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APPLICATION REPORT

Report No: 151-8
Sample No: 2.2.1566

CONFIDENTIAL

REPORT: Alumina – metal coated – wafer cutting by Laser-MicroJet®

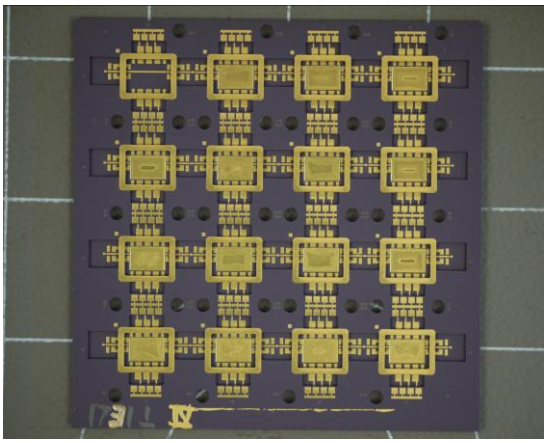
for Anonymous

by Mr. Stephane Delahaye, Synova SA

TASK

The Laser-MicroJet® technology has been tested for cutting of ~0.9 mm thick alumina wafers, with several metallic layers on top and inside the chip.

The aim of this third test session is to provide enough devices to Anonymous for testing the compatibility of the LMJ cutting process with the next manufacturing steps.
The main goal is to determine whether the cutting parameters and contamination have an impact on the bonding strength.



PICTURE 1: Image of the sample before processing

Release of application report			
Project Leader		Responsible Application Group	
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Date:	28.01.2015	Date:	29.01.2015
Visum:	SDE	Visum:	BC

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Brown alumina
	Thickness	~900 *µm*
	Quantity	5 *pc*

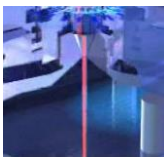
The ceramic wafers, 58 mm by 58 mm, were diced with a chip size of ~9.75 mm by 8.2 mm.
The wafers have been taped on Lintec ADWILL D-611 UV-tape and a support was used to avoid any vibrations.

Note: The UV-tape has been removed before packing.

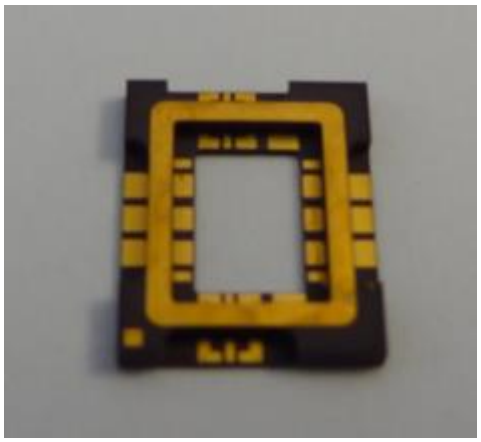
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the DCS300 equipped with a frequency-doubled Q-switched Nd-YAG laser has been used as the machine configuration in our lab.

In the table below, the machine configuration is summarized:

	**SYSTEM**	Machine type	DCS300
	**MICROJET® PARAMETER**	Nozzle diameter	50 *µm*
		MicroJet® diameter	42 *µm*
		Water pressure	300 *bar*
		Assist gas	He 0.7 l/min
	**LASER PARAMETER**	Laser type	L51G
		Wavelength	532 *nm*

RESULTS



PICTURE 2: digital camera picture of a sample

The first set of experiments was performed during the visit:

	Nozzle size [µm]	Water Press [bar]	Freq [kHz]	Speed [mm/s]	Number of passes	Phead [W]	Pjet [W]	Pulse width [ns]	overall speed [mm/s]
1	50	300	10	100	180	30	15.6	240	0.56
2	50	300	10	100	160	28	14.6	150	0.63
3	50	300	10	80	140	28	14.6	150	0.57
4	50	300	14	80	115	32	16.6	120	0.70
5	50	300	10	60	120	30	15.6	310	0.50
6	50	300	10	80	120	30	15.6	150	0.67
7	50	300	10	10	43	12	6.2	150	0.23
8	50	300	10	10	43	12	6.2	150	0.23
9	50	300	10	10	60	12	6.2	150	0.17
10	50	300	10	10	66	15	7.8	150	0.15

TABLE 1: Cutting parameters used for the first set of experiments

According to the preliminary results a DOE has been created and executed to evaluate the most relevant factors regarding the bonding strength.

Methodology:

- The tiles were divided in four rows and then four dies (for one row) were cut for each set of parameters.
  Please note that when one row was cut out of the tile, the others were protected with UV-tape to avoid any contamination. This first cut was performed without any support to see the number of passes requested to cut the ceramic.
- If some cutting parameters did not allow cutting through the ceramic then manual hand breaking were used.

- The cuts performed within the row were realised with UV tape and support and surfactant was always applied before the start of the process.
- Regarding the cleaning: the samples were flush under water and IPA and then dry with clean air.

	Nozzle size [µm]	Water Press [bar]	Freq [kHz]	Speed [mm/s]	Number of passes	Phead [W]	Pjet [W]	Pulse width [ns]	overall speed [mm/s]
1	50	400	12	100	130	30	15.6	300	0.77
2	50	300	10	55	125	21	10.9	215	0.44
3	50	400	8	100	230	30	15.6	130	0.43
4	50	200	8	100	290	12	6.2	130	0.34
5	50	200	8	10	32	30	15.6	130	0.31
6	50	400	12	100	325	12	6.2	130	0.31
7	50	200	12	100	500	12	6.2	300	0.20
8	50	200	8	10	60	12	6.2	300	0.17
9	50	200	8	100	215	30	15.6	300	0.47
10	50	200	12	10	50	12	6.2	130	0.20
11	50	400	12	10	80	12	6.2	300	0.13
12	50	400	8	10	35	12	6.2	130	0.29
13	50	200	12	100	185	30	15.6	130	0.54
14	50	200	12	10	45	30	15.6	300	0.22
15	50	400	8	10	25	30	15.6	300	0.40
16	50	300	10	55	145	21	10.9	215	0.38
17	50	400	8	100	400	12	6.2	300	0.25
18	50	400	12	10	22	30	15.6	130	0.45
19	50	200	12	10	80	12	6.2	300	0.13
20	50	300	10	55	125	21	10.9	215	0.44

TABLE 2: Cutting parameters used for the first set of experiments

Note:
Sample n°19 is an extra sample. Wrong water pressure was initially used to process sample n°11.
Sample n°20: a protective thin layer was added one day prior sample processing. Sample was cleaned with “Cillit bang” and rinse with DI water and IPA.

CONCLUSION

The cutting of alumina wafer was investigated on SYNOVA DCS 300. 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 allowing an excellent accuracy, advantages that are essential for cutting alumina wafers with high quality.

Five plates (~80 devices) have been cut successfully according to your DOE for analysis.

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.