

REPORT: Hard-material cutting by Laser-MicroJet®

for Anonymous

by Ronan Martin; Synova SA

TASK

The Laser-MicroJet® technology has been tested for the cutting of PcBN and PCD/WC tool bits.

SAMPLE DESCRIPTION AND PREPARATION

Two pieces of wafers were provided for the tests.

SAMPLE 1	Material	PcBN
	Thickness	1 mm
SAMPLE 2	Material	PCD/WC
	Thickness	1.6 mm

PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, an LCS 150 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 any kind of hard material.


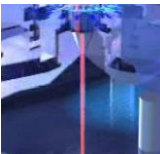

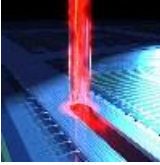
Major advantages of Laser-MicroJet® technology with regards to your application are:

- Advantageous process rates
- Parallel cut
- Narrow kerf
- Excellent wall surface quality
- Negligible contamination / re-deposition

Release of application report			
Project Leader		Responsible Application Group	
Name:	Ronan Martin	Name:	Manuel Meizoso
Date:	11.04.2012	Date:	11.04.2012
Visum:	ROM	Visum:	MM

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The table below summarizes the optimized processing parameters used in the experiments.

	SYSTEM	Machine type	LCS 150
	MICROJET® PARAMETERS	Nozzle diameter	80 μm
		MicroJet® diameter	72 μm
		Water pressure	200 <i>bar</i>
		Assist gas	He
	LASER PARAMETERS	Laser type	L202G
		Wavelength	532 <i>nm</i>
		Pulse frequency	14 <i>kHz</i>
		Average power	140 <i>W</i>
	CUTTING PARAMETERS	Motion speed	30 <i>mm/s</i>
		Number of passes	PcBN: 50 PCD/WC: 100
		Overall speed	PcBN: ~30 <i>mm/min</i> PCD/WC: ~15 <i>mm/min</i>
		Fixture	waxed on aluminium

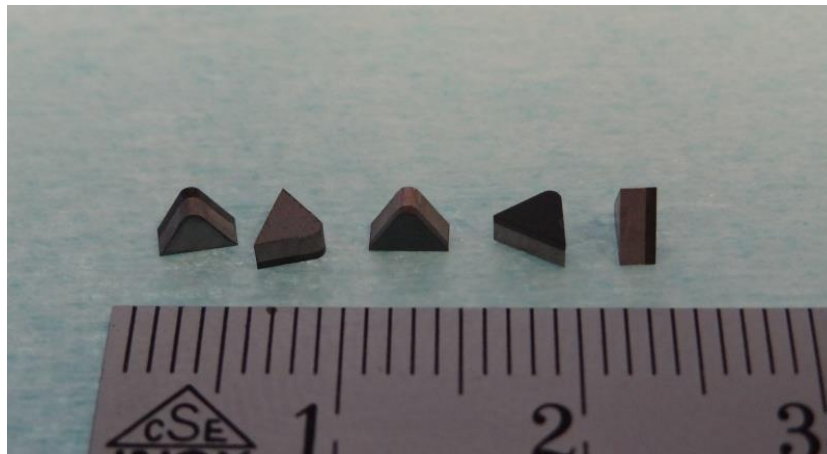
After processing, the wax was dissolved with a special solution in an ultrasonic bath for 10min.

RESULTS

Five tools bits were cut in each material, as shown in the pictures below. These bits have a triangular shape, with one rounded angle, as it was specified.



PICTURE 1: Photograph of the processed PcBN tool bits



PICTURE 2: Photograph of the processed PCD/WC tool bits

The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology in both materials. The edges are clean and sharp, with very limited HAZ. Burrs and cracks are negligible. The front side edge is more regular than the back side edge.



