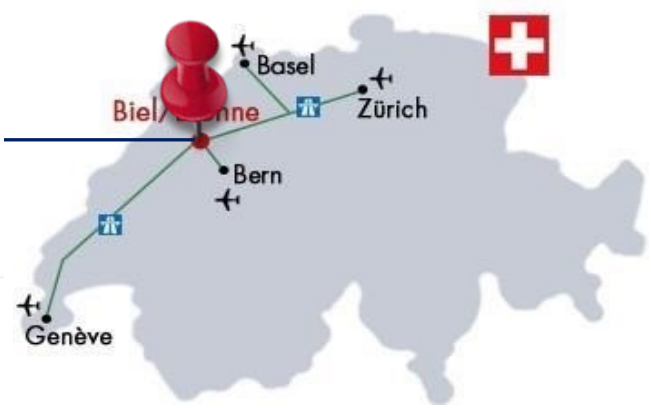
posalux®
SWISS MADE

08th of February 2017

Posalux SA - Switzerland



Founded in 1943, Posalux is a leading Suisse manufacturer for micro technologies for mass production.

Posalux is headquartered in Biel-Bienne, one of the most important cities of Switzerland, which is famous not only as a watch metropolis, but also as one of the most important centers for advanced and micro technologies.

Global presences:

- Subsidiaries of Posalux in Germany, Korea and Taiwan
- Worldwide network of sales and service agents in major countries

Posalux – Business Strategy

Best in class **system solution provider** to enhance and grow our customers business and become supplier of choice with mutual benefit and success

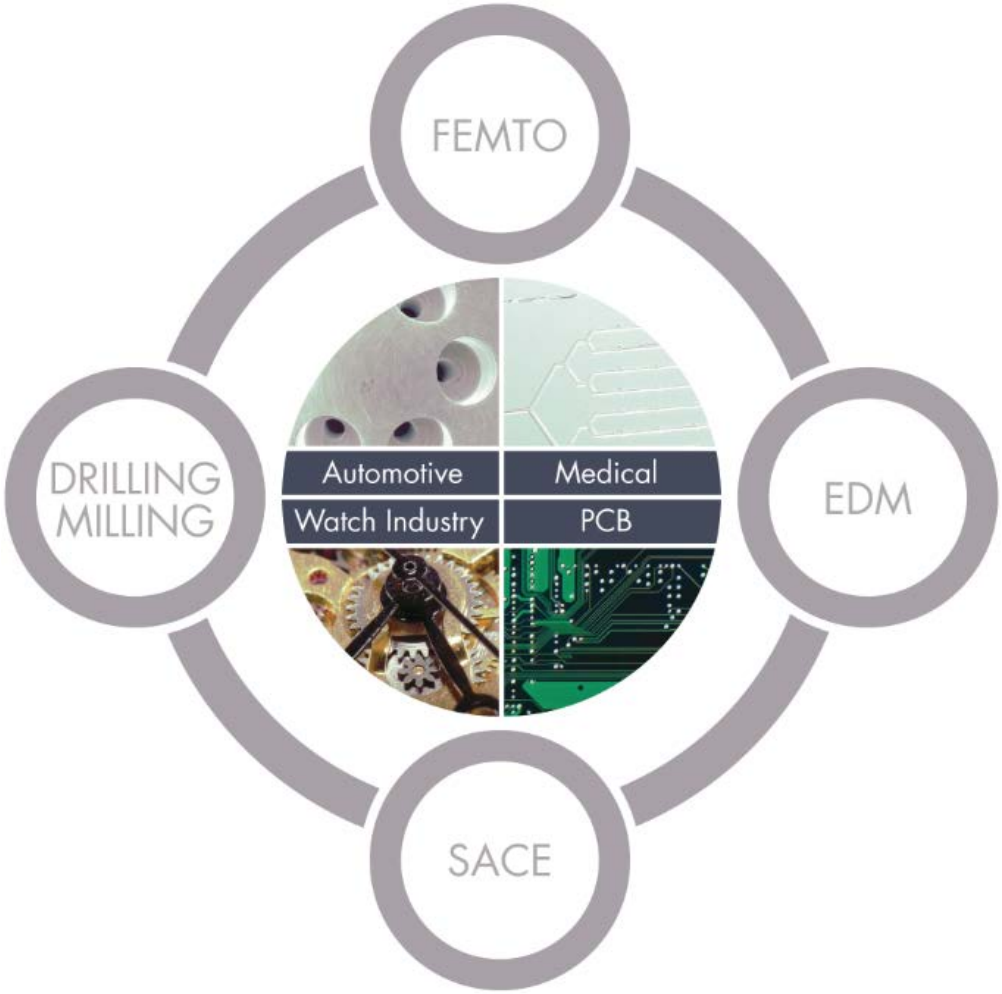
Development and industrialization of standardized high-technology machines for mass production in niche markets

Fulfill and exceed our **customers expectations**, internal & external

Attract, develop and retain highly talented people to ensure **long-term success** for Posalux

Foster national and **international collaborations with Universities** and Universities of applied sciences to increase the speed of innovation

Four technology families for four markets



Posalux Core Competencies

Joint development of future applications with our customers,
to meet and exceed product-process specifications

Supply of highly accurate and productive equipment,
95% for export worldwide

We provide **complete solutions** – not only machine tools

Application knowledge and **process support** for our customers

Worldwide Service - active and very efficient worldwide

Excellent knowledge of our **worldwide markets**

Posalux Customers

Major customers are Automotive and Electronics with strong requirements. E.G. to reach final goals: PPM 0km < 2 and vehicles warranties from 2 to 7 years

Quality first : Cpk > 1,67 / Cp > 2,0

FMEA process mandatory with customers, final concept and design validated in common with Posalux and customers

Common building for maintenance plans and setting

Posalux warranty from 18 to 24 months, service reactivity max 24h

Quality dossier, with measurements report by Posalux, arrived from customer equivalent or better devices

Individual traceability or post process devices integration…

POSALUX - 4 Technologies

µ-Machining

µ-Drilling & Routing

Milling

EDM

µ-Drilling & µ-Milling

SACE

Drilling, µ-Cutting, µ-Milling & Texturation

Femto-LASER

Femto for µ-Drilling, µ-Cutting & Ablation

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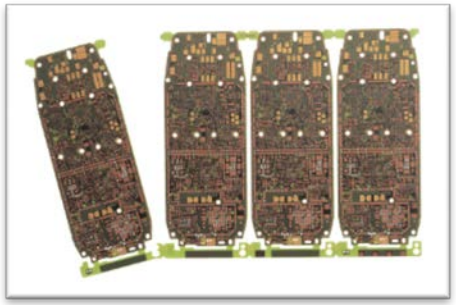
2D µ-Drilling and Routing

Specifications

- Hole diameter of 75 microns
- Hit rate: 1’200 hit/min/spindle
- Accuracy ±25 microns
- Axes acceleration up to 4g
- Diameter/depth ratio 1/10
- 12 spindles per machine
- 12’000 tools embedded



Applications

Dedicated to non ferrous material

- Printed circuit board (PCB) ➔ epoxy-glass fiber
- Watch industry ➔ brass
- Aerospace industry ➔ aluminum

2D µ-Drilling and Routing

Technology

- High frequency spindle 350’000 rpm
- Full linear motion
- Tool management
- Controlled depth +/- 10 microns
- SPC (Statistical Process Control)
- Tactile and intuitive MMI

Machine configuration

- GA6000: 6 stations, 6 or 12 spindles — up to 6’000 tools
- DUO, TRIO: 2 or 3 stations, 2 to 6 spindles — up to 4’200 tools
- MONO: 1 station, 1 or 2 spindles — up to 2’000 tools

µ-Drilling-Routing Mono-E

Specifications

- Tool diameter from 100 microns
- Hit rate: up to 484 hit/min/spindle
- Accuracy +/- 4 microns
- Axes acceleration up to 4g
- Diameter/depth ratio 1/10
- 2 spindles per machine
- 2'000 tools embedded

