REPORT: Cutting of Carbon Fiber Reinforced Polymere by Laser-MicroJet®

For Anonymous

by Mr. Stéphane Delahaye; Synova SA

1. TASK

The Laser-MicroJet® technology has been tested for the cutting of carbon-fiber composite. The main focus of these first tests was to check the feasibility of the process.

2. SAMPLE DESCRIPTION

Two samples were available for the tests.

Supplied Material	Thickness	Dimension	Quantity
Samples 1: CFK/Steel	~4 mm	150*300 mm	1
Samples 2: CFK	~4 mm	150*300 mm	1

The figure below illustrates the cutting path:

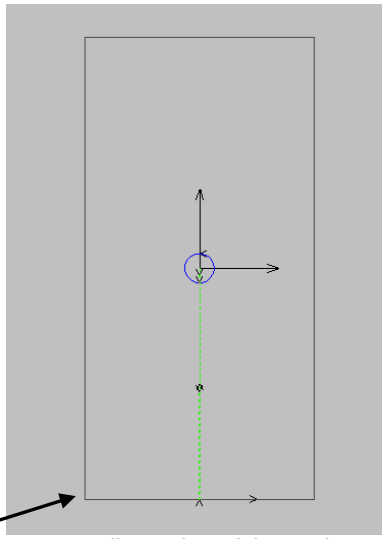

FIGURE 1: Illustration of the cutting path

Please note that 4 corner radius of 80 µm have been added to the original drawing to facilitate the cutting of the sample.

Release of application report			
Project Leader		Industry BU Responsible	
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Date:	06.05.2015	Date:	06.05.2015
Visum:	SDE	Visum:	BC

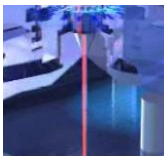
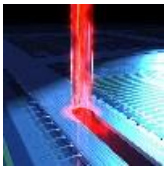
3. PROCESS: INSTRUMENT & TEST PARAMETERS

For this application, the LCS150, equipped with a dual cavity green laser, has been selected as the best machine configuration available in the lab.

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

- Cutting of arbitrary shapes
- Low heat damage to the material
- Advantageous process rates

In the table below, the machine configuration is summarized:

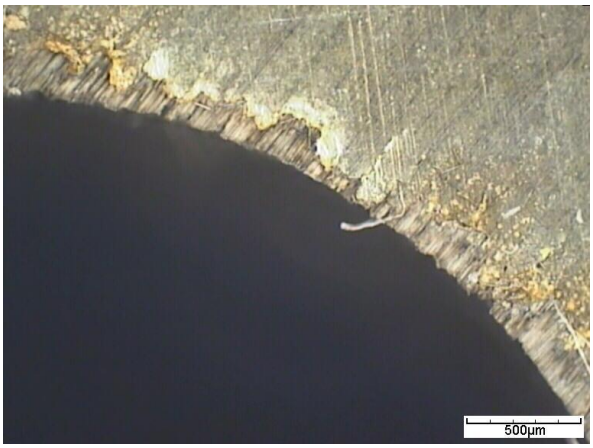
	**SYSTEM**	Machine type	LCS150	
	**MICROJET® PARAMETERS**	Nozzle diameter	60	*µm*
		MicroJet® diameter	48	*µm*
		Water pressure	300	*bar*
		Assist gas	He	
	**LASER PARAMETERS**	Laser type	L202G	
		Wavelength	532	*nm*
		Pulse frequency	20	*kHz*
		Power in jet	80	*W*
		Pulse width	~180	*ns*
	**CUTTING PARAMETERS**	Cutting speed	10	*mm/s*
		Number of passes	Sample 1: 20 Sample 2: 30	
		Overall speed	Sample 1: 30 Sample 2: 20	*mm/min* *mm/min*
		Process time	Sample 1: ~10 Sample 2: ~15	*min* *min*
		Fixation	Clamps	

4. RESULTS

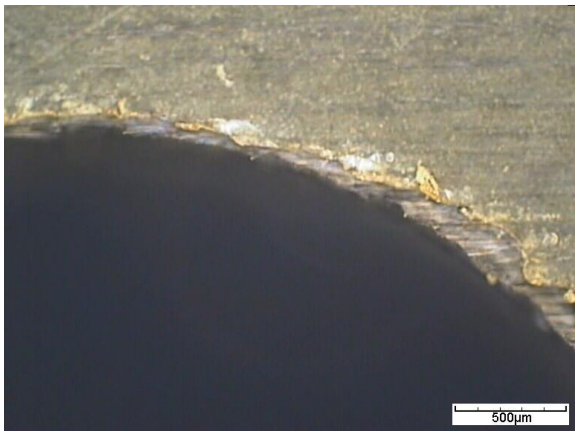
PICTURE 1: Digital camera picture of the sample

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

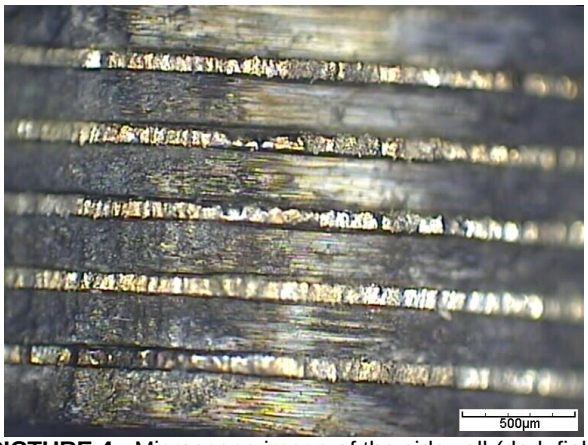
- **SAMPLE 1 CFK/Steel**



PICTURE 2: Microscope image of the frontside (dark field illumination)

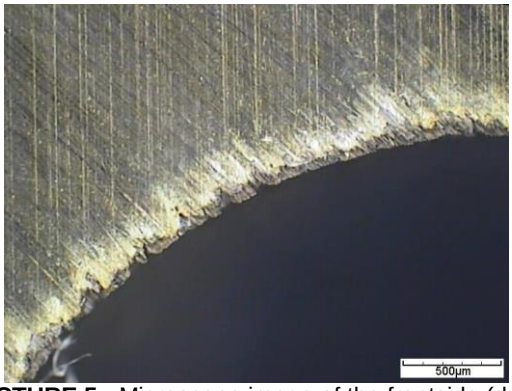


PICTURE 3: Microscope image of the backside (dark field illumination)



PICTURE 4: Microscope image of the sidewall (dark field illumination)

- **SAMPLE 2 CFK**



PICTURE 5: Microscope image of the frontside (dark field illumination)

PICTURE 6: Microscope image of the backside (dark field illumination)

PICTURE 7: Microscope image of the sidewall (dark field illumination)

5. CONCLUSION

The cutting of carbon-fiber composite reinforced polymer samples has been performed with a SYNOVA LCS150.
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 cutting carbon-fiber with high quality.

These tests show:

- The feasibility of the process
- Various geometries can be cut with a good quality and limited delamination on both sides
- Process time for requested pattern (rectangle 100x50mm and hole ∅ 6.355 mm)
    - Sample 1 CFK/Steel: ~10 min
    - Sample 2 CFK: ~15 min
- Overall speed (durchschnittliche Vorschubgeschwindigkeit)
    - Sample 1 CFK/Steel: ~30 mm / sec
    - Sample 2 CFK: ~20 min / sec

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

6. REMARKS

Unfortunately both “proben” for each sample have been processed with the same diameter of ∅ 6.355 mm.
We ask you kindly to take our apologize for this mistake.