REPORT: Dicing Aluminium Ceramic from a sintered matrix using Laser-MicroJet®

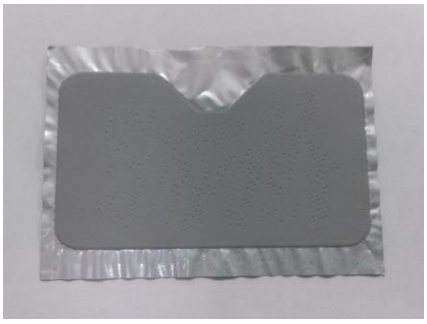
for Anonymous
by Jerry Chera; Synova USA

TASK/OBJECTIVES

To test the Laser-MicroJet® technology for dicing aluminium ceramic from a sintered matrix.

SAMPLE DESCRIPTION AND PREPARATION

Material	Al sheet sandwiched between two sintered Al plates
Dimensions	Approx. 2.1340 inch x 1.1058 Inch
Thickness	430 microns
Quantity	> 10 pieces



Picture 1: Sample as received.

•	1st layer:	Oxidized Sintered Aluminium	thickness:	200 µm
•	2end layer:	Solid Aluminium Substrate (1000 Series)	thickness:	30 µm
•	3rd layer:	Oxidized Sintered Aluminium	thickness:	200 µm

Release of application report			
Project Leader		Responsible Application Group	
Name:	Jerry Chera	Name:	Dr Benjamin Carron
Date:	10.08.2014	Date:	10.08.2014
Visum:	JC	Visum:	BC

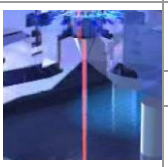
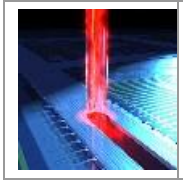
Process: Instrument & Test Parameters

For these experiments, a Synova LDS 200 laser cutting system, equipped with a frequency-doubled Q-switched Nd:YAG laser was used. Tests were conducted in the Fremont CA micro-machining center. The LDS 200 is a manually loaded machine that allows cutting and drilling of any kind of metal piece.

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

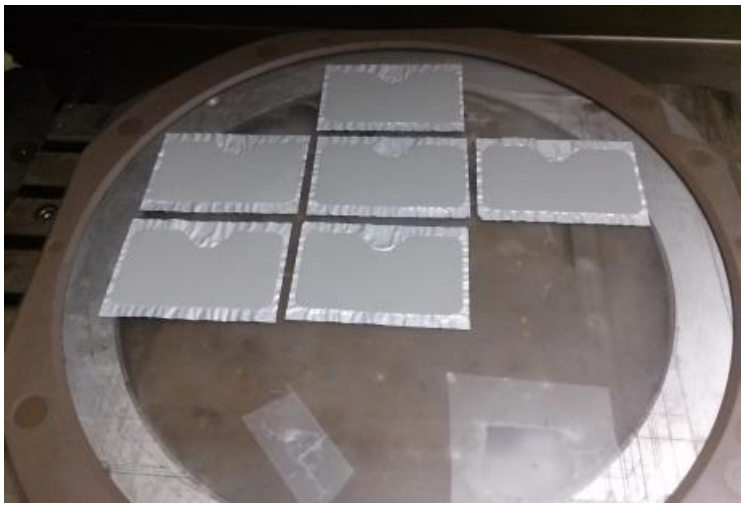
- High quality cutting
- Cutting of non cartesian patterns
- Low heat damage to the material

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

	**SYSTEM**	Machine type	LDS200
	**MICROJET® PARAMETER**	Nozzle diameter	50 µm
		Water pressure	300 bar
		Assist gas	He (1.00 L/min)
		Working distance	15 mm
	**LASER PARAMETERS**	Laser type	LDP-200MQG
		Wavelength	532 nm
		Pulse frequency	20 kHz
		Internal power	35 W
		SHG temp.	30.9 deg
	**CUTTING PARAMETERS**	Speed	50 mm/sec
		No. of passes	2 for Al, 15 for sintered Al
		Cutting time	1 min per part

STRATEGY

The pieces were held by Advil tape mounted onto a metal frame, as shown in the picture below:



Picture 2: Sample shown mounted to cutting tape

Initial cuts were done and the quality was checked using an optical microscope, thereby establishing a parameter set for processing samples.