Applications

Dedicated to non ferrous material

- Watch industry ➔ Brass
- Medical ➔ Titanium, Aluminum

High precise Drilling-Routing Mono-E

Technology

- High frequency spindle 200’000 rpm
- High stiffness routing spindle 60’000 rpm
- Full linear motion
- Tool management
- Controlled depth +/- 10 microns
- SPC (Statistical Process Control)
- Tactile and intuitive MMI

Machine configuration

- MONO: 1 station, 2 spindles, up to 2’000 tools
- Automation: individual loader with 8 stacks

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µ-Milling

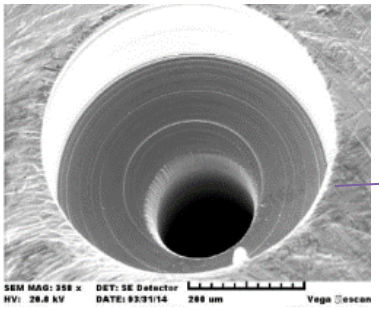
Specifications

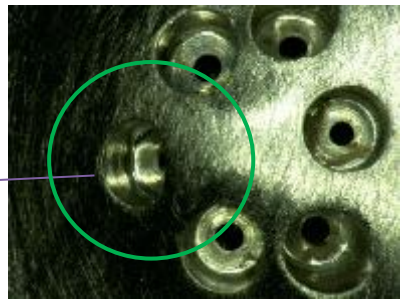
- µ-Milling for hardened material e.g.< 67 HRC, ∅ 0.3 - 0.9 mm
- High productivity: 6 step-holes and 2 marks < 11 sec
- Vibration reduction during milling process
- Cutting force optimized
- Tool life optimized > 5'000 holes
- Dedicated to customer application

Applications

Dedicated to hardened ferrous material

- Stainless steel
- Titanium
- Automotive and Medical



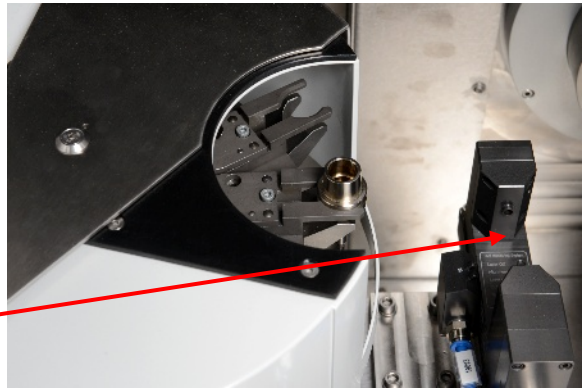


µ-Milling

Tool magazine
(12 positions)

Milling process

Tool check @100%
by laser



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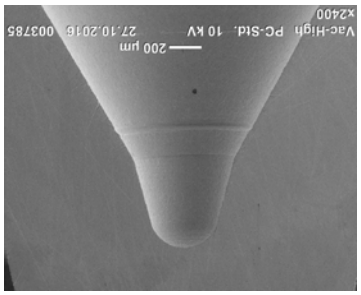
Example for µ-Milling

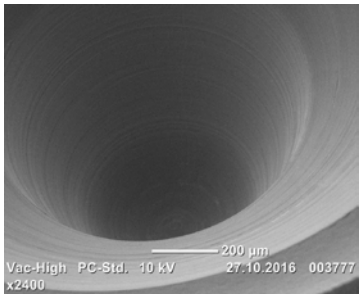
Nozzle micro sac

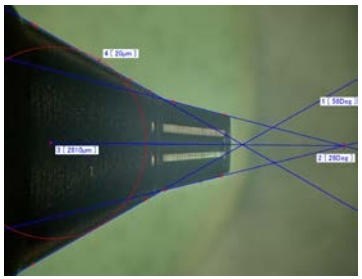
Micro-sac for Nozzle milled after heat-treatment.
Control Sac volume (position + diameter), strong repeatability

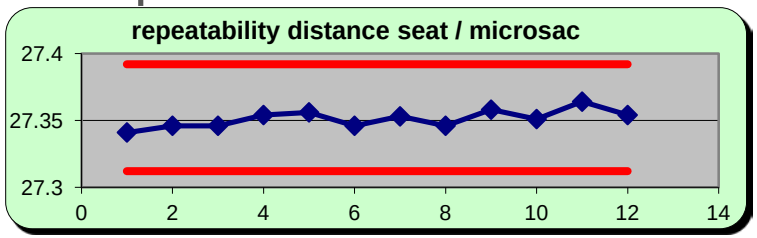
Advantages:

- Concentricity between Seat and Sac
- Correction of microsac roundness **after heat-treatment**
- Control microsac volume and no presence of burrs









Tol. distance seat/micro-sac ± 20 µm
Concentricity <15 µm
Roundness <5 µm
Roughness Ra <0.37 µm

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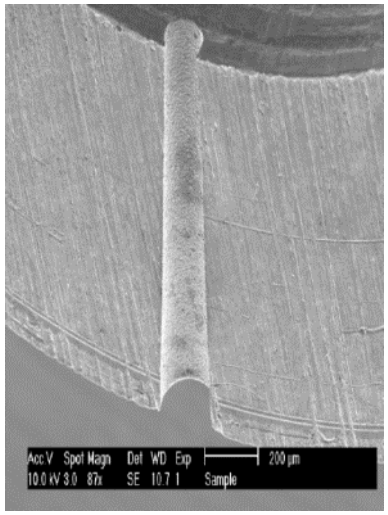
µ-Drilling with EDM

Specifications

- Hole diameter of 50 microns
- Accuracy +/- 3 microns
- Diameter/depth ratio 1/12
- 4 spindles per machine
- Conical hole
- Positive and negative taper
- Blind shapes, step holes

Ø 50 µm



Applications

Dedicated to conductive material

- Automotive industry : - Diesel high pressure
  - Gasoline Direct Injection (GDI)

µ-Drilling with EDM

Technology

- Short pulse SARIX generator (80 nano secondes)
- Regulation by average voltage
- 6 axes machine

Machine configuration

- HP4: 1, 2 or 4 spindles
- FP1 – HFP : 1 spindle

- Available options

➔ Automatic load/unload of parts
➔ Flow control
➔ Individual traceability
➔ Camera positionning

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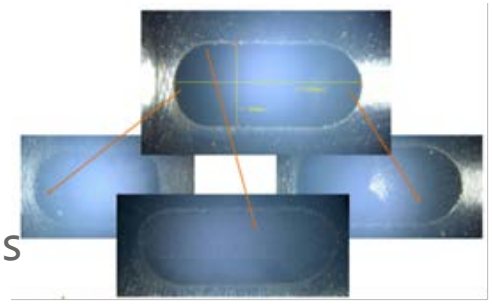
µ-Drilling with EDM

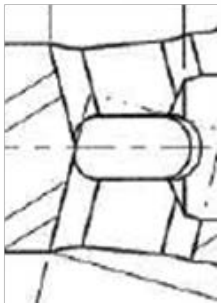
New 2017 serial machines : HP4-EDM V7

- Productivity improvements : more than +30%
- 6 axes machine & 3 axis interpolations
- Tilting head : accuracy increase at 0.1 µm instead of 1
- New generator with low energy : machining small hole with surface finish from Ra 0.3 µm to Ra 0.15 µm
- Integration of a current measurement accuracy for measuring spark lower than 100 ns and lower amperage

