REPORT: Dicing SiC Wafer by Laser-MicroJet®

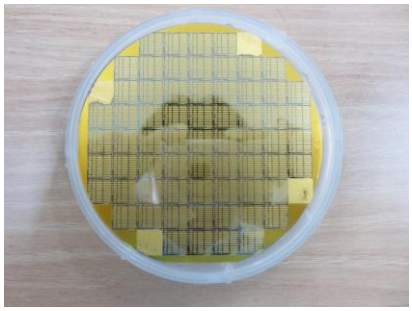
for Anonymous

by Andrew Chung, Synova SA

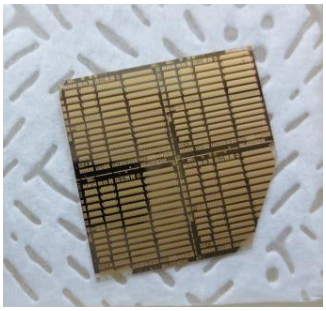
TASK

The purpose of the test is to cut Sic Wafer and eliminate Glue from the back side of UV tape as requested.
Two type of samples have been processed. First test is to do the Dicing process of 4 inch-Wafer. This consists of Au and SiN+GaN+SiC. Second one is to the Dicing process of Au deposited additionally on the back side of the sample. The sample shoud be made after the condition of Dicing and UV Curing is acquired.

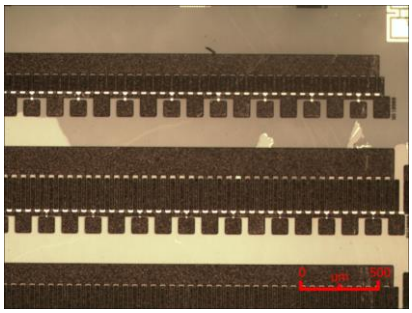
SAMPLE DESCRIPTION AND PREPARATION



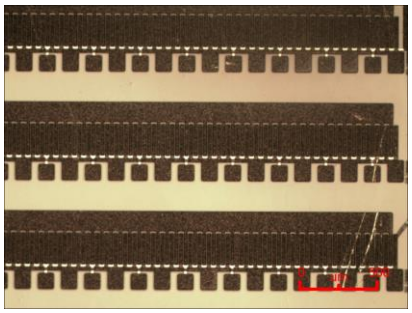
PICTURE 1: Digital camera image of the 4inch SiC Sample. (First experiment sample.)



PICTURE 2: Digital camera image of the SiC piece samples.(Second experiment samples.)

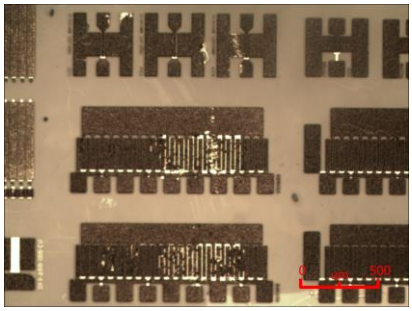


PICTURE 3: Microscope image before the process. (Metal evaporation is not good partly.)



PICTURE 4: Microscope image before the process **(**Scratch is seen partly.)

Release of application report			
Project Leader		Responsible Application Group	
Name:	Andrew Chung	Name:	Benjamin Carron
Date:	12.04.2013	Date:	12.04.2013
Visum:	ACH	Visum:	BC



PICTURE 5: Microscope image before the process **(**Pattern Delamination of Metal at the upper side is seem partly.)

About the picture 1, we've done the first dicing process to deposit the lower metal on 4 inch-wafer as requested. On picture 2, the lower Metal was deposited in order to do the dicing process as the shape of Die. On pictures 3, 4, 5, pictures were taken as soon as we received samples from the customer. Some problems were checked before the process.

▪ SAMPLE STRUCTURE & THICKNESS

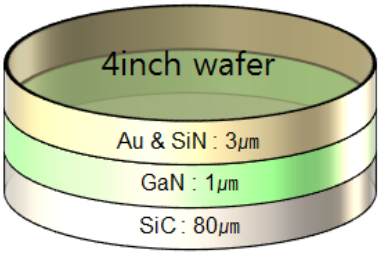


Figure 1: Sample structure & Thickness (First sample)

