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APPLICATION REPORT

Report No: 135-6
Sample No:

CONFIDENTIAL

REPORT: Wafer dicing by Laser-MicroJet®

for Anonymous

by Mr Stéphane Delahaye; Synova SA

TASK

The goal of this study is to show the potential of the LMJ technology for cutting silicon and black molding wafers and to give a review of the different options available.

SAMPLE DESCRIPTION AND PREPARATION

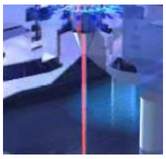
SAMPLE	Material	Silicon and black material
	Dimension	Ø 300 *mm*
	Thickness	330 *µm*
	Quantity	2 *pcs*

Release of application report			
Project Leader		Responsible Application Group	
Name:	Mr Stephane Delahaye	Name:	Dr Benjamin Carron
Date:	22.05.2013	Date:	22.05.2013
Visum:	SDE	Visum:	

PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LDS 200M equipped with a short pulse laser has been used as the machine configuration in our lab.

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

	**SYSTEM**	Machine type	LDS 200M	
	**MICROJET® PARAMETER**	Nozzle diameter	40(L101G and EO60G)/30(EO21G)	*µm*
		MicroJet® diameter	~32/24	*µm*
		Water pressure	150	*bar*
		Assist gas	He	

RESULTS

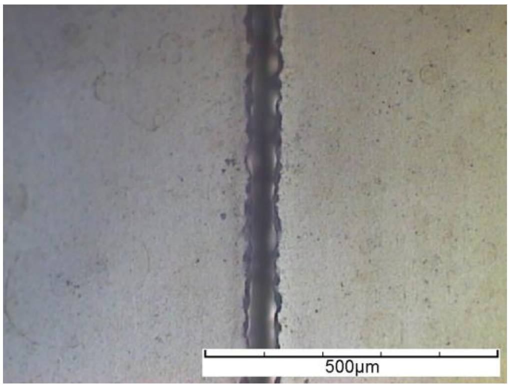
As already mentioned the highest priority was to optimize the process to get the best cutting quality.

L101G

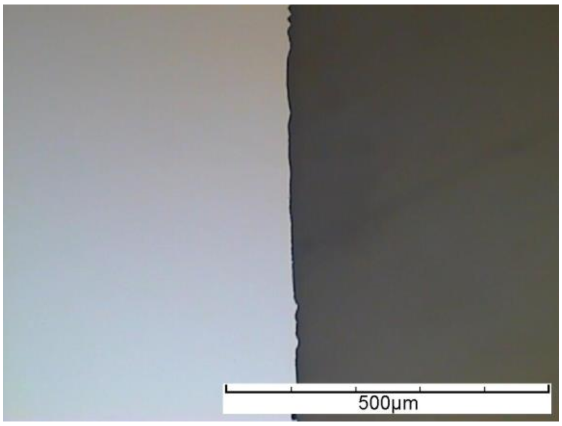
Strategy	A	B	C	E	
Pulse frequency	40	40	40	40	*kHz*
Average power	~10	~10	~10	~16	*W*
Average power (Into water jet)	~4.5	5	5	8	*W*
Cutting speed	100	100	200	100	*mm/s*
Pulse width	~300	~120	~120	~120	*ns*
Number of passes	14	18	36	14	
Overall speed	*~7*	*~5.6*	*~5.6*	*~7*	*mm/s*

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

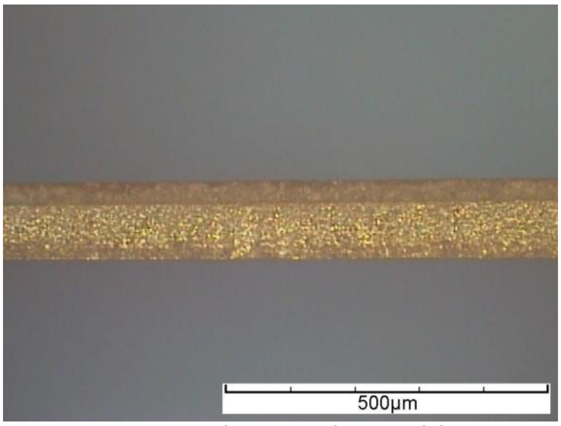
Strategy A



PICTURE 1: Microscope image of the cut (top view)

