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APPLICATION REPORT

Report No: 156-6
Sample No: 2.2.1649

CONFIDENTIAL

REPORT: Anodized aluminum cutting by Laser MicroJet®

for attention of Anonymous

by Ronan Martin, Synova SA

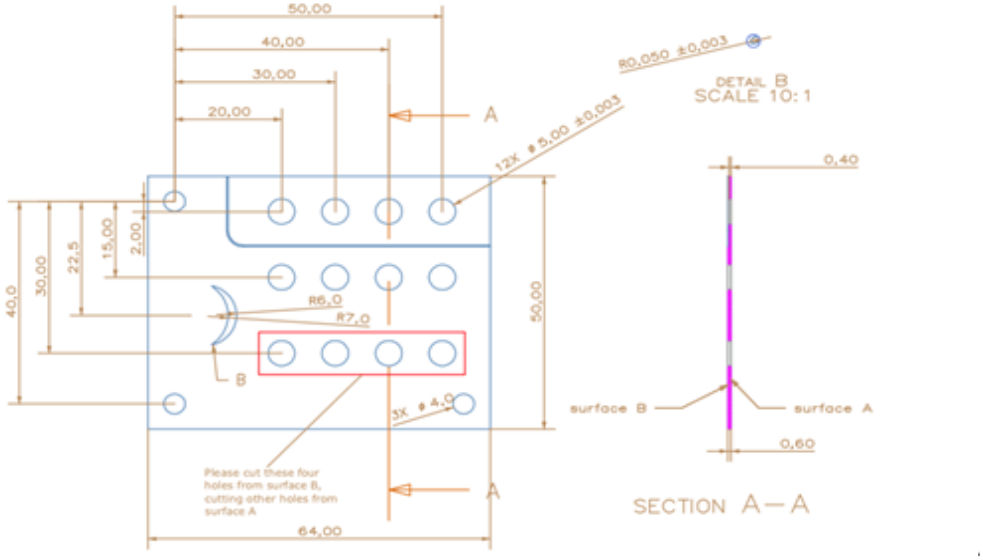
TASK

The Laser MicroJet® technology has been tested for cutting anodized aluminum plates. The aim of the tests was to avoid any discoloration or chipping in the anodized layer, and to show that the technology can achieve a good dimensional precision.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Anodized aluminum
	Dimension	65 x 50 *mm*
	Thickness	metal: 0.6 / 0.4 *mm* anodized layer: 13 *µm*
	Quantity	5 *pcs*

Release of application report			
Project Leader		Director of Applications Engineering	
Name:	Ronan Martin	Name:	Dr Benjamin Carron
Date:	25.06.2015	Date:	26.06.2015
Visum:	ROM	Visum:	BC



Picture 1: description of the features to machines in the plates

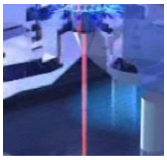
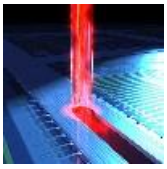
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, a DCS 150 equipped with a frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab. This machine allows cutting any kind of metal.