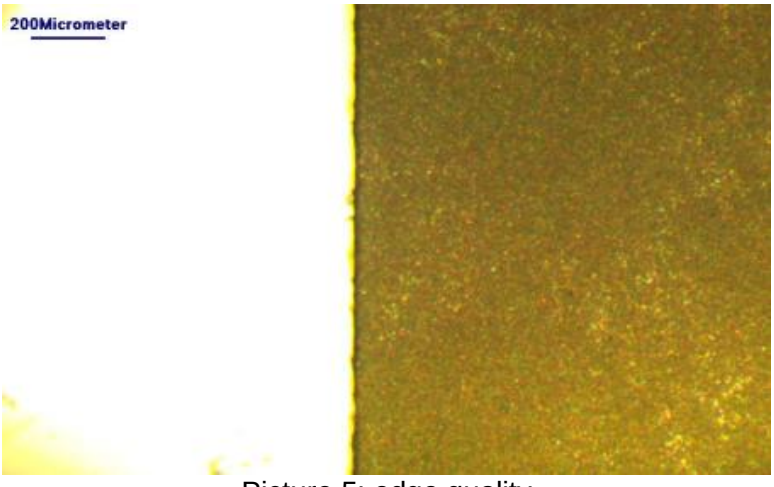
The test was performed at 10, 14, 18 and 20 Khz and best results were obtained at 20Khz. The quality was further improved by adjusting the laser power and processing speed.

Picture 3: first sample processed

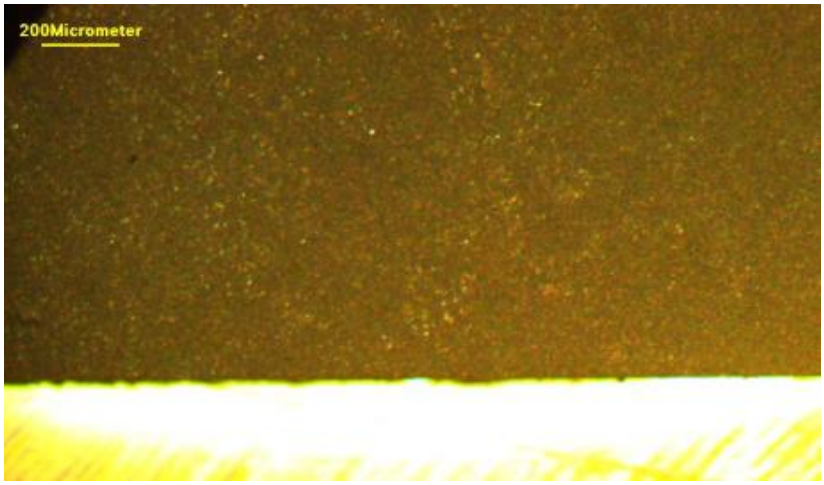
Picture 4: first sample taken out of the tape

RESULTS

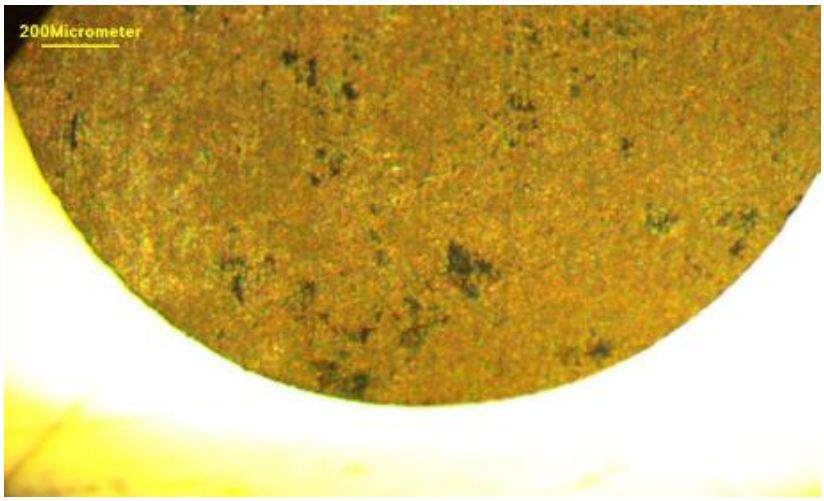
The following pictures highlight the quality obtained with the Laser-Microjet® technology:



