# REPORT: Cutting of teeth on a PCD toroidal sample by Laser-MicroJet®

*For* Anonymous

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## 1. TASK

The Laser MicroJet® technology has been tested for cutting very small geometries on the circumferential edge of a PCD torus. The aim of this application was to optimize the laser parameters as well as the cutting strategy in order to:

- Cut 2 to 4 µm teeth on the circumference of the sample ;
- Optimize the cut quality and the cut repeatability.

The Laser MicroJet® technology gives precise cuts and no HAZ on the work-piece cut faces, thanks to the water jet. The latter enables to reach cutting speeds higher than other cutting processes like electric discharge machining, as well as competitive roughness.

## 2. SAMPLE DESCRIPTION AND PREPARATION

| | | | |
|---|---|---|---|
| **SAMPLE** | Material | PCD | |
| | Diameter | 2 | *mm* |
| | Thickness | 630 | *µm* |
| | Quantity | 6 | *pcs* |

| Release of application report | | | |
|---|---|---|---|
| Project Leader | | Industry BU Responsible | |
| Name: | Mr Sébastien Kurzen | Name: | Dr Benjamin Carron |
| Date: | 19.01.2015 | Date: | 21.01.2015 |
| Visum: | SEK | Visum: | BC |

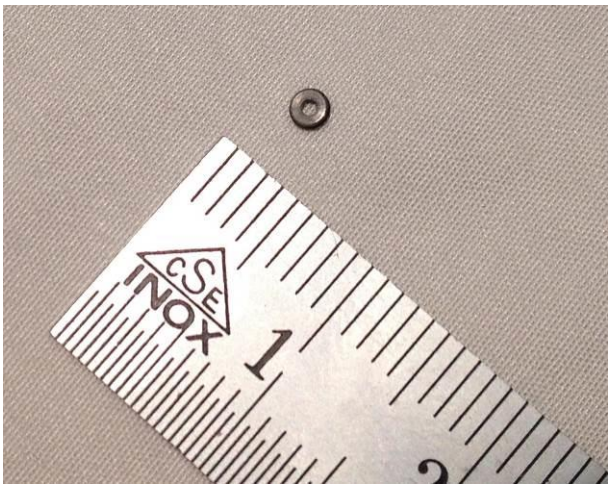
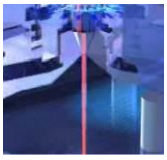
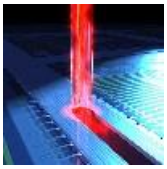


Figure 1: Macroscopic view of the final sample.

## 3. PROCESS: INSTRUMENT & TEST PARAMETERS

A Synova DCS 150, equipped with a 100 W diode-pumped solid state laser source, has been used as the machine configuration the most appropriated for your application.

The table below summarizes the optimized processing parameters used for the tests:

| | | | | |
|---|---|---|---|---|
|  | **MICROJET® PARAMETER** | Nozzle diameter | 30 | *µm* |
|  | **LASER PARAMETER** | Laser type | L101G | |
| | | Wavelength | 532 | *nm* |
| | | Pulse frequency | 6 | *kHz* |
| | | Power in jet | 6.5 | *W* |
| | | Pulse width | 170 | *ns* |
|  | **CUTTING PARAMETER** | Cutting speed | 1 | *mm/s* |
| | | Process duration | <5 | *sec* |
| | | Fixation | Clamp | |

## 4. RESULTS

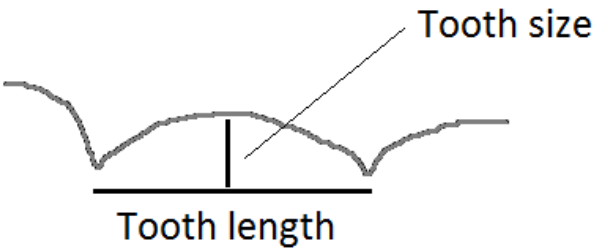



Figure 2: Definition of the measured quantities.

| **Cut duration** | **Average size** | *Size standard deviation* | ***Average length*** | *Length standard deviation* |
|---|---|---|---|---|
| **1 – 3 s** | **3.6 µm** | 0.5 µm | **28.9 µm** | 1.8 µm |