HP4
FP1

- 3 axis interpolations





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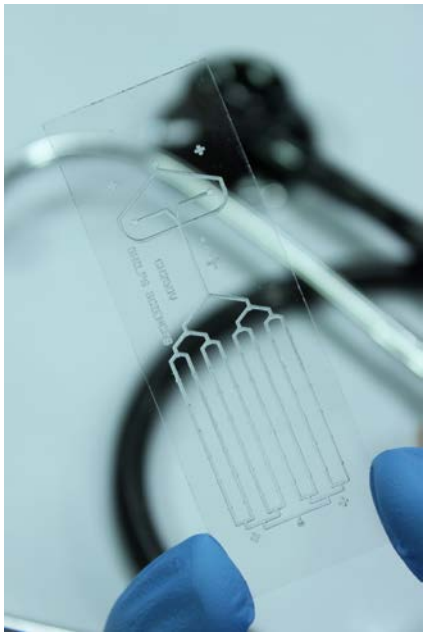
Spark Assisted Chemical Engraving

Micromachining of glass

(and all materials that contain SiO_2)

Glass, a fantastic material



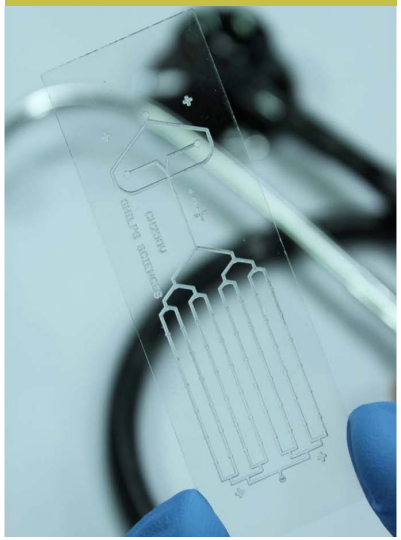
- ✓ Sterilisable
- ✓ Wide optical transparency
- ✓ Impermeable to gases
- ✓ Low thermal expansion
- ✓ Excellent chemical inertness
- ✓ Biocompatible

Nevertheless glass is difficult to machine…

until SACE technology introduction

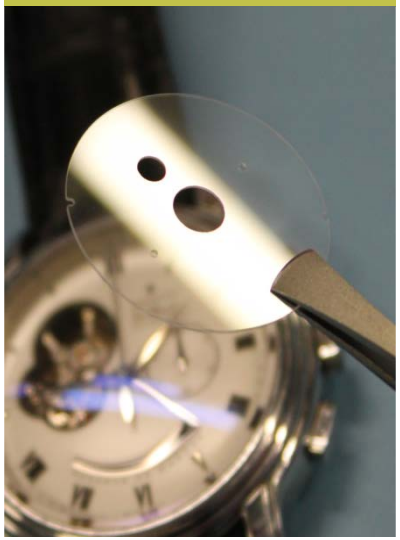
Various applications

Medical



- Medical (Lab-On-Chip)
- Chemical (mixer chips, micro-reactor)
- Multi-layers chips

Watch Industry

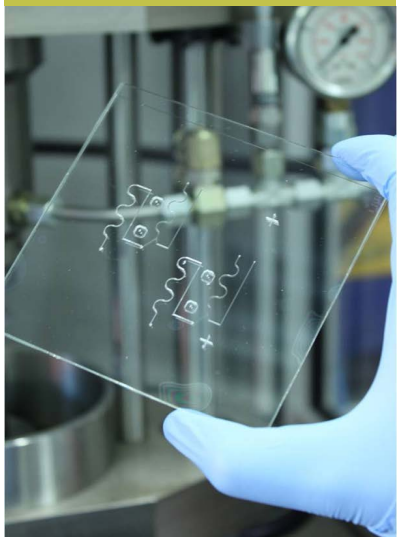


- Watch dial glass
- Mechanical parts
- Process for product anti-counterfeiting marks

Consumer Electronics

- Through Glass Vias (TGV)
- Packaging
- Automatic “stop etch function” when touching conductive layer

Rapid Prototyping



- Industrial R&D
- Fundamental Research
- Surface texturing
- “Batch Size 1”

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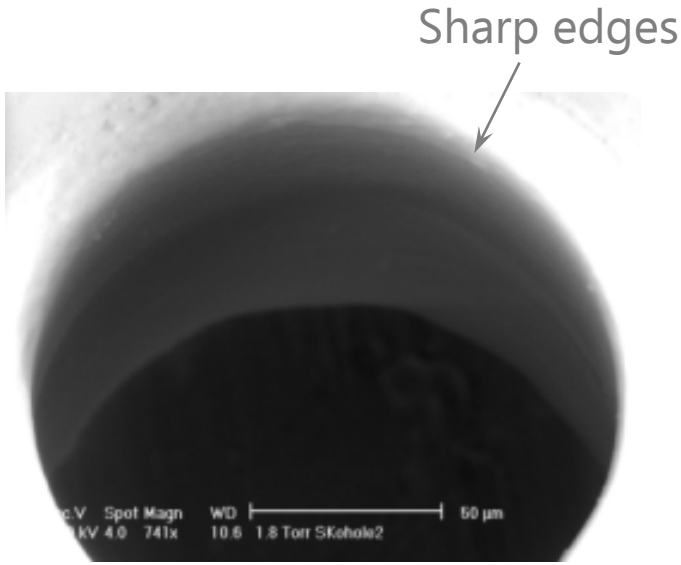
Why the SACE ?

SACE is a solution with:

- ✓ No micro-cracks
- ✓ No burs (easy fusion bonding)
- ✓ No masks needed
- ✓ No highly toxic chemicals, No HF

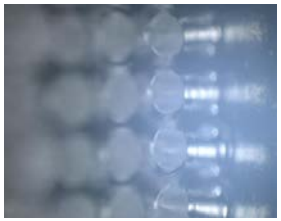
- ✓ Clean room compatible
- ✓ Flexible technology

- ✓ And cost effective :
  - Low cost chemical used (NaOH, KOH)
  - Low cost tools (similar to used in PCB)
  - Long life of the tools
  - Low maintenance



Which materials

Glass
Pyrex,
BF33,
D263T,
Mempax,
AF32,
B270,
…

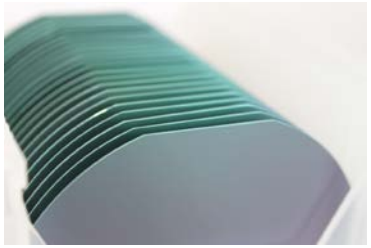


Quartz
Fused silica

All materials that contains SiO_2

Enamel

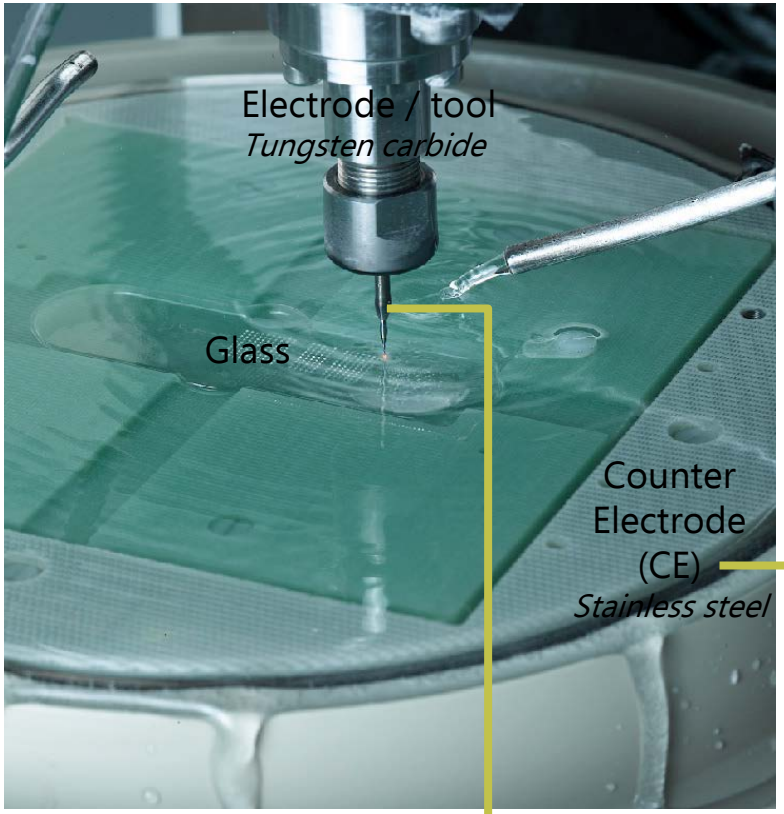
Tempered glass
Corning Gorilla,
AGC Dragontrail,
Schott Xensation,
…