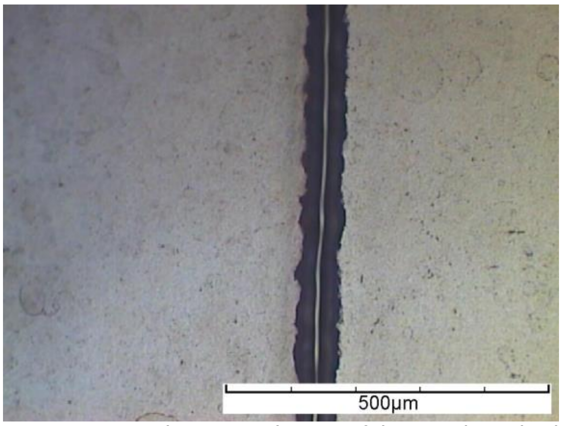


PICTURE 2: Microscope image of the cut (sidewall view)

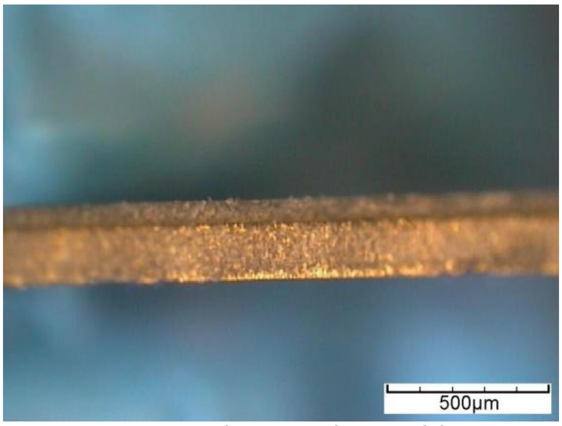


PICTURE 3: Microscope image of the cut (backside view)

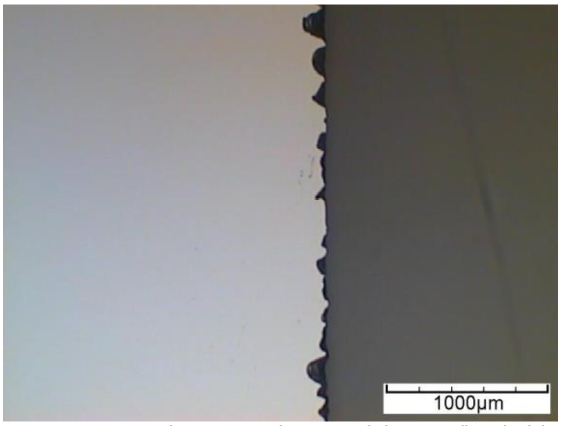
Strategy B



PICTURE 4: Microscope image of the cut (top view)

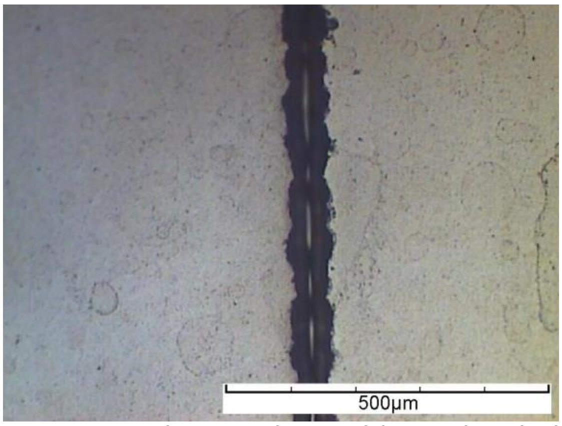


PICTURE 5: Microscope image of the cut (sidewall view)

