REPORT: PcBN cutting by Laser-MicroJet®

for Anonymous

by Ronan Martin; Synova SA

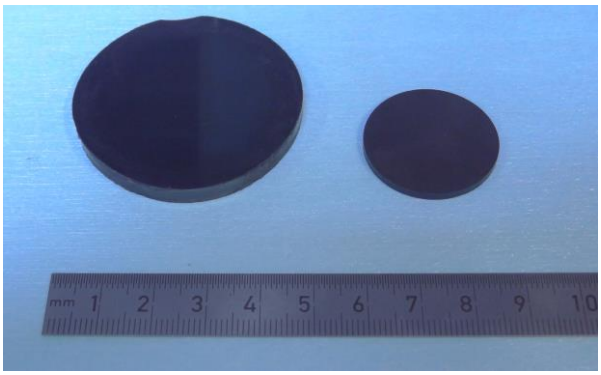
TASK

The Laser-MicroJet® technology has been tested for cutting of PcBN. 10 trapezoidal bits were cut in a 2mm-thick wafer, while 3 cylinders and 4 squares were cut in a 4.76mm-thick wafer.

SAMPLE DESCRIPTION AND PREPARATION

THICK SAMPLES	Material	PcBN
	Dimension	Ø 47 *mm*
	Thickness	4.76 *mm*
THIN SAMPLES	Material	PcBN
	Dimension	Ø 28 *mm*
	Thickness	2 *mm*

The picture below shows a comparison of the sizes of the as-received wafers:



Release of application report			
Project Leader		Responsible Application Group	
Name:	Ronan Martin	Name:	Dr Benjamin Carron
Date:	16.03.2012	Date:	16.03.2012
Visum:	ROM	Visum:	BC

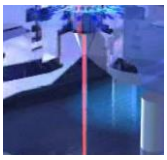
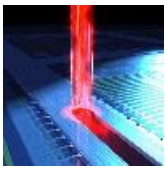
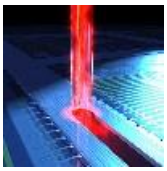
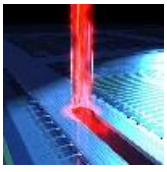
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LCS300 equipped with a dual cavity 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:

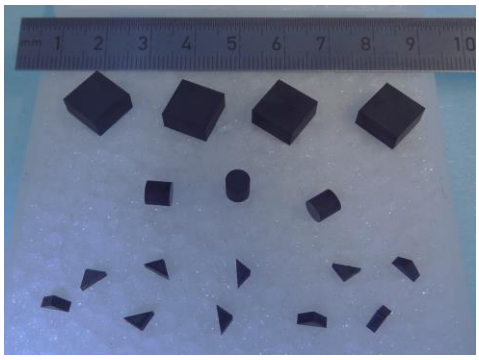
- Advantageous process rates
- Cutting of arbitrary shapes
- Parallel cut
- Excellent wall surface quality
- Negligible contamination / re-deposition

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

	**SYSTEM**	Machine type	LCS300
	**MICROJET® PARAMETER**	Nozzle diameter	80 *µm*
		MicroJet® diameter	72 *µm*
		Water pressure	300 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L202G
		Wavelength	532 *nm*
		Pulse frequency	14 *kHz*
		Average power	140 *W*
	**CUTTING PARAMETER Cylinders**	Motion speed	40 *mm/s*
		Number of passes	200
		Overall speed	12 *mm/min*
	**CUTTING PARAMETER Squares**	Motion speed	40 *mm/s*
		Number of passes	160
		Overall speed	15 *mm/min*
	**CUTTING PARAMETER Bits**	Motion speed	40 / 20 *mm/s*
		Number of passes	90 / 60
		Overall speed	23 *mm/min*

RESULTS

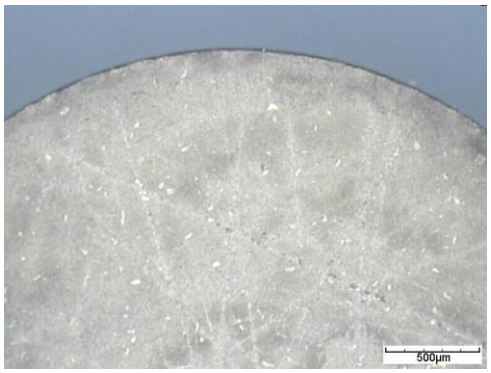
The pictures below shows all the processed parts:



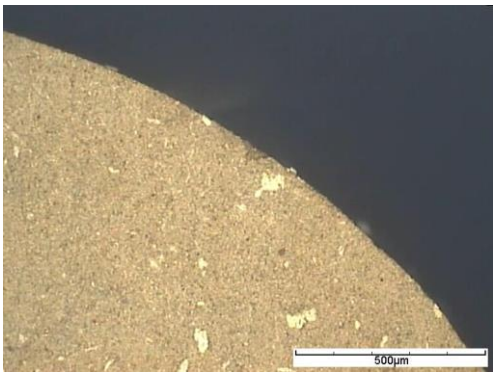
- *Cylinder cutting – 4.7mm thick*

The cylinders processed in the lab have a diameter of 5.81mm.

