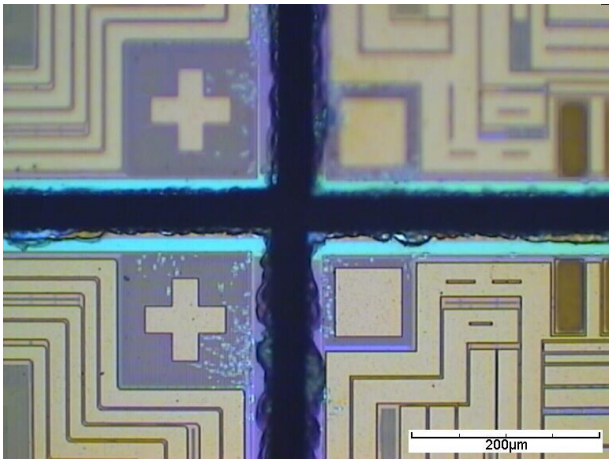


PICTURE 5: Microscope image of the street intersection at higher magnification (dark field illumination).

Part 2

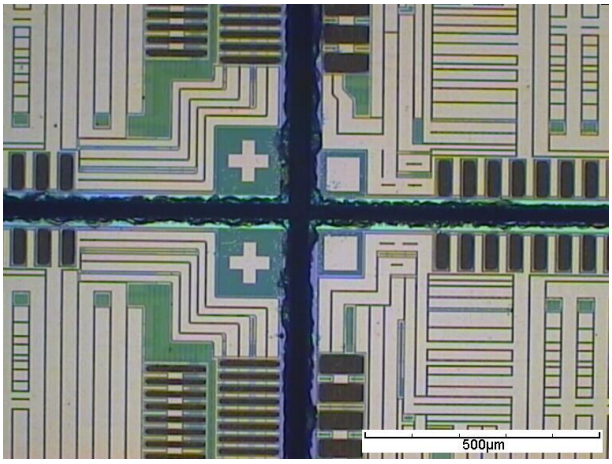


PICTURE 6: Microscope image of the street intersection (dark field illumination)

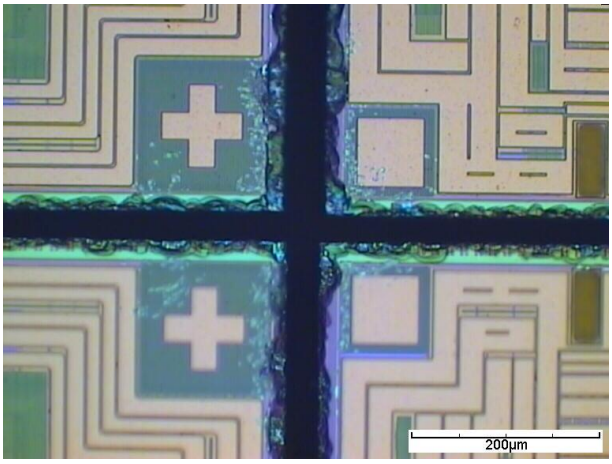


PICTURE 7: Microscope image of the street intersection at higher magnification (dark field illumination).

Part 3



PICTURE 8: Microscope image of the street intersection (dark field illumination)



PICTURE 9: Microscope image of the street intersection at higher magnification (dark field illumination).

The table below summarizes Anonymous expectations and our results

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Heat-damage free:	X	Limited heat damage visible
Chipping/Cracks:	X	Some chipping is visible on the frontside (~10-15 µm)
Contamination	X	No contamination is visible along the streets

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:

- Better cutting quality is achievable with high cutting speed
- Limited chipping is visible on the frontside

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.