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

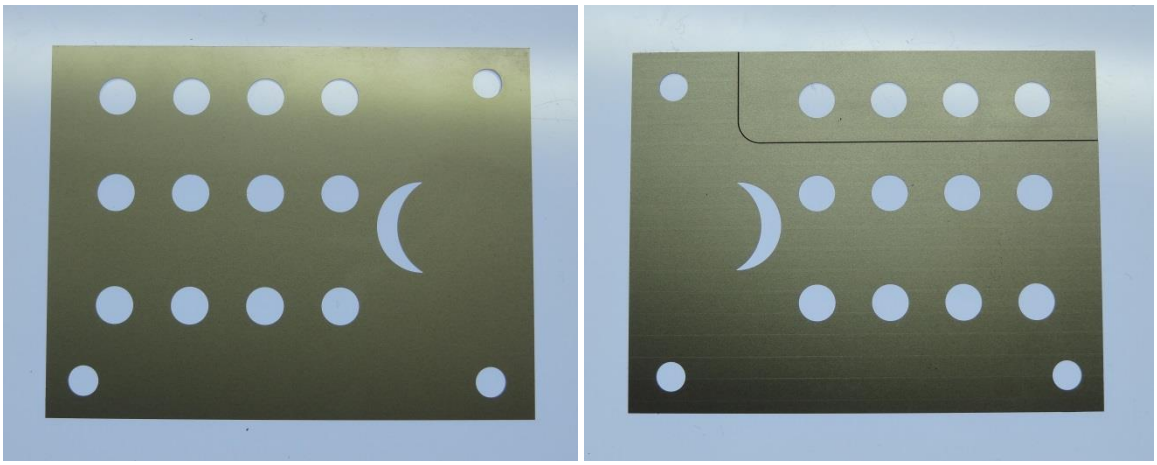
- Cutting of arbitrary shapes
- Minimal chipping
- Negligible heat damage
- Excellent wall surface quality

The table below summarizes the optimized processing parameters used in the experiments. Since there were only requests concerning the quality, these tests were solely focused on that, hence the use of a small nozzle diameter and a very low laser power. The process speeds are given here as an indication, but can easily be increased.

	**SYSTEM**	Machine type	DCS 150
	**MICROJET® PARAMETER**	Nozzle diameter	30 *µm*
		MicroJet® diameter	25 *µm*
		Water pressure	450 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L101G
		Wavelength	532 *nm*
		Pulse frequency	3 *kHz*
		Internal power	3.2 *W*
		Power in jet	1.5 *W*
		Pulse width	100 *ns*
	**CUTTING PARAMETER**	Cutting speed	cutting: 10 *mm/s* finishing: 1 *mm/s*
		Number of passes	0.6mm cutting: 24 0.4mm cutting: 16 finishing: 1
		Offset for finishing	6 *µm*
		Overall speed	0.6mm: 17.6 *mm/min* 0.4mm: 23.1 *mm/min*
		Fixation	clamps

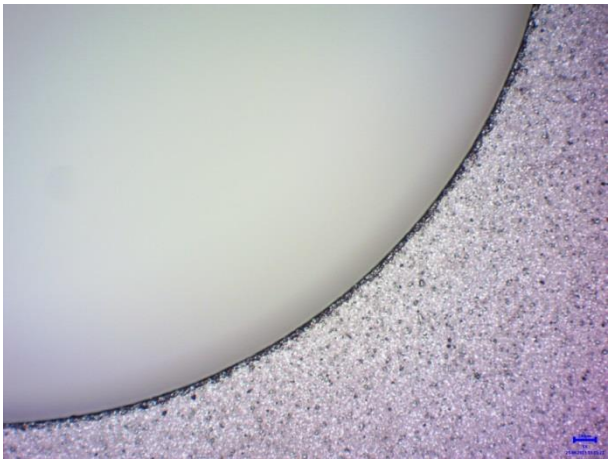
RESULTS

One of the plates has been used for tests, and the other four were all processed using the same parameters. The photos below show both faces of a processed plate. As described in picture 1, most of the features were machined from the anodized face, with only the lower row of four holes being machined from the raw face.