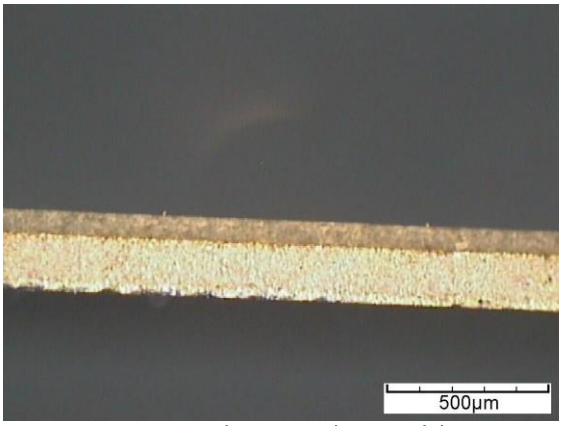


PICTURE 6: Microscope image of the cut (backside view)

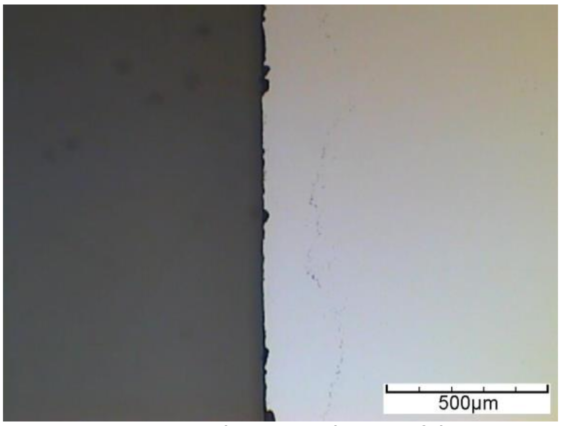
Strategy C



PICTURE 7: Microscope image of the cut (top view)

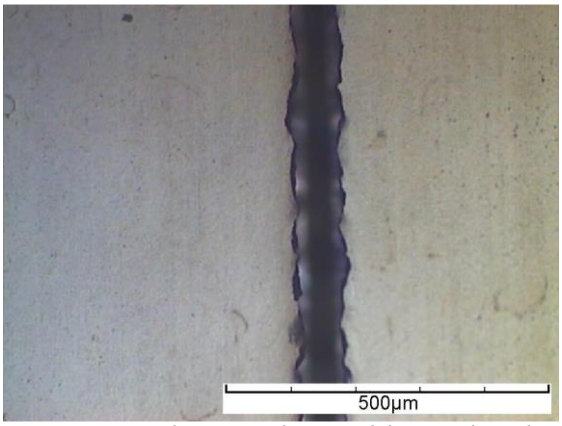


PICTURE 8: Microscope image of the cut (sidewall view)

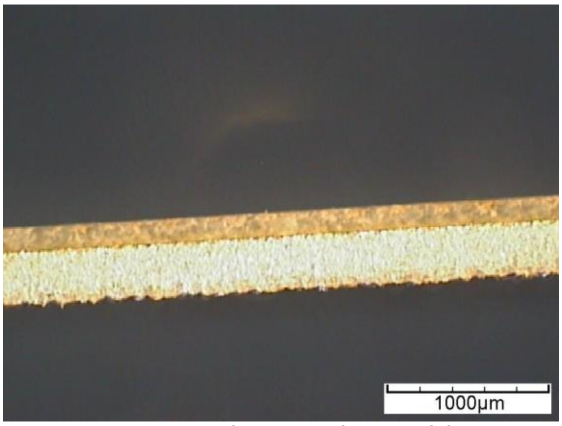


PICTURE 9: Microscope image of the cut (backside view)