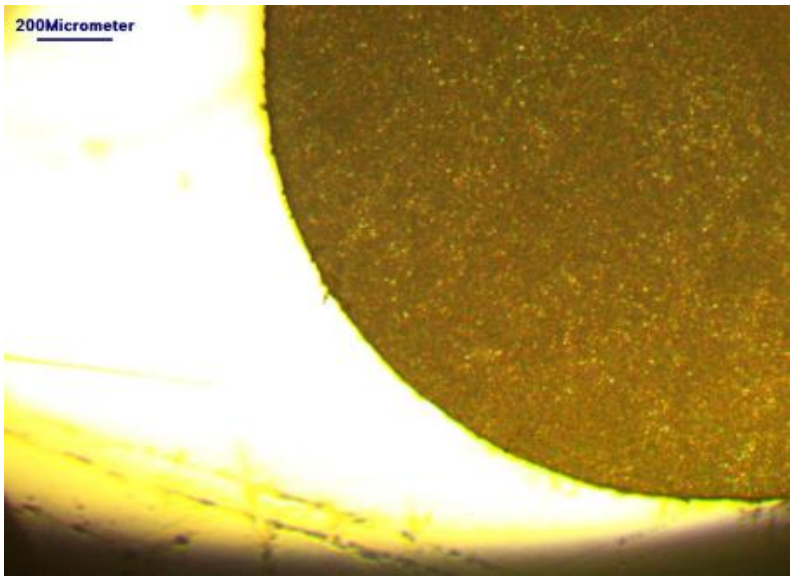
Picture 5: edge quality



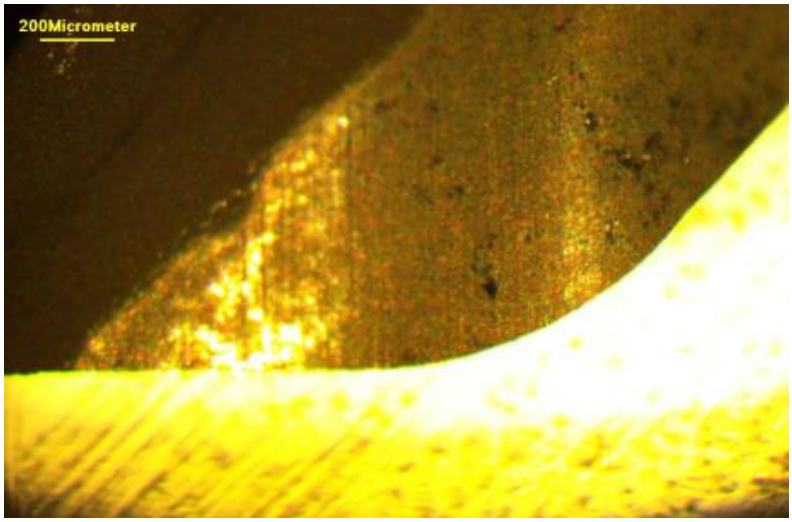
Picure 6: another view of side edge quality