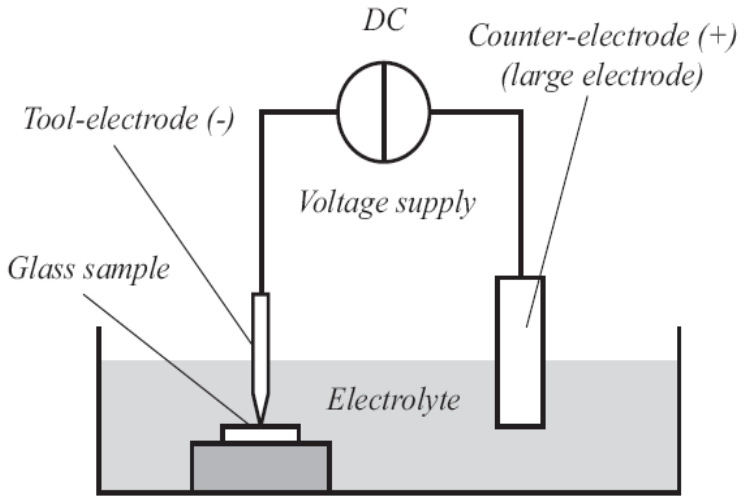


Silicon

How does the SACE work?

SACE setup





A potential is applied
between
the tool and a counter electrode

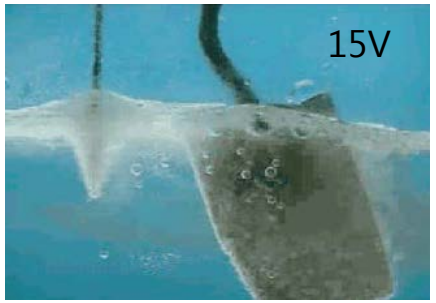
Voltage supply (DC)

Gas film and spark formation

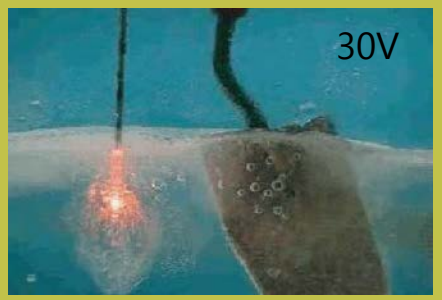
$$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$$

Potential applied to the tool

Gas film production around the tool

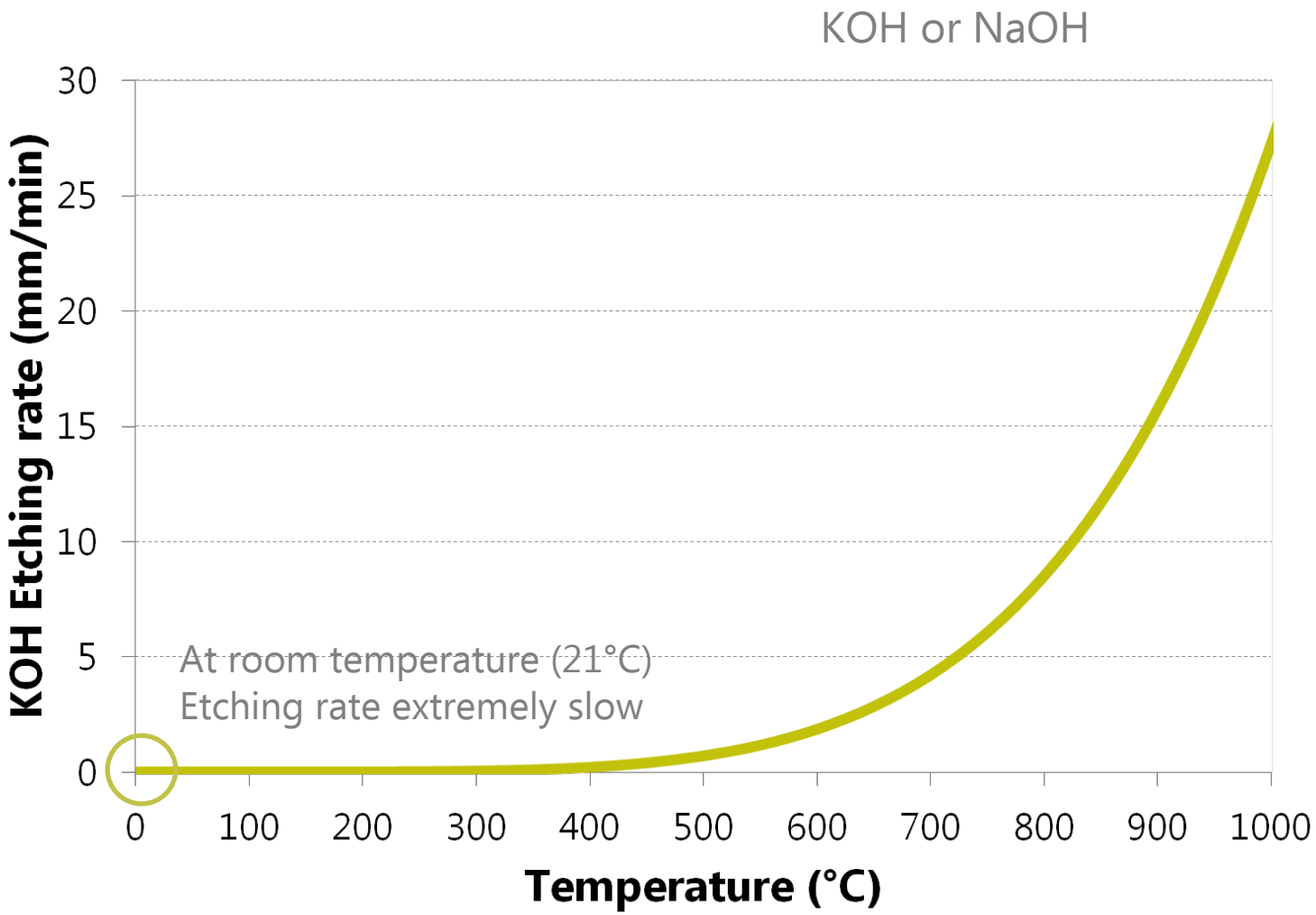


Gas film electrochemically formed insulate tool from electrolyte (t ~ 5ms)