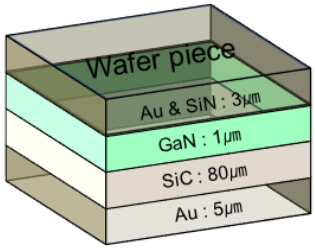
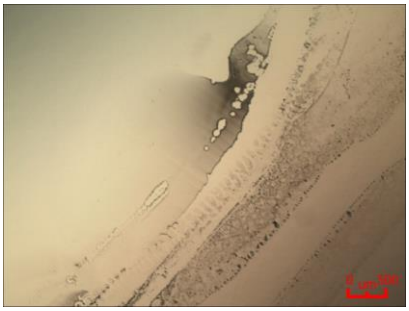


Figure 2: Sample structure & Thickness (Second sample)

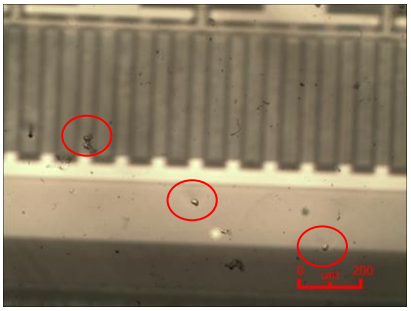
SAMPLES	Quantity	First	1 x 4 inch SiC wafer(without backside metal)
		Second	1 x Piece of SiC wafer(with backside metal)
		Trial	5 x pieces of SiC wafers(without backside metal)
			2 x pieces of SiC wafers(with backside metal)

▪ EXPLANATION ABOUT SAMPLES AFTER PROCESSING

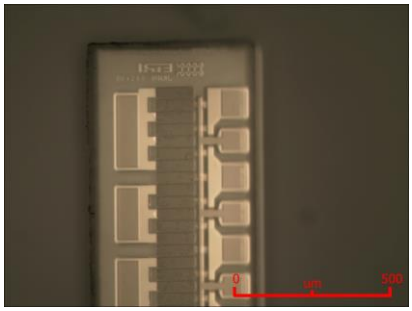
▪ UV Curing Test for SiC Wafer (without backside metal)



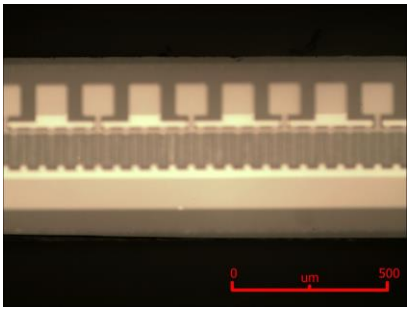
PICTURE 6: UV tape Glue is seen on the back side of SiC wafer after UV Curing for 30 seconds.



PICTURE 7: UV tape Glue is seen on the back side of SiC wafer after UV Curing for 600 seconds.



PICTURE 8: UV tape Glue is seen on the back side of SiC wafer after UV Curing for 500 seconds.



PICTURE 9: UV tape Glue is seen on the back side of SiC wafer after UV Curing for 500 seconds.

In order to eliminate glue from the back side of Sic Sample, we used our UV Curing machine to find the best condition. We figured out that UV light radiation for 500 seconds was needed. And then the removal of UV Tape without glue was successful.

As you see on picture 6, much glue remained. As you see on picture 7, glue also remained when we did UV curing job for more than 500 seconds. We think that much longer time for UV Curing is not good for the generated heat from the lamp.

▪ Process: Instrument & Test Parameters

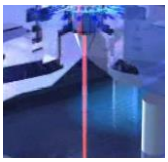
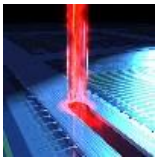
For these experiments, the LDS300 equipped with a frequency-double Q-switched Nd:YAG laser has been used as the machine configuration in our lab.

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:
- Cutting of arbitrary shapes
- No chipping on front side, minimal chipping on backside
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation

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

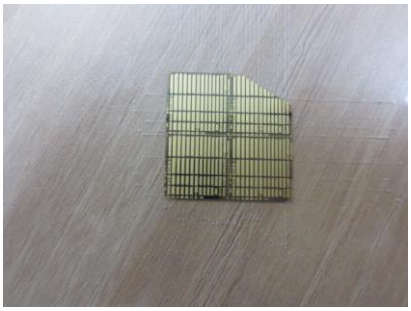
▪ Dicing condition of SiC Samples

	**SYSTEM**	Machine type	LDS300M			
			1st		**2nd**	
	**MICROJET® PARAMETER**	Nozzle diameter	40	*µm*	40	*µm*
		MicroJet® diameter	35	*µm*	35	*µm*
		Water pressure	250	*bar*	250	*bar*
		Assist gas	He		He	
	**LASER PARAMETER**	Laser type	L51G			
		Wavelength	532*nm*			
		Pulse frequency	10	kHz	10	*kHz*
		Average power	7.8	*W*	5.7	*W*
	**CUTTING PARAMETER**	Cutting speed	50	*mm/s*	50	*mm/s*
		Number of passes	10		10	
		Overall speed	5	mm/s	5	*mm/s*
		UV Tape	Lintec D-520T			
		Sample fixation	8” vacuum chuck			