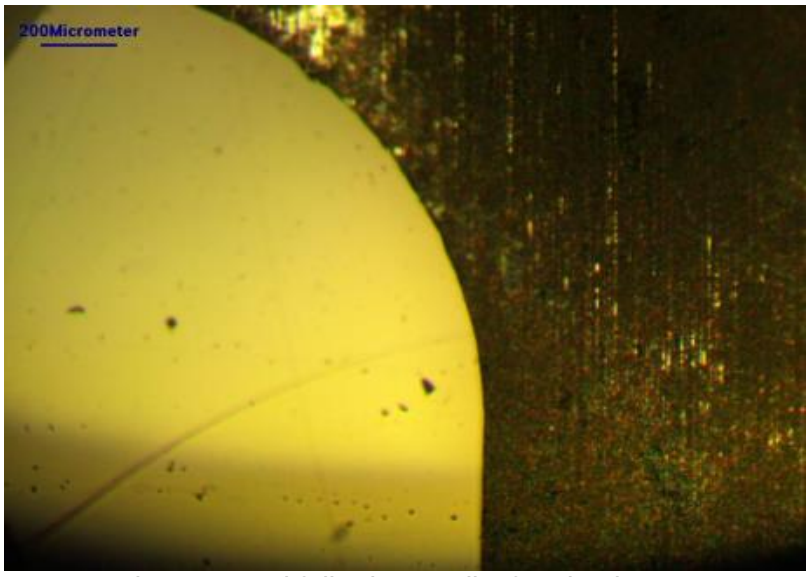
Picture 7: circular section edge quality



Picture 8: another view showing circular section edge quality



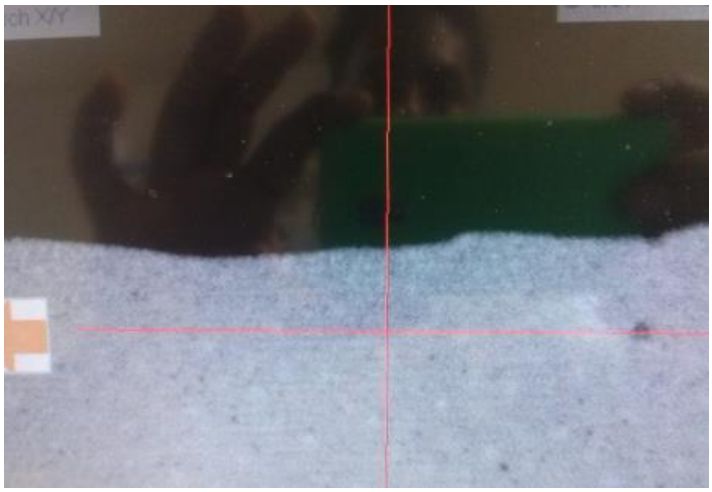
Picture 9: Al foil edge quality



Picture 10: Al foil edge quality for circular cut

DISCUSSION:

The main issue encountered during the whole process was alignment of the part. It took almost 15 minutes to align a single part because edges are not straight (instead they are wavy as shown in the below pic) and hence very difficult to align the piece.



Picture 11: pic showing edge during alignment process

There is great risk of dimensional inaccuracy for processed part due to this aligment issue.

Ideally, two fiducial reference features should be provided for alignment. Other options can also be explored such as aligning to a fixture.

The total time to cut the shape was about 57 seconds. It took 6 secs to cut thru Al foil and 51 secs to cut out the sintered Al.

The microscopic pics show almost no heat affected zone.

CONCLUSION

Cutting of sintered Al was investigated on a SYNOVA LDS200 system. At its core, the machine incorporated Synova's Laser MicroJet® technology, which combines the advantages of a 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 cleaning the surface.

The overall quality was very good without any heat affected zones. The chipping and cracks quality was very good as seen from microscopic pics. The edge roughness seems to be in good conditon.
The only issue may be dimensional accuracy due to issues encountered during alignment.

An alignment scheme needs to be mapped out in order for testing to move forward.

In addition, a fixturing approach needs to be finalized and fixtures need to be sent to Synova for final tests on "clean parts".

We thank you for your interest in our technology. We do believe that the Laser Microjet technology offers the capability, quality and a path to higher throughputs for this application.