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Switzerland
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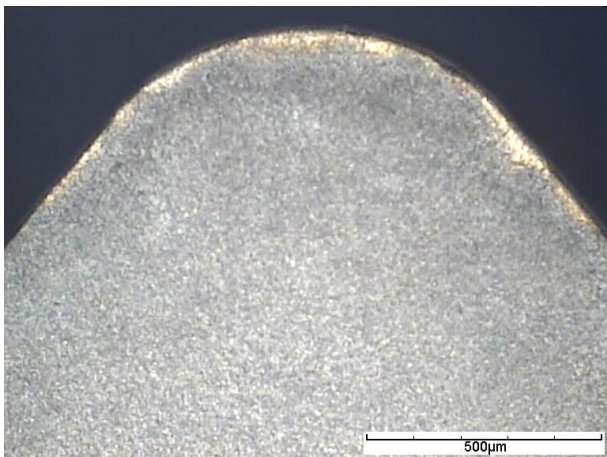
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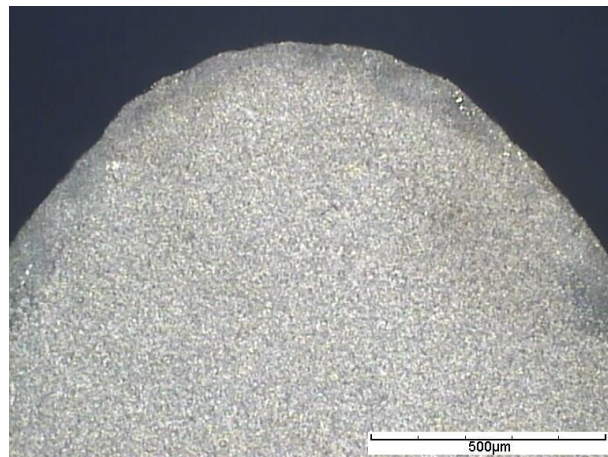
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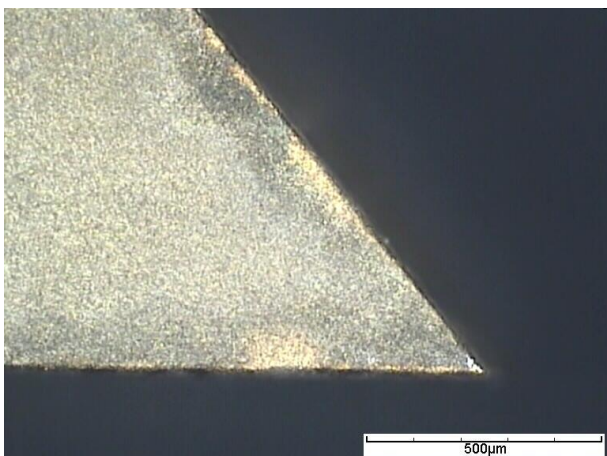
- **PcBN**



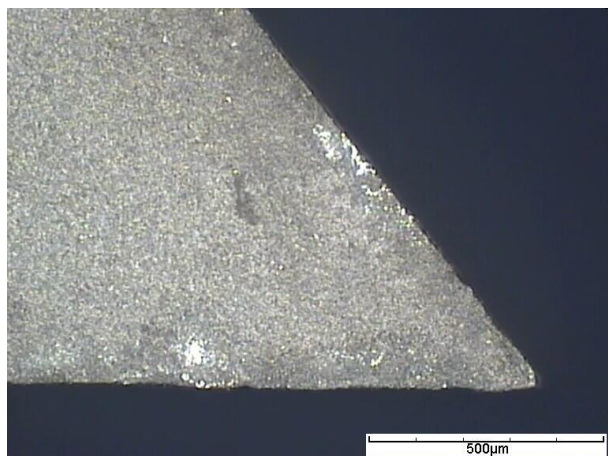
PICTURE 3: Microscope image of the front side of a PcBN bit (dark field illumination; top view)