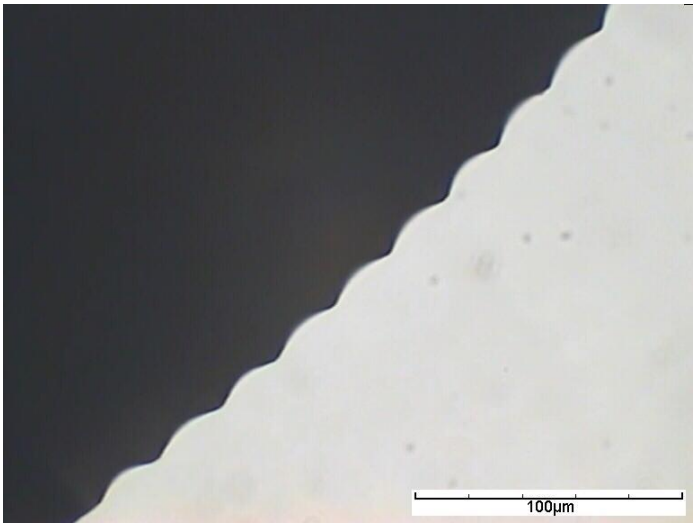



Figure 3: Edge view.

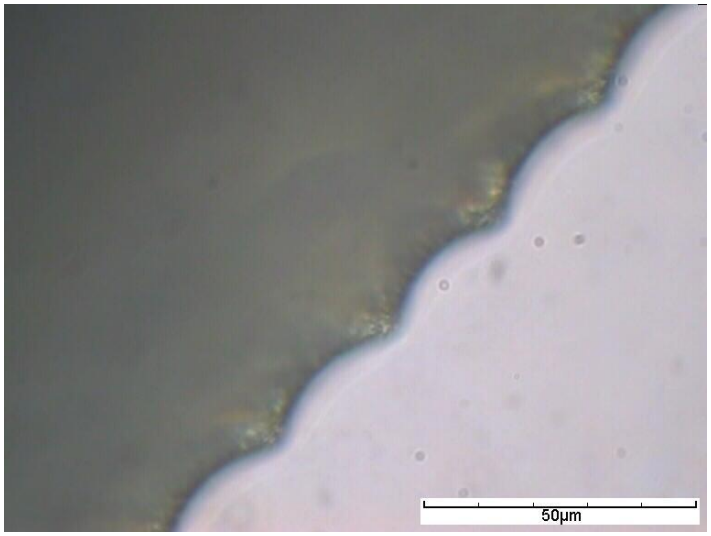



Figure 4: Edge view.

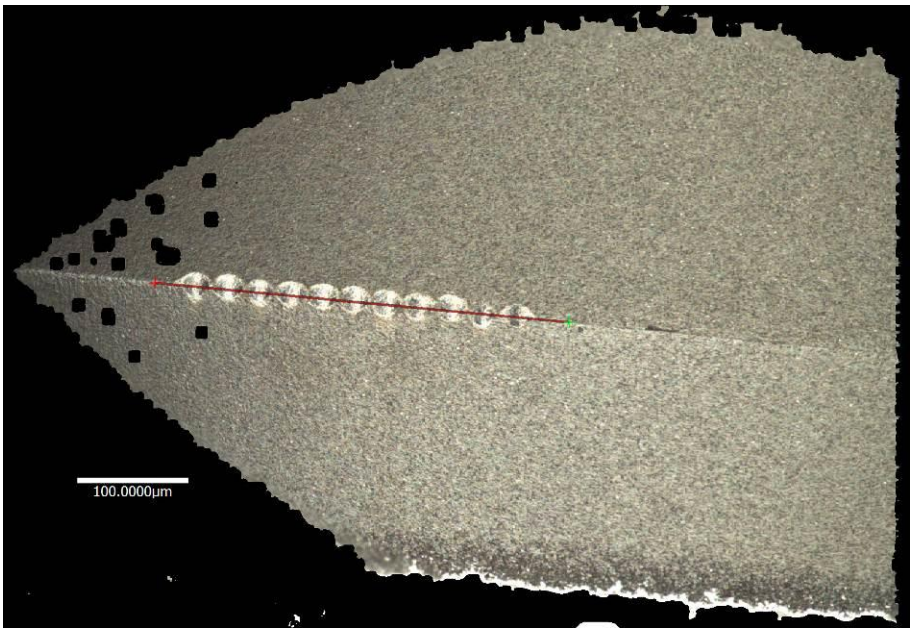


Figure 5: 3D view of the 11 cut teeth.

## 5. CONCLUSION

The cutting of small teeth on a PCD torus edge has been performed with a SYNOVA DCS 150. 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 processing all kinds of tools with high quality.

These feasibility tests showed:

- The possibility to cut less than 4 µm teeth in PCD samples ;
- The repeatability of these cuts ;
- A process time smaller than 1 second ;
- The 1-µm accuracy of the laser positioning on the work-piece.

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