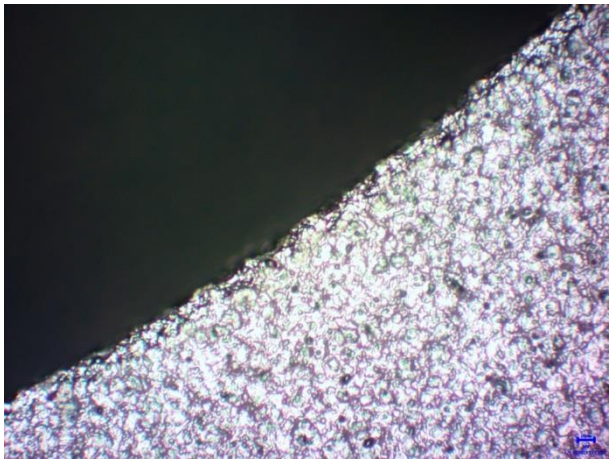


Pictures 2a and 2b: processed plate; left: anodized face, right: raw face

The following microscope pictures give an overview on the quality obtained with the Laser-MicroJet® technology. There is absolutely no discoloration visible for the holes cut from the anodized face. (Only some of the holes cut from the raw face may show some slight discoloration). Chipping is invisible to the naked eye, since the chip size normally does not exceed 10 or 15µm. The holes cut from the raw face show even a slightly lower chipping.

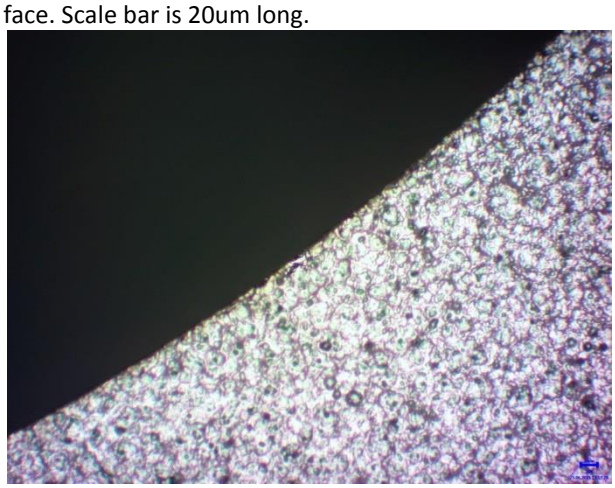


Picture 3a: Microscope image of the **anodized face** (**front side**) of a 5mm hole drilled from the anodized face. Scale bar is 100um long.

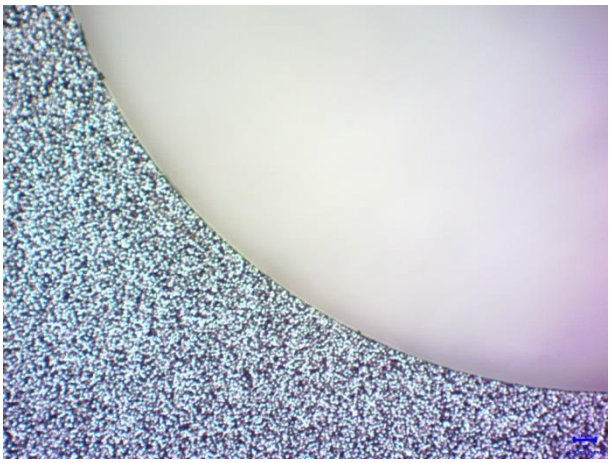


Picture 3b: Microscope image of the **anodized face** (**front side**) of a 5mm hole drilled from the anodized face. Scale bar is 20um long.

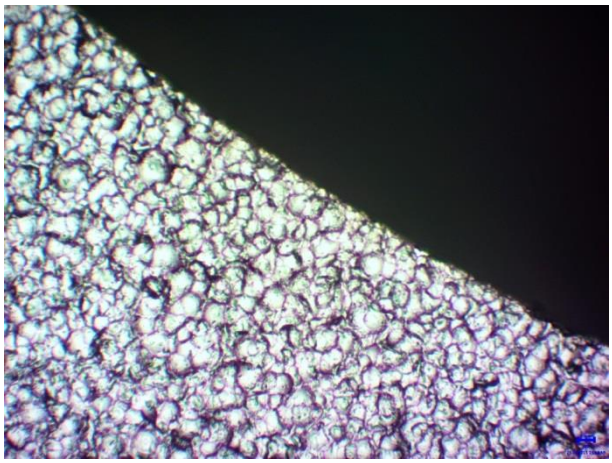
Picture 4a: Microscope image of the **anodized face** (**back side**) of a 5mm hole drilled from the raw face. Scale bar is 100um long.