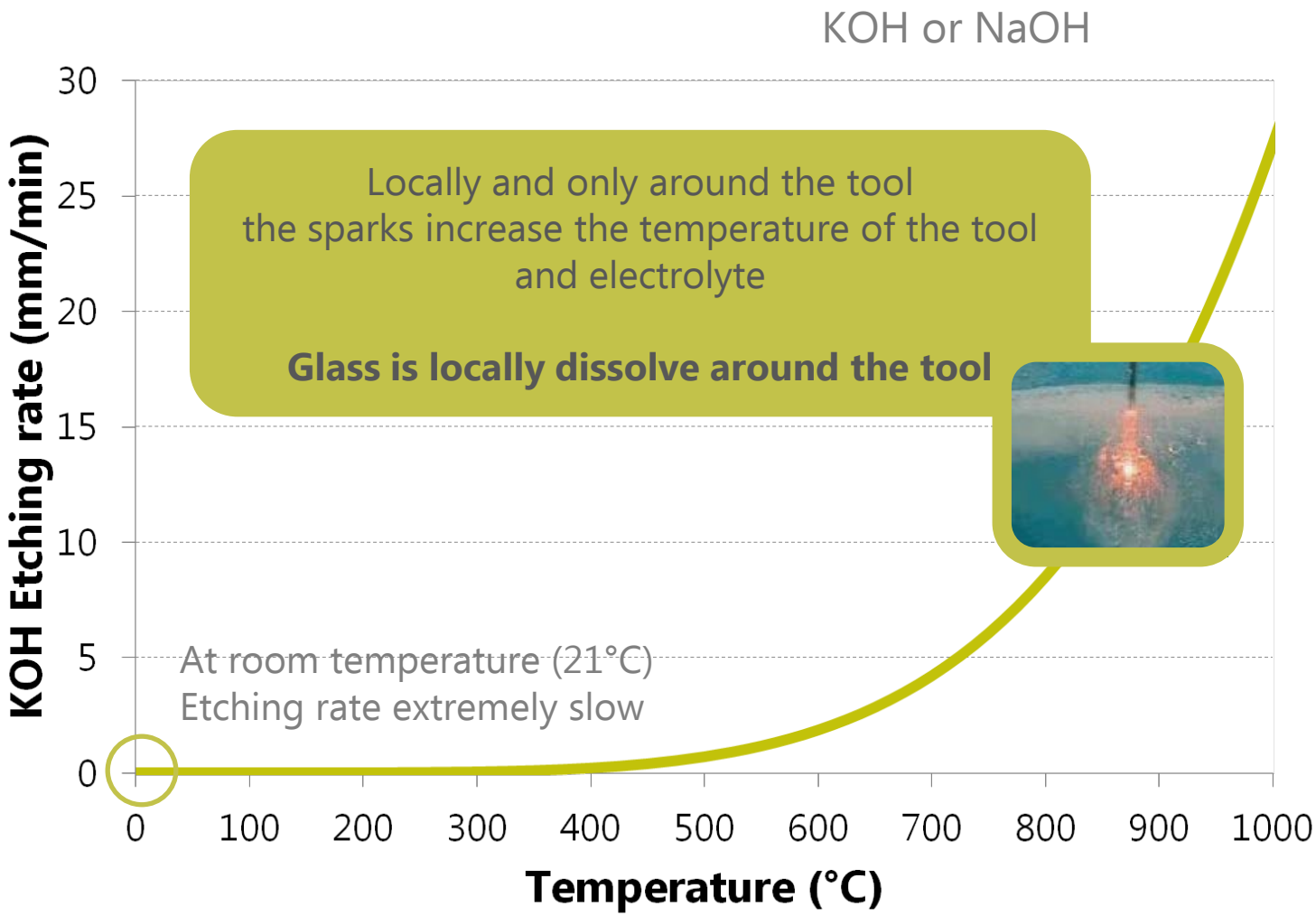


Sparks appear through gas film (U>30V)

