REPORT: Taiko ring removal and dicing of thin silicon wafers by Laser-MicroJet®

for Anonymous

by Mr Stephane Delahaye; Synova SA

TASK

The Laser-MicroJet® technology has been tested for dicing and downsizing of 50 µm thick silicon wafers.

This application is a pilot run testing for ring removal and the target is to facilitate the die-picking process.

The challenge is clearly when the Taiko Ring is still on the tape, the tape can't be stretched and the dice can't be picked up. For this reason several scenarios are possible.

1. Cut the ring into pieces equal to the die-size
2. Cut the ring into 4 or 8 pieces, so we can stretch the tape and hopefully the dice can be picked.
3. Don't cut the ring (only edge grind) and remove it manually.

Feasibility of option 3 was tried and 2 wafers have been processed.
(downsized with a diameter of 138 and 140.1 mm and diced using a 1.98mm X 1.98mm grid)

Release of application report			
Project Leader		Responsible Application Group	
Name:	Stephane Delahaye	Name:	Dr Benjamin Carron
Date:	20.08.2012	Date:	20.08.2012
Visum:	SDE	Visum:	MM

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Silicon
	Dimension	~Ø 150 *mm*
	Thickness	Si substrate: 50 *µm* Si Taiko ring around wafer: 500
	Quantity	2 *pcs*

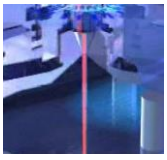
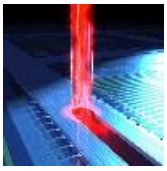
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LDS 200M equipped with a frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab.
It is a manually loaded 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:

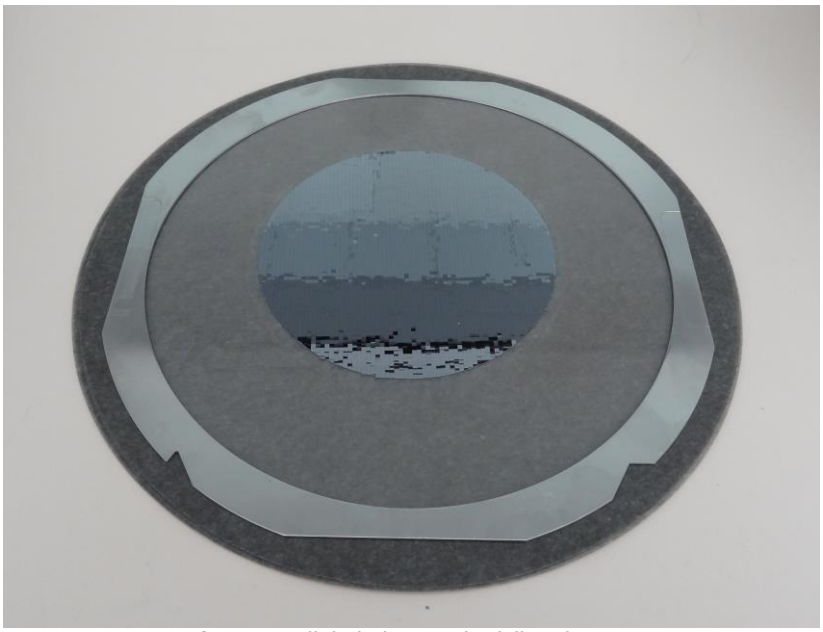
- No chipping on front side, minimal chipping on backside
- Negligible heat damage to the material
- Negligible contamination / re-deposition
- Very good wall surface quality
- Advantageous process rates

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

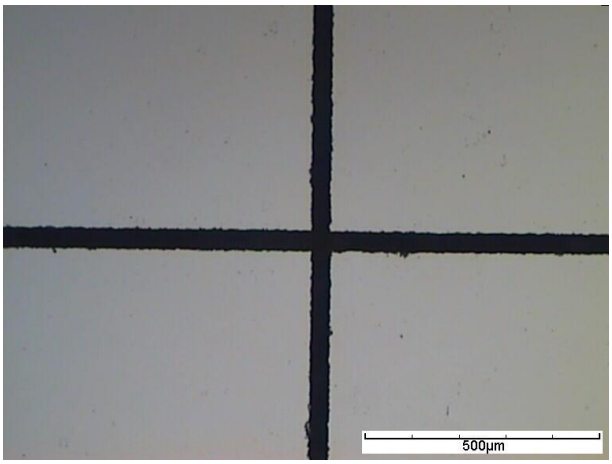
	**SYSTEM**	Machine type	LDS 200
	**MICROJET® PARAMETER**	Nozzle diameter	40 *µm*
		MicroJet® diameter	32 *µm*
		Water pressure	200 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	EO21G
		Wavelength	532 *nm*
		Pulse frequency	300 *kHz*
		Average power	Downsizing ~12 *W* Dicing ~12
		Pulse width	~26 *ns*
	**CUTTING PARAMETER**	Cutting speed	Downsizing: 120 *mm/s* Dicing: 80
		Number of passes	Downsizing: 3 Dicing: 2
		Overall speed	Downsizing: 40 *mm/s* Dicing: 40
		Tape	Adwill D-611

