REPORT:

Wafer Scribing by Laser-MicroJet® - Short Pulse Laser Tests

for Anonymous

by Samuel Obi, Synova SA

TASK

The Laser-MicroJet® technology has been tested for scribing the dicing lines of a silicon wafer.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Fully patterned silicon wafer
	Dimension	Ø300 *mm*
	Thickness	790 *µm*

Release of application report			
Project Leader		Responsible Application Group	
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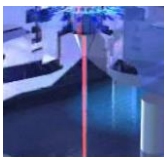
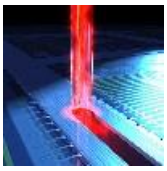
Date:	11.04.2012	Date:	
Visum:		Visum:	

PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LDS 200 M equipped with a very short pulse green laser has been selected as the most suitable machine configuration.
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 machining of silicon with high quality. It is a manually loaded clean-room compatible machine, allowing to cut, drill, groove, scribe, trench, mark, or grind wafers of any kind of semiconductor material.

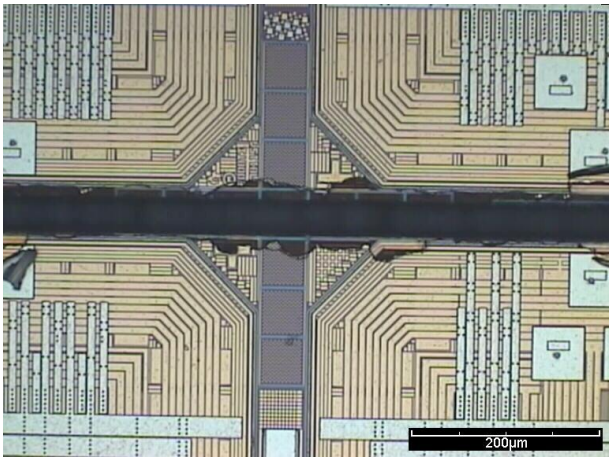
In the table below, the optimized processing parameters used in the experiments are summarized:

	**SYSTEM**	Machine type	LDS 200 M		
	**MICROJET® PARAMETER**	Nozzle diameter	40	30	*µm*
		Water pressure	200	400	*bar*
		Assist gas	He	He	
	**LASER PARAMETER**	Laser type	EO31G	EO31G	
		Wavelength	532	532	*nm*
		Pulse frequency	150	150	*kHz*
		Average power	24	20	*W*
	**CUTTING PARAMETER**	Cutting speed	80	80	*mm/s*
		Number of passes	1	1	

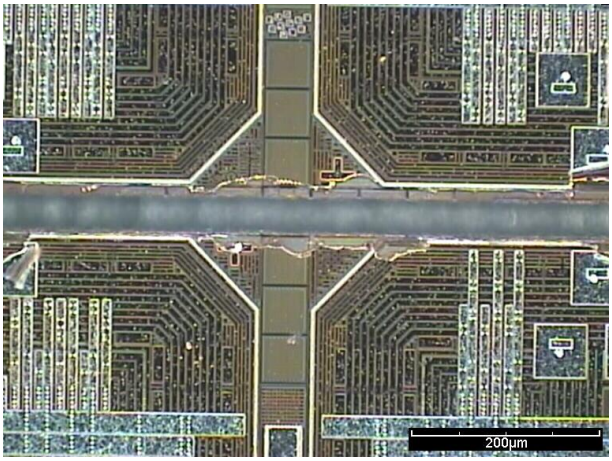
Two main settings have been tested:
- 40µm nozzle
- 30µm nozzle

RESULTS – 40 MICROMETER NOZZLE

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

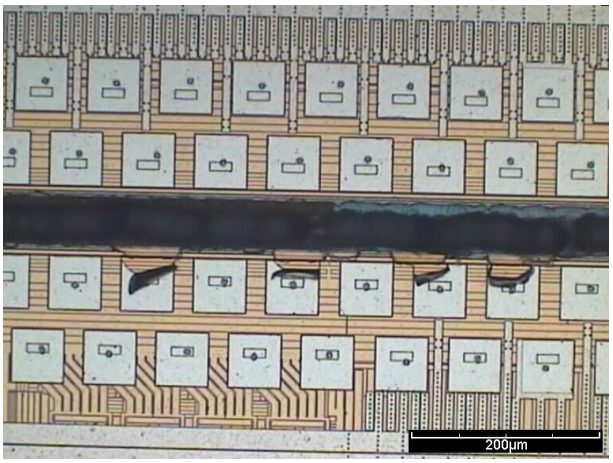


PICTURE 1-1: Microscope image of a line cut into the silicon wafer with the 40µm nozzle.
(bright field illumination)