SACE Electrolyte



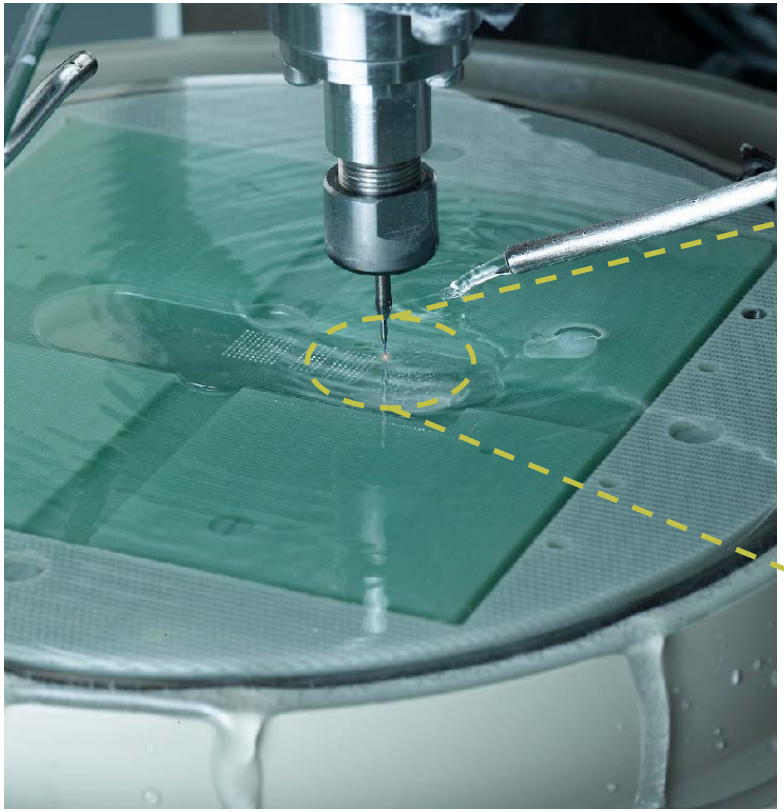
SACE Electrolyte

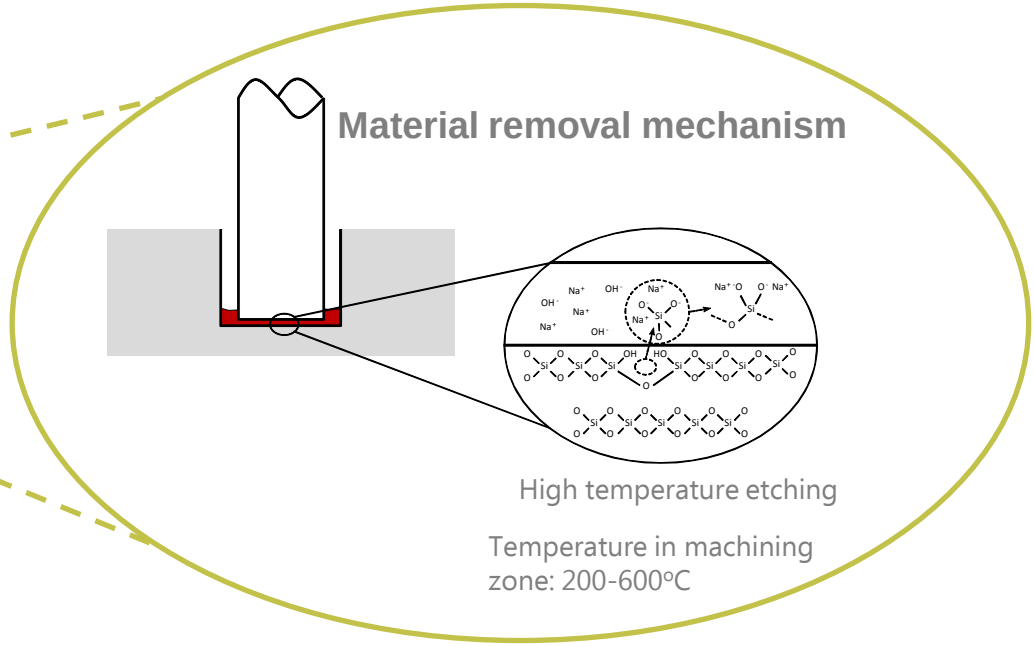


SACE a hybrid process

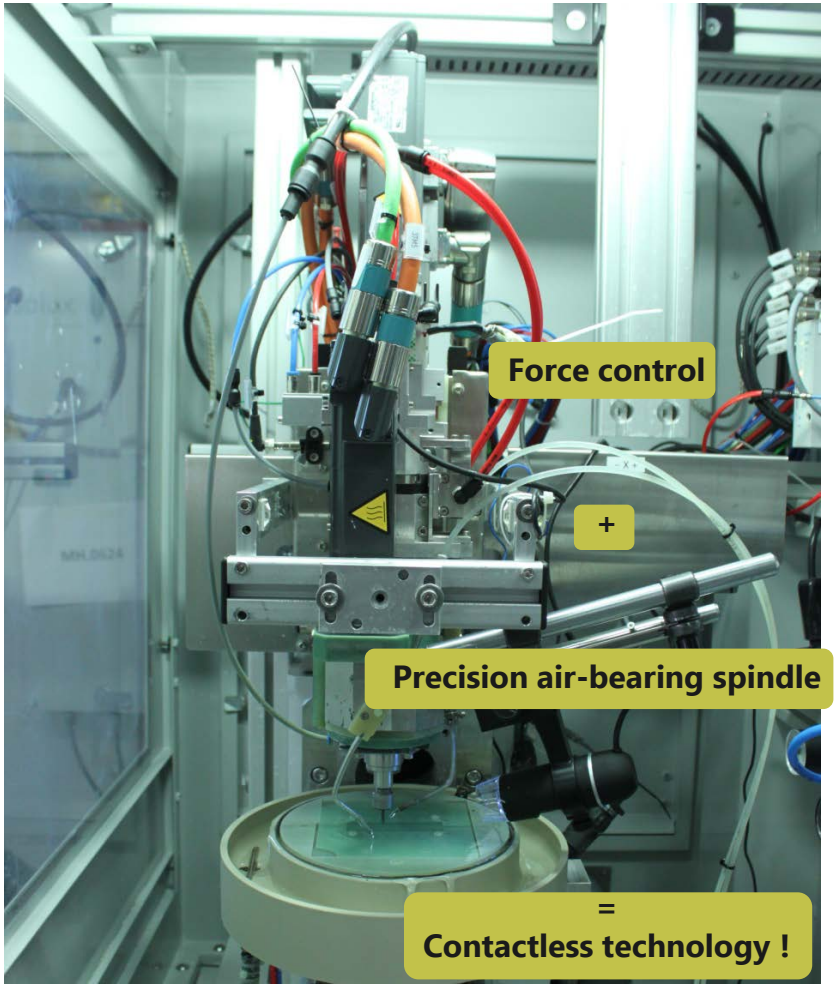
SACE combines advantages from 3 processes:

- Chemical ➔ good surface quality
- Thermal ➔ speed
- Mechanical ➔ versatility





SACE a unique and patented technology



Glass is a strong and brittle material to machine

Our patented spindle machine the glass with **zero force**

Polishing step

Only electrochemical process machines it !

Accuracy achieved and expected

➢Test part done on demonstrator (with encoder for loop control)

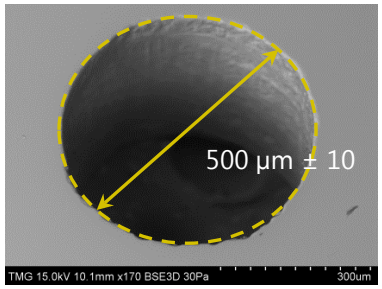
	Position			
	X	Y	Diameter	Circularity
NOM	0	0	0.22	0
MEAN	-0.0020	-0.0001	0.2260	0.0093
MAX	0.0007	0.0009	0.2278	0.0137
MIN	-0.0050	-0.0012	0.2234	0.0073
RANGE	0.0057	0.0021	0.0044	0.0064
STD DEV.	0.0016	0.0006	0.0011	0.0013

➢Expectation on production machine (with linear scale for loop control)

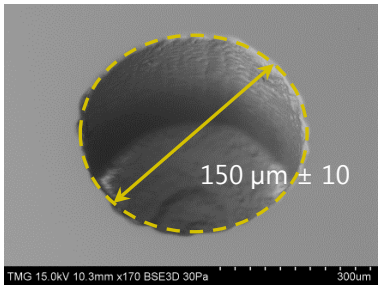
	Position	diameter	Circularity
STD DEV	<0.0005	<0.001	<0.001