RESULTS

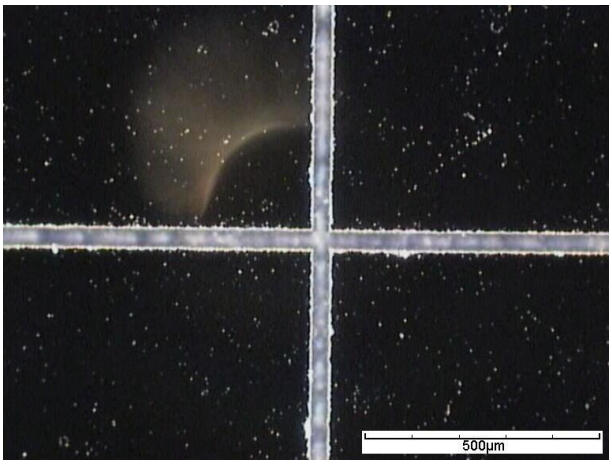
The following microscope picture give an overview on the quality obtained with the Laser-Microjet® technology.



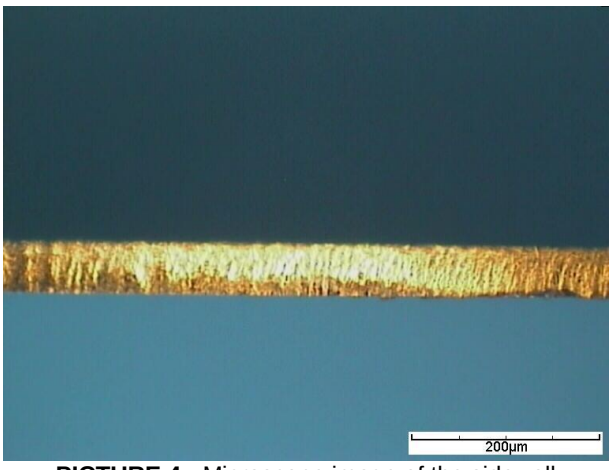
Picture 1: digital picture of a full wafer



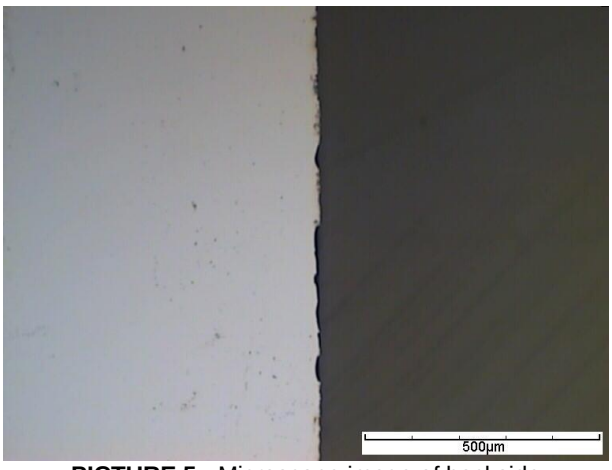
PICTURE 2: Microscope image of the fronside (bright field illumination)



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



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



PICTURE 5: Microscope image of backside (bright field illumination)

Note: to avoid any breakage of the wafers no specific cleaning was used. The wafers were only rinsed with DI water.

The table below summarises Anonymous expectations and our results.

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Depth control:	X	Tape was not damaged
Chipping/Cracks:	X	Very limited on the backside

CONCLUSION

The dicing and downsizing of thin 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 dicing and downsizing of thin silicon wafers with high quality.

These tests show the feasibility of Taiko ring removal.

- Two different diameters were used for downsizing to see if a smaller diameter (wafer2) can facilitate the Taiko ring removal. It has been found that option 3 is feasible but dicing should start into the wafer or in the middle of the Taiko ring to avoid any breakage when the ring is removed.

- Cutting quality is very good with minimal backside chipping.

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.