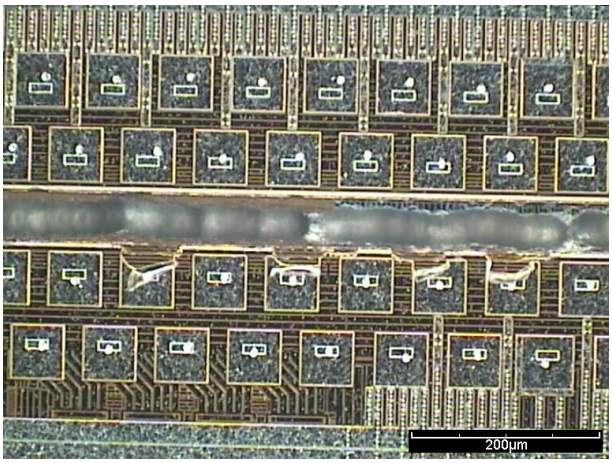


PICTURE 1-2: Microscope image of a line cut into the silicon wafer with the 40µm nozzle.
(dark field illumination)

The top coating on the silicon wafer is peeled away in some areas, especially at the dicing street intersections and close to contact pads (see below).



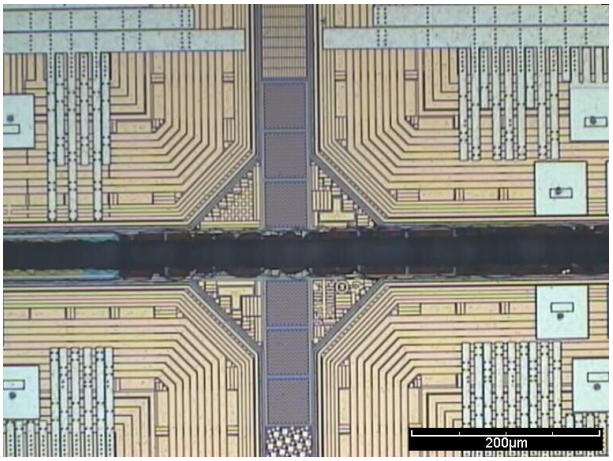
PICTURE 1-3: Microscope image of a line cut into the silicon wafer with the 40µm nozzle.
(bright field illumination)



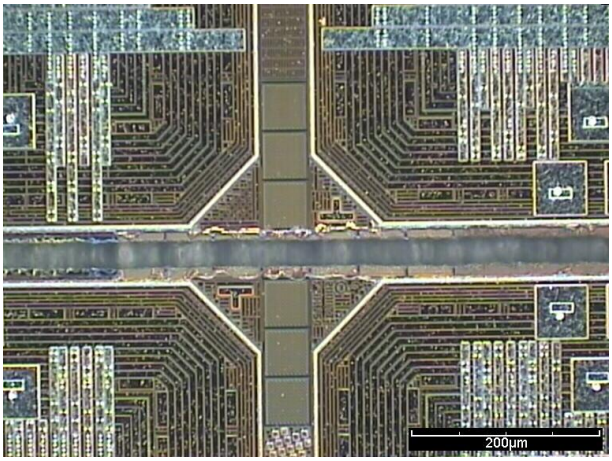
PICTURE 1-4: Microscope image of a line cut into the silicon wafer with the 40µm nozzle.
(dark field illumination)

RESULTS – 30 MICROMETER NOZZLE

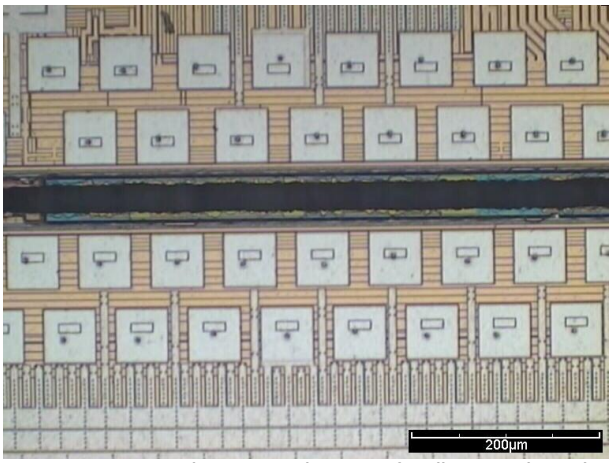
The goal of the tests with the diameter 30µm nozzle was to restrain the delamination inside the dicing street.



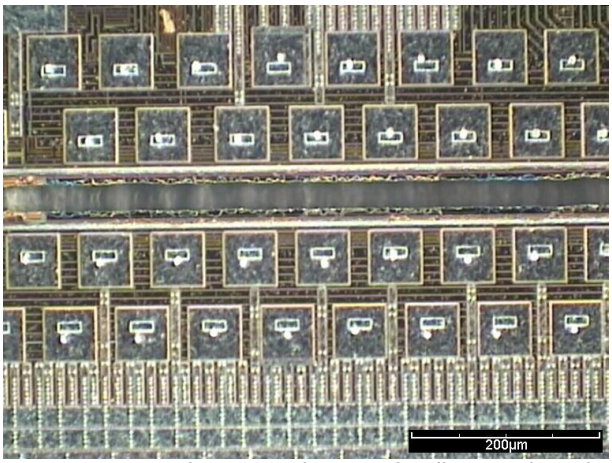
PICTURE 2-1: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(bright field illumination)