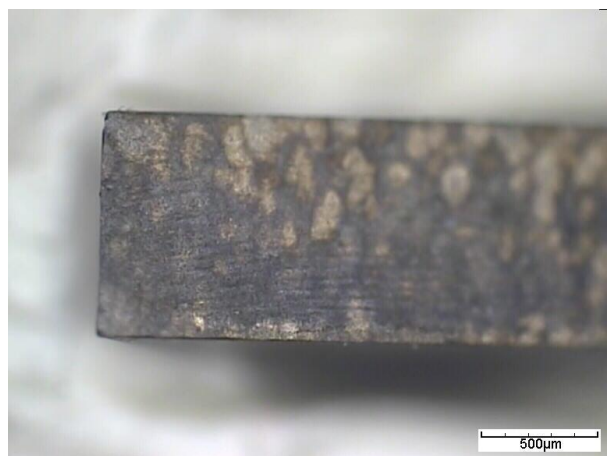
PICTURE 4: Microscope image of the back side of a PcBN bit (dark field illumination; bottom view)



PICTURE 4: Microscope image of the front side of a PcBN bit (dark field illumination; top view)



PICTURE 5: Microscope image of the back side of a PcBN bit (dark field illumination; bottom view)



PICTURE 6: Microscope image of the cut wall of a PcBN bit (dark field illumination; side view)



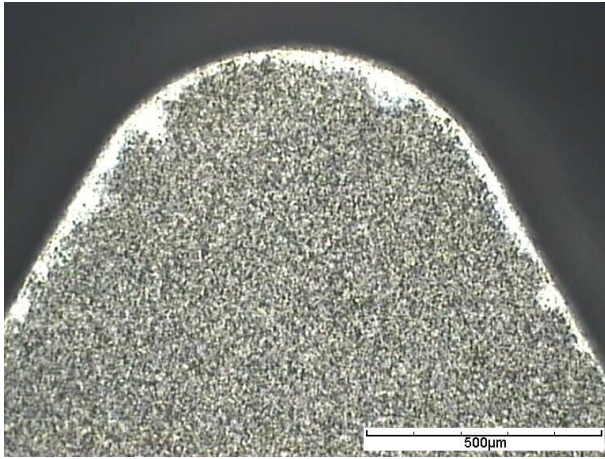
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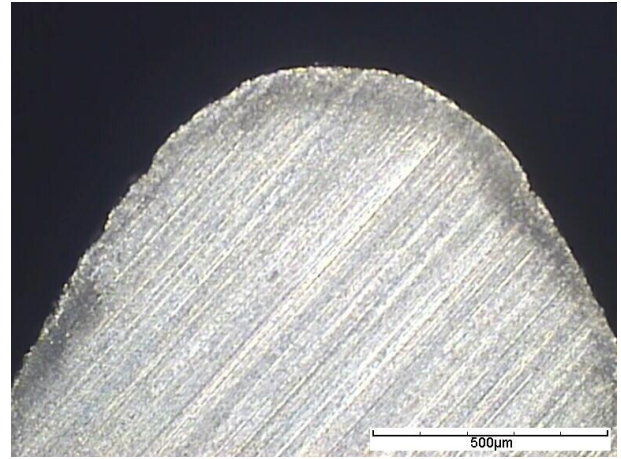
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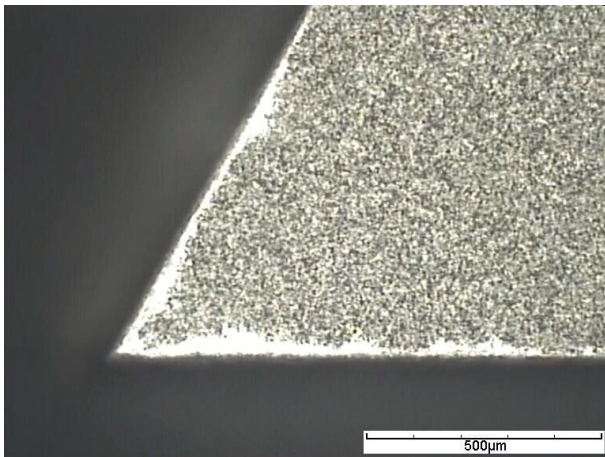
- **PCD/WC**