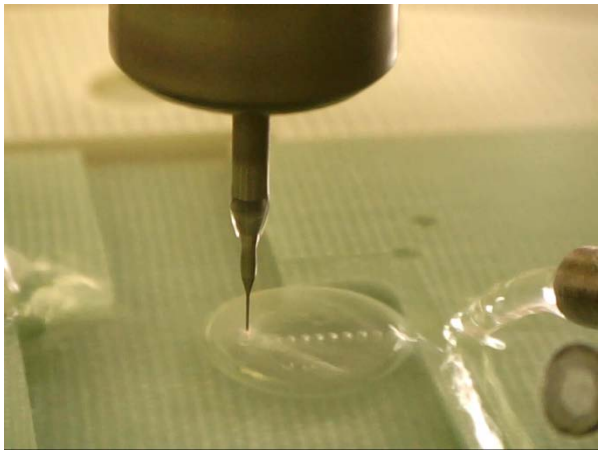
Drilling

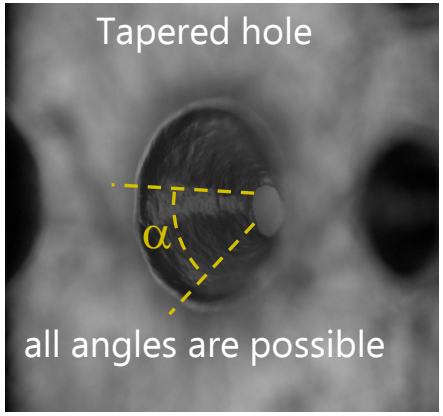
hole

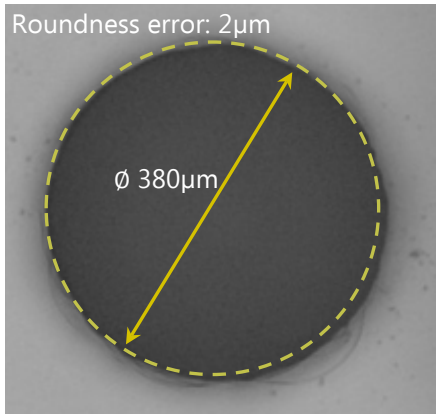


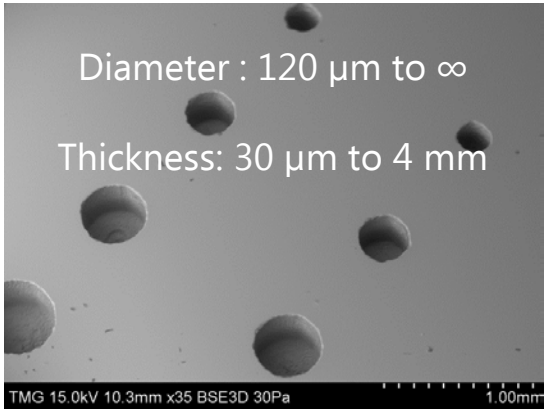
Blind hole











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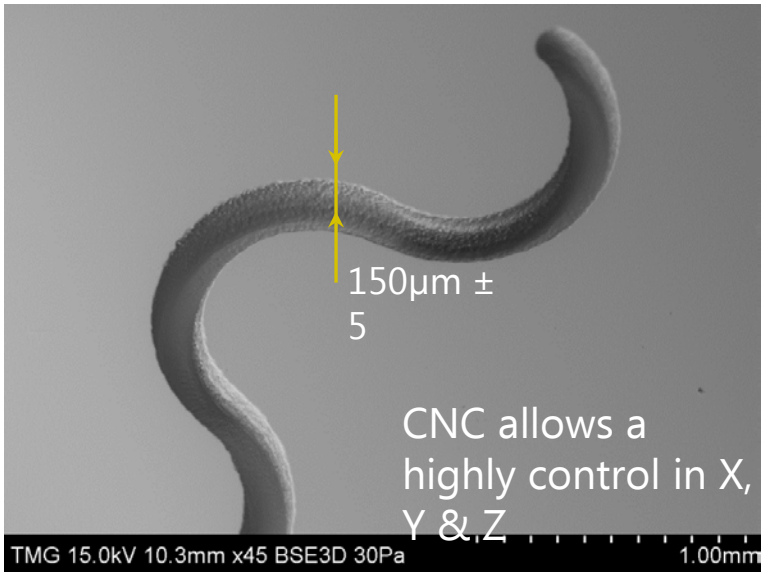
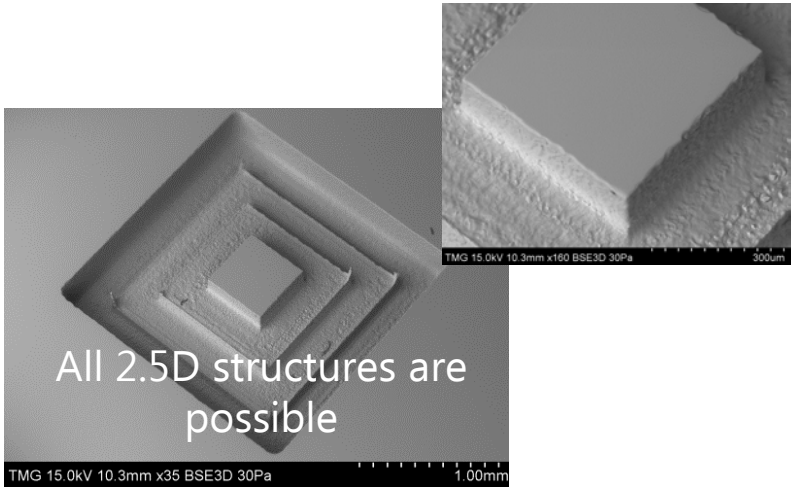
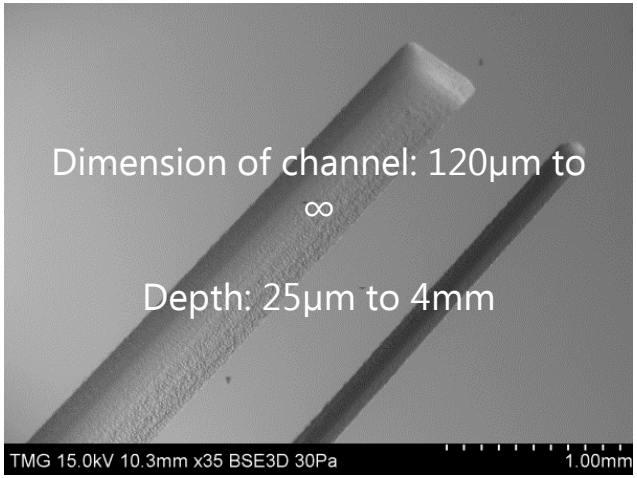
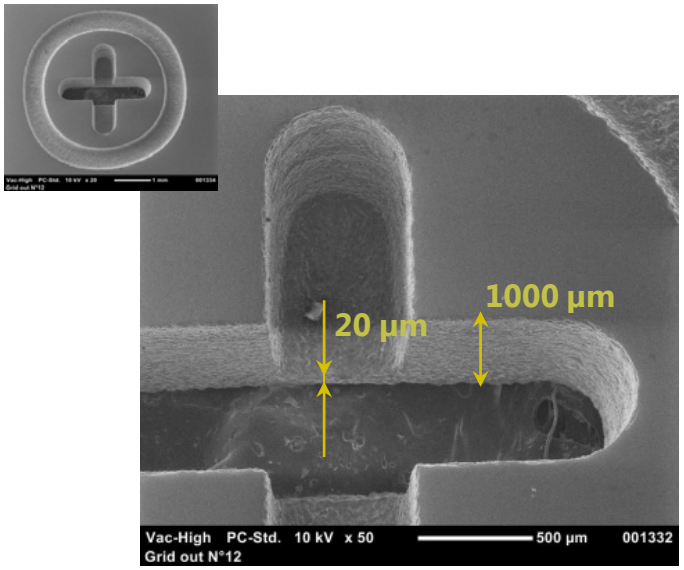
Milling









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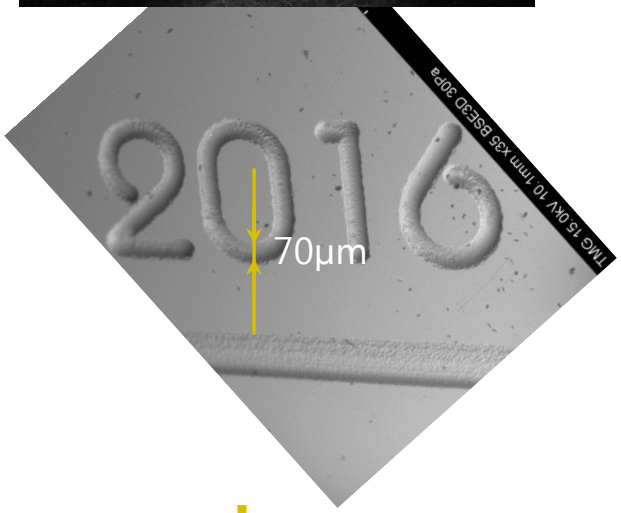
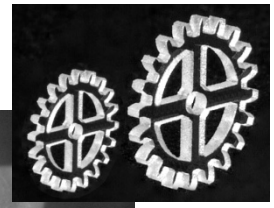
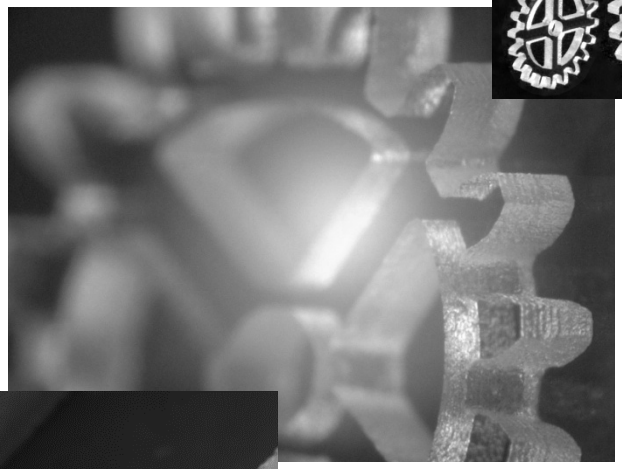
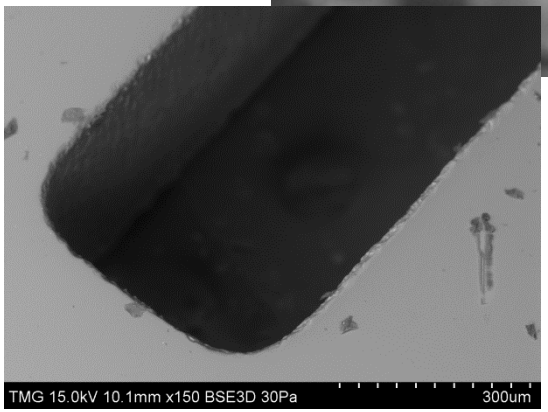
Engraving & cutting