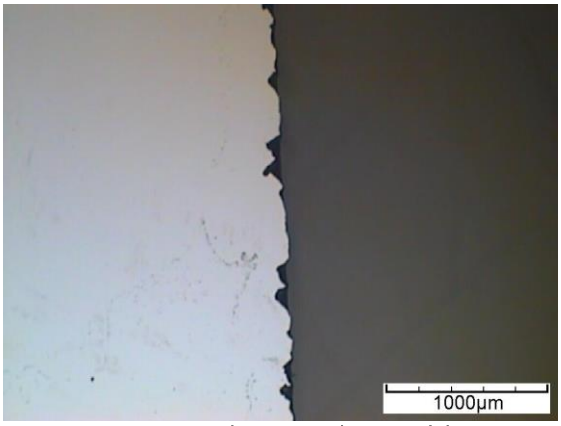
Strategy E



PICTURE 13: Microscope image of the cut (top view)



PICTURE 14: Microscope image of the cut (sidewall view)



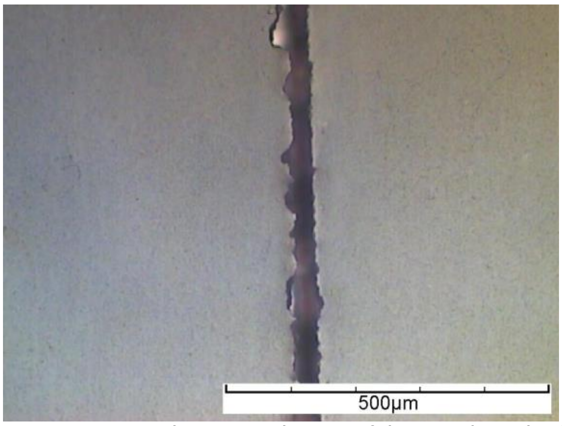
PICTURE 15: Microscope image of the cut (backside view)

EO21G/EO60G

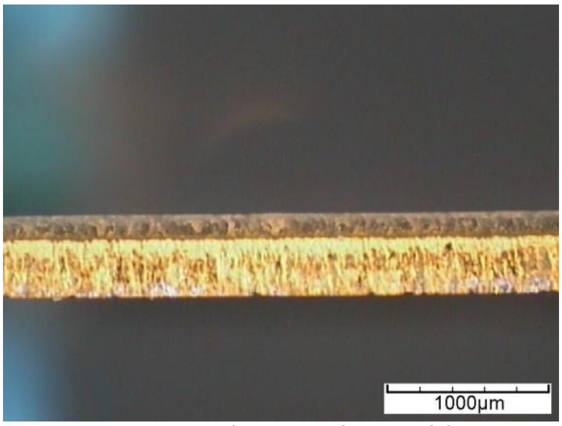
Strategy	G	K	
Laser type	EO21G	EO60G	
	Cutting	Cutting	
Pulse frequency	250	250	*kHz*
Average power	~14	~15	*W*
Average power (Into water jet)	~9	10	*W*
Cutting speed	100	100	*mm/s*
Pulse width	~25	~25	*ns*
Number of passes	16	18	
Overall speed	*~6.3*	*~5.6*	*mm/s*

Note: sample G has been processed with higher fluence because the nozzle size was smaller.

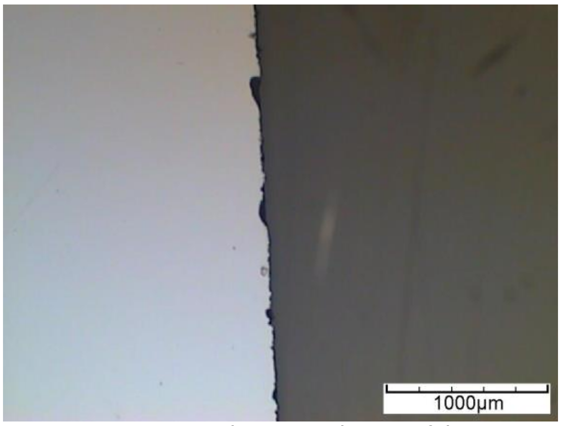
Strategy G



PICTURE 13: Microscope image of the cut (top view)