PICTURE 2-2: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(dark field illumination)

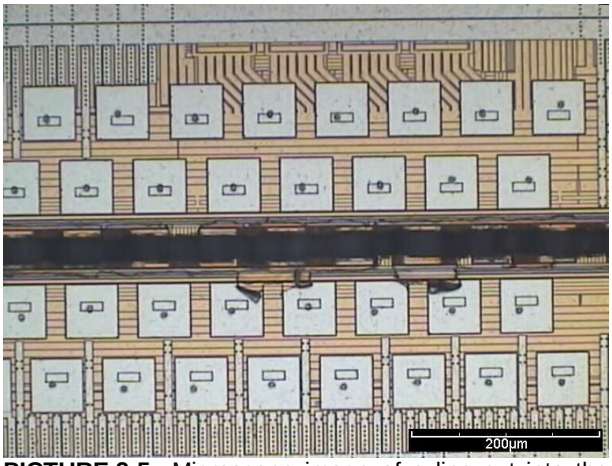


PICTURE 2-3: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(bright field illumination)

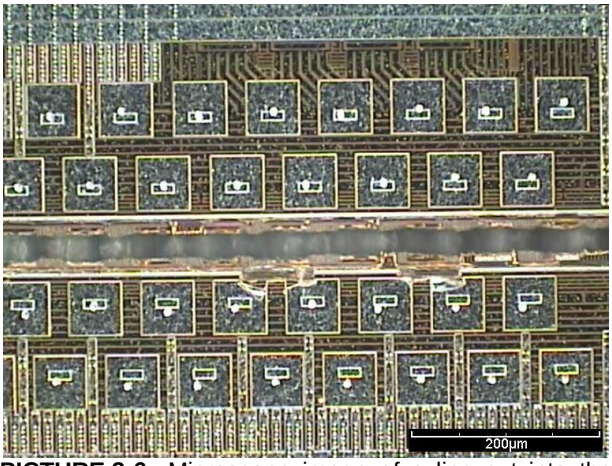


PICTURE 2-4: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(dark field illumination)

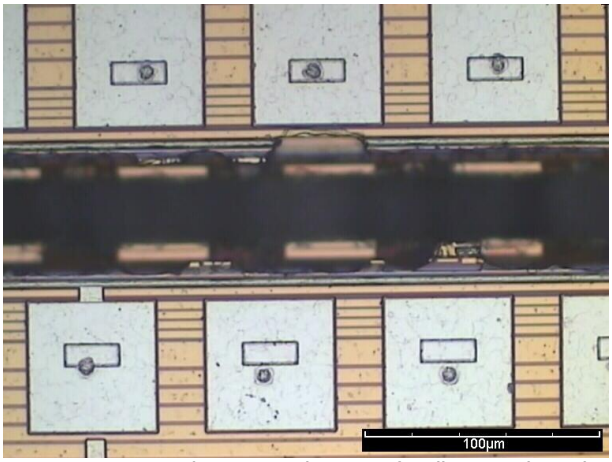
In general, there is less delamination occurring with the 30µm nozzle, but in some areas the top layer is also affected beyond the border of the dicing street (see below).



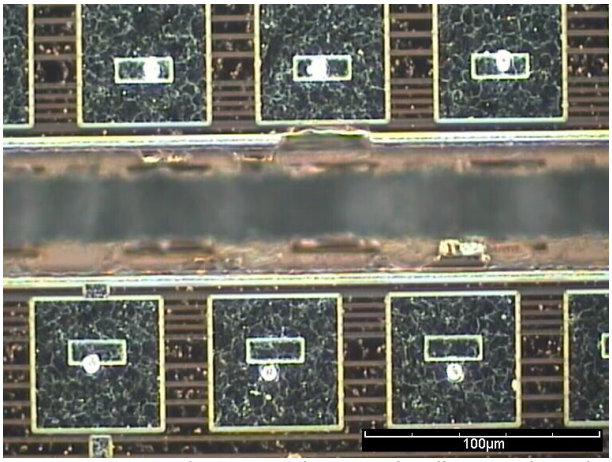
PICTURE 2-5: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(bright field illumination)



PICTURE 2-6: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(dark field illumination)



PICTURE 2-7: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(bright field illumination, zoom)



PICTURE 2-8: Microscope image of a line cut into the silicon wafer with the 30µm nozzle.
(dark field illumination, zoom)

CONCLUSION

The cutting of grooves into coated silicon wafers was investigated on the SYNOVA LDS 200M with a short pulse green laser.

The top layers of the coated wafer are not absorbing the laser radiation as well as the silicon underneath. During the cutting process, the evaporated material below will lift these top coating upwards with the consequence of delamination. Some areas are less prone to delamination than others and with a smaller nozzle the effect can be reduced. However, the problem still persists in all settings that have been tested.

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