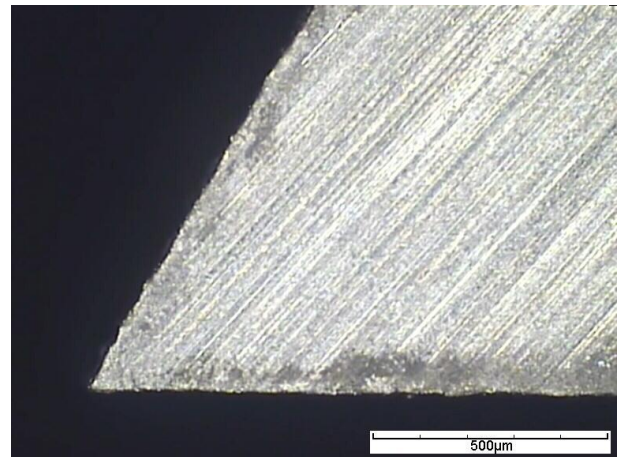
PICTURE 7: Microscope image of the front side of a PCD/WC bit (dark field illumination; top view)



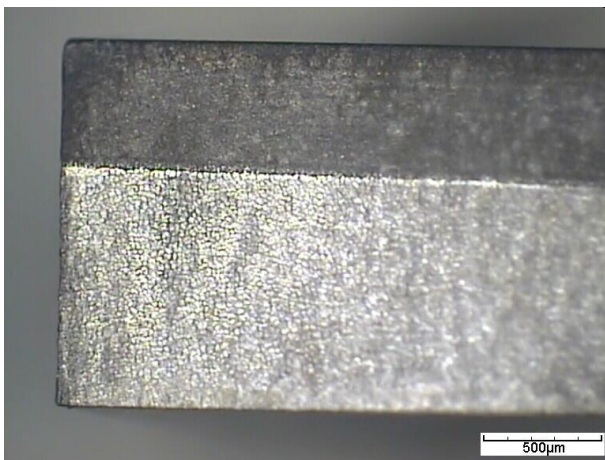
PICTURE 8: Microscope image of the back side of a PCD/WC bit (dark field illumination; bottom view)



PICTURE 9: Microscope image of the front side of a PCD/WC bit (dark field illumination; top view)



PICTURE 10: Microscope image of the back side of a PCD/WC bit (dark field illumination; bottom view)



PICTURE 11: Microscope image of the cut wall of a PCD/WC bit (dark field illumination; side view)

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The table below compares the specifications of the customer to the achieved results. With the exception of the speed which is quite lower, all the items appear fulfilled. Concerning tolerances, as seen above, the precision is better on the front side. Also notice that measuring precisely the kerf width with the final parameters on each material can allow to increase the precision a bit.

	Expected	Achieved
Speed / throughput:	Min 50mm/min	PcBN: ~30mm/min PCD/WC: ~15mm/min
Kerf-width:	<0,3	~0.1mm
Burr-free:	Max burr 0,05	Negligible burrs
Cracks	No cracks	Yes
Tolerances:	0,025mm	Yes

CONCLUSION

The cutting of PcBN and PCD/WC was investigated on a SYNOVA LCS 150. This machine is based on the Laser-MicroJet[®] technology and combines the advantages of a high-energy pulsed laser and of a hair-thin water jet. While the laser is used for material ablation, the waterjet is used for guiding the laser light, cooling the edges and preventing the sample from particle contamination, advantages that are essential for cutting hard materials with high quality.

PcBN and PCD/WC were cut with high quality, with the following results:

- overall speeds respectively about 30mm/min and 15mm/min
- kerf width about 0.1mm
- clean and sharp edges, especially on the front side
- very limited HAZ
- negligible burrs and cracks

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