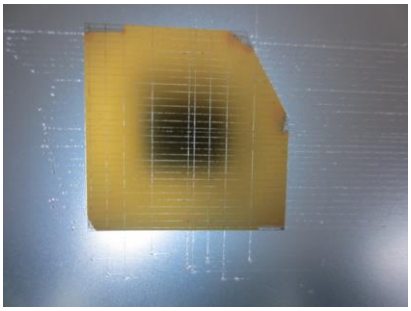
As you see the above table, the second sample is a bit thicker than the first one. But the process was done by the lower energy level.
We think that the absorption factor of Au from 532nm is better.

▪ Processing Results

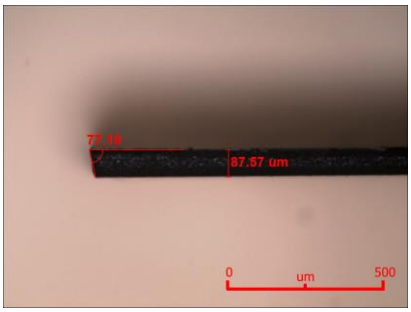
The following microscope picture give an overview on the quality obtained with the Laser-Microjet® technology.



PICTURE 10: Digital image of the SiC sample.

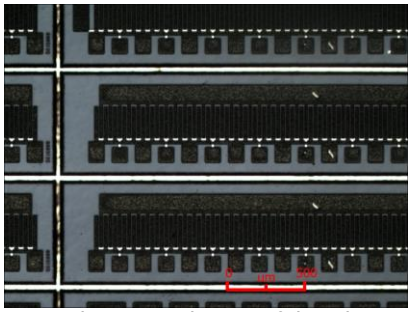


PICTURE 11: Digital image of the SiC sample.



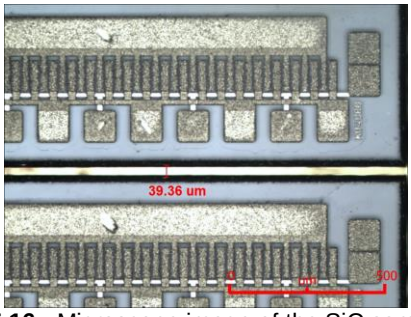
PICTURE 12: Microscope image of the SiC sample. (bright field illumination; cross-section view)

PICTURE 13: Microscope image of the SiC sample. (bright field illumination; top view)

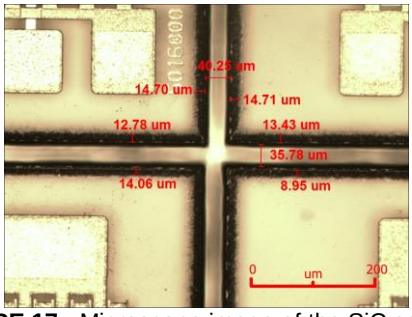


PICTURE 14: Microscope image of the SiC sample. (bright field illumination; top view)

PICTURE 15: Microscope image of the SiC sample. (bright field illumination; top view)



PICTURE 16: Microscope image of the SiC sample. (bright field illumination; top view)



PICTURE 17: Microscope image of the SiC sample. (bright field illumination; top view)

The table below summarizes Anonymous expectations and our results

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Speed/throughput:	N/A	50mm/s
Kerf-width:	<50 µm	<40 µm
Burr-free:	Burr-free	About 15 µm
Contamination/particles:	N/A	Some particles
Front chipping/Cracks:	No chipping / cracks	No chipping / No cracks

CONCLUSION

The cutting of SiC wafers were investigated on SYNOVA LDS300. 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 SiC wafer dicing with high quality.

These tests show:

1. The chipping of the front side was not found under the fractography.
2. Burr & Splash size after the process was less than 15 µm.
3. UV Tape is well removed from SiC Wafer after UV Curing. Glue does also not remained.
4. The quality is good. We are expecting the satisfaction from the customer.

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.