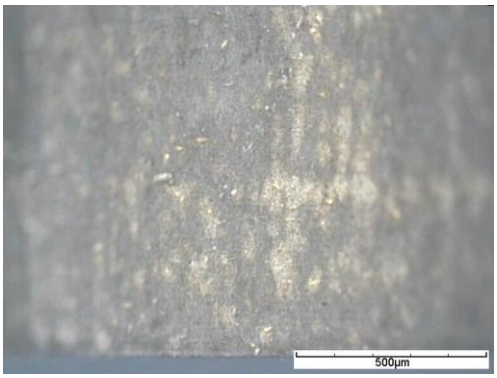
The following microscope picture give an overview on the quality obtained with the Laser-Microjet® technology.



PICTURE: Microscope image of front side edge (dark field illumination; top view)



PICTURE: Microscope image of the back side edge (dark field illumination; bottom view)



PICTURE: Microscope image of the wall (dark field illumination; side view)

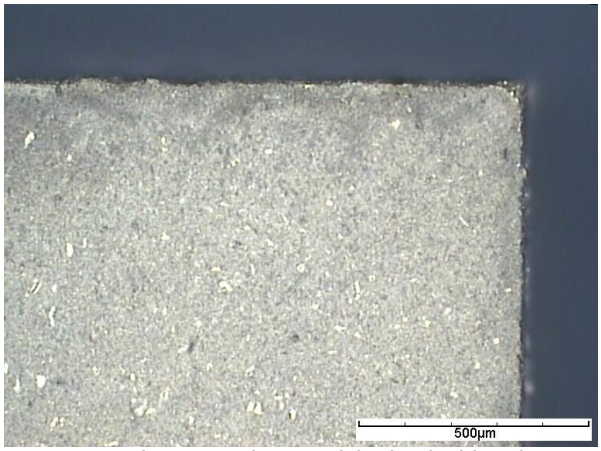
Overall quality is very good: edges are clean and sharp without noticeable chipping.

- *Square cutting – 4.7mm thick*

The squares processed in the lab have a side of 9.77mm.

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

PICTURE: Microscope image of front side edge (dark field illumination; top view)



PICTURE: Microscope image of the back side edge (dark field illumination; bottom view)

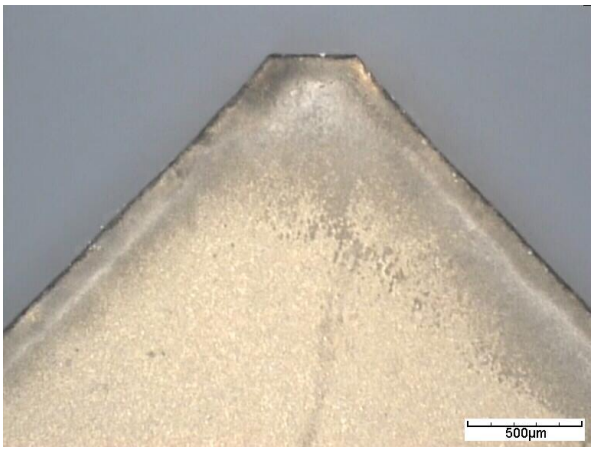
PICTURE: Microscope image of the wall (dark field illumination; side view)

Overall quality is again very good, with sharp edges and very limited chipping.

- *Bit cutting –2mm thick*

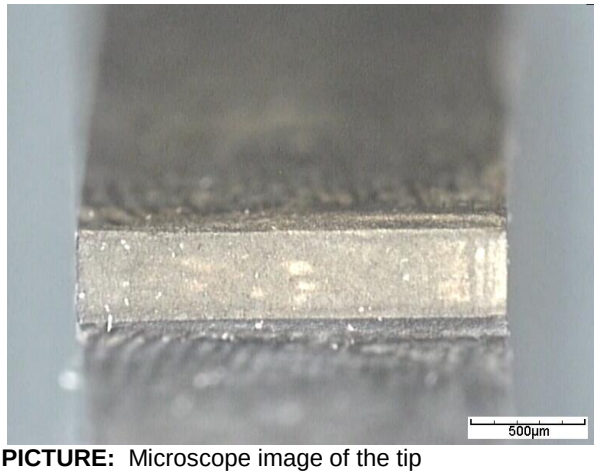
The bits processed in the lab have a length of 5.68mm, a height of 2.65mm and 45° angles.

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



PICTURE: Microscope image of front side edge (dark field illumination; top view)

PICTURE: Microscope image of the back side edge (dark field illumination; bottom view)



PICTURE: Microscope image of the tip (dark field illumination; tip view)

Like previously, overall quality is very good, with sharp edges and negligible chipping.

The table below presents a comparison between your expectations and the actual results.

	What are your priorities? (please put a cross)	Quantified expectations or improvements
• Speed / throughput:	18 – 30 mm/min	12 – 23 mm/min

CONCLUSION

The cutting of PCBN wafers into triangle- and circular- and square-shapes with chamfer was investigated on a SYNOVA LCS300. This machine is based on the Laser-MicroJet® technology and combines the advantages a high-energy pulsed double 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.

Quality

The quality is very good for all the samples of the wafer cutting. Edges are sharp and chipping is very limited.

Speed

Speeds are typical of our technology performance in comparable materials. Below you can find a summarizing table for the cutting speeds:

Material	*Speed (mm/min)*
4.7 *mm* PCBN – Cylinders	**~ 12**
4.7 *mm* PCBN – Squares	**~ 15**
2.0 *mm* PCBN – Bits	**~ 23**

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