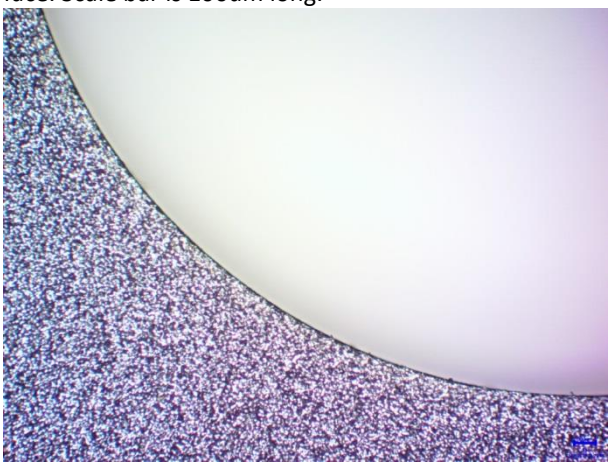
Picture 4b: Microscope image of the **anodized face** (**back side)** of a 5mm hole drilled from the raw face. Scale bar is 20um long.



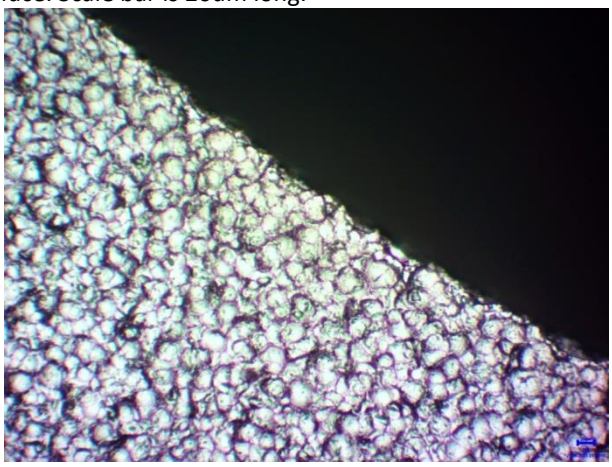
Picture 5a: Microscope image of the **raw face** (**back side**) of a 5mm hole drilled from the anodized face. Scale bar is 100um long.



Picture 5b: Microscope image of the **raw face** (**back side**) of a 5mm hole drilled from the anodized face. Scale bar is 20um long.



Picture 6a: Microscope image of the **raw face** (**front side**) of a 5mm hole drilled from the raw face. Scale bar is 100um long.



Picture 6b: Microscope image of the **raw face** (**front side**) of a 5mm hole drilled from the raw face. Scale bar is 20um long.

The kerf width had been measured with a microscope before launching the production of the four plates, in order to ensure that the diameters would be correct. After having machined all the plates, we checked the diameters of the 5mm holes on a Micro-Vu Sol312. The diameter measured in the holes cut from the anodized face was correct on the front side, but it was a bit lower on the back side, as you can see in the table below. This is probably due to a border effect as the walls are perfectly parallel. It has to be noted that the diameter of the holes cut from the non-anodized layer show a smaller discrepancy between both faces.

Diameters	0.4mm thickness, cut from anodized face	0.6mm thickness, cut from anodized face	0.6mm thickness, cut from raw face
Anodized face	5.003mm	5.003mm	4.993mm
Raw face	4.989mm	4.977mm	4.990mm

CONCLUSION

The cutting of anodized aluminum was investigated on a Synova DCS 150. This machine is based on the Laser MicroJet® technology and 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 preventing the sample from particle contamination, advantages that are essential for cutting metals with high quality.

During these tests, we have shown that we are able process anodized aluminum:

- without discoloration,
- with negligible chipping
- with high precision.

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.