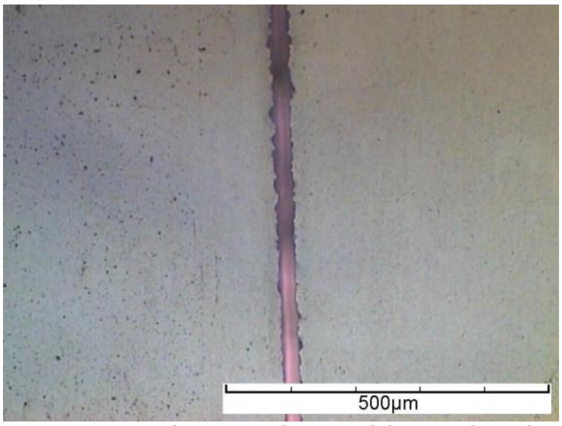


PICTURE 14: Microscope image of the cut (sidewall view)

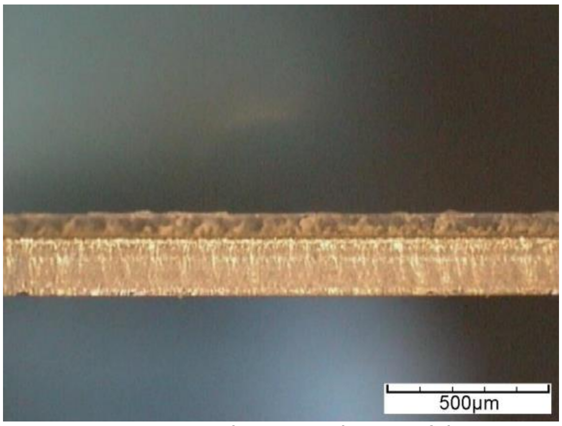


PICTURE 14: Microscope image of the cut (backside view))

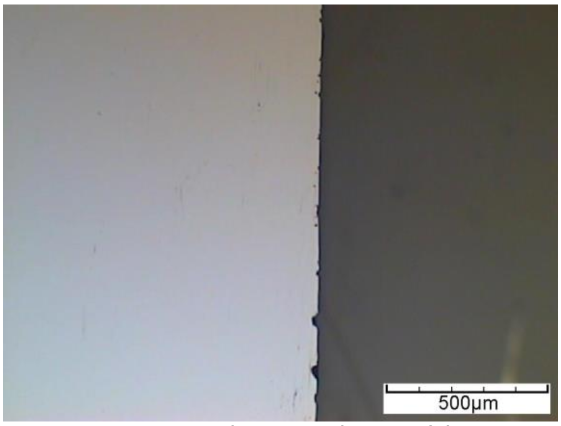
Strategy K



PICTURE 13: Microscope image of the cut (top view)



PICTURE 14: Microscope image of the cut (sidewall view)



PICTURE 14: Microscope image of the cut (backside view))

CONCLUSION

Thin silicon wafers (<100µm)

- EO21G and EO60G give the best results. 3 passes are necessary with EO21G and 2 passes with EO60G.
- Low Pressure and low fluence are very important to limit the chipping and delamination of the mold compound.
- 80-100 mm/s seems to be the optimal range cutting speed.

Black molding wafers (~300µm)

- High cutting quality with minimal chipping on backside and smooth cut walls are achieved with high frequency and low fluence.

- 80-100 mm/s seems to be the optimal range cutting speed.

- L101G: does not have any thickness limitation but do not give the best cutting quality. Backside chipping may be reduced with further tests.

- EO21G: Our current version doesn't not allow to cut through because the threshold fluence which is necessary for cutting materials whose the thickness is >100µm is too high.

- EO60G: our current version has more average power (~50 instead of ~18W), longer pulse width (~28 instead of 15-18ns) and lower frequency (250 instead of 300 kHz). It gives the best cutting quality and the characteristics can be adjusted according to your needs.