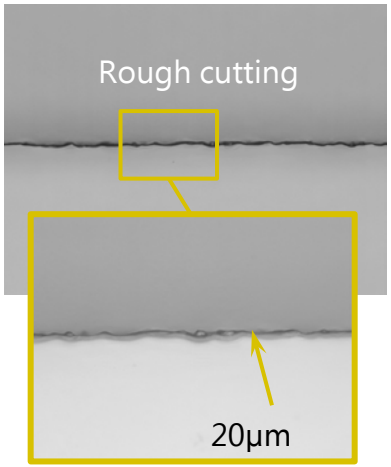


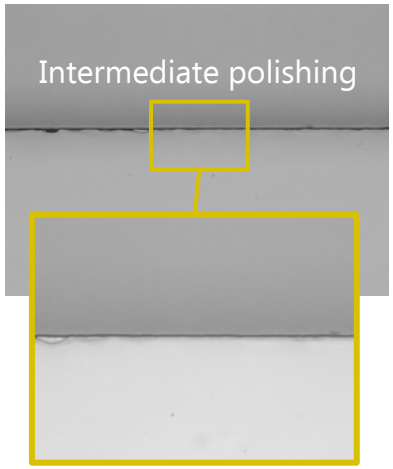


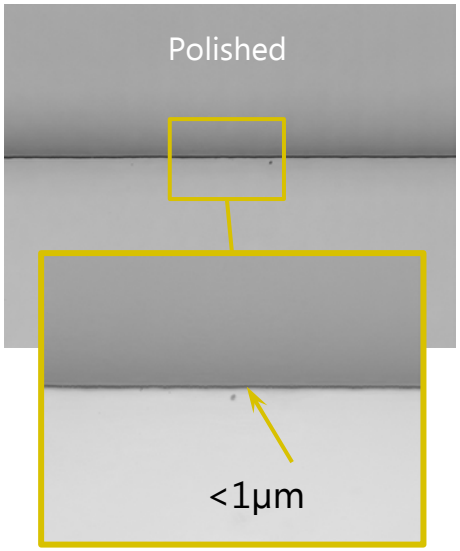


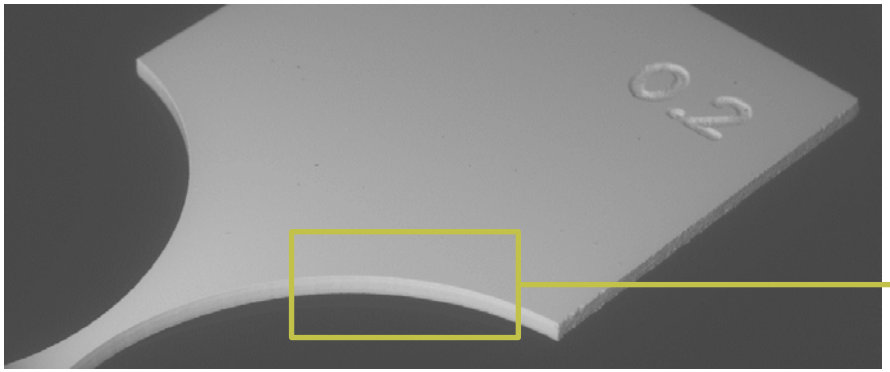
Cutting thickness:
30µm to 4mm

Surface finishing

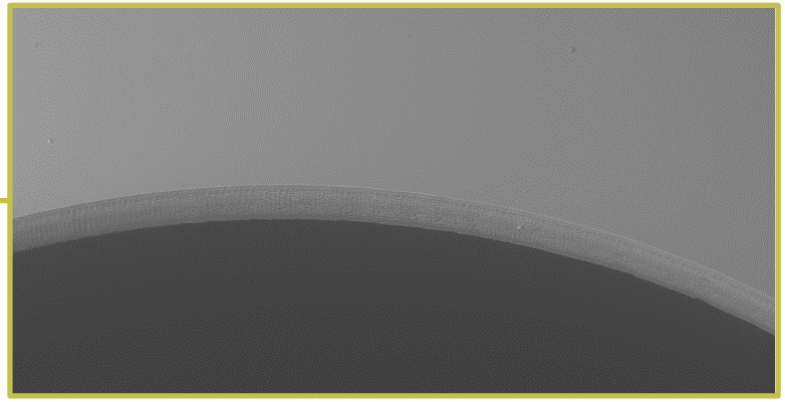






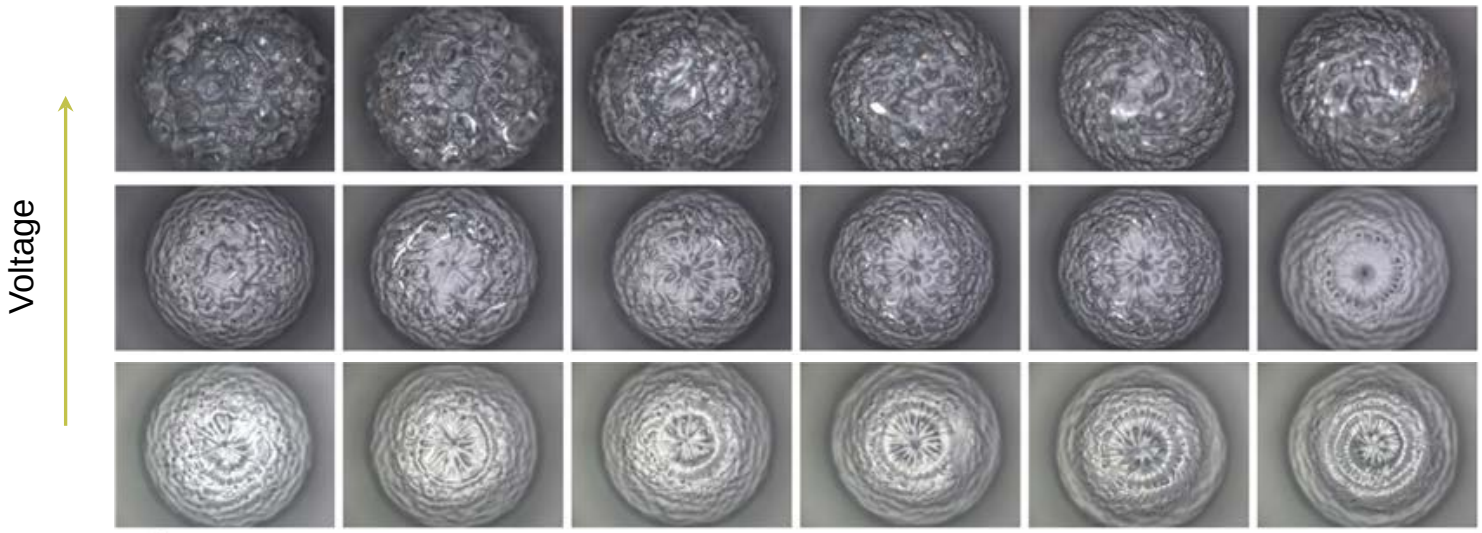


Glass thickness: 500 µm



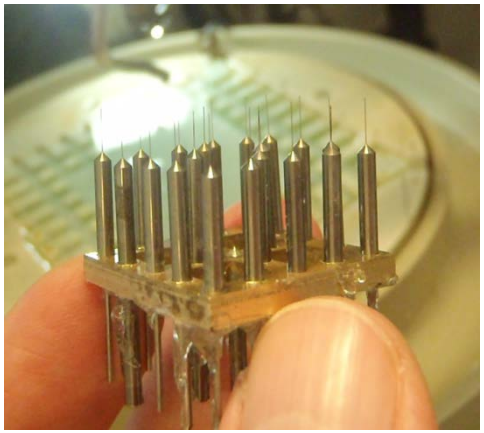
Surface texturing

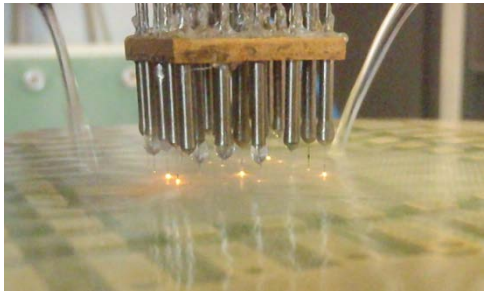
Micro-hole texturation

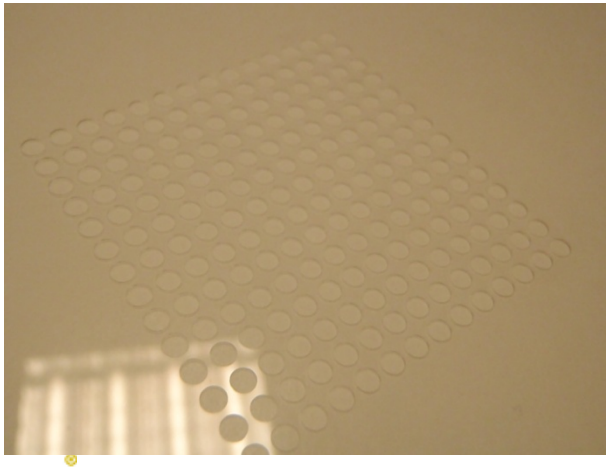


Different machining settings generate
different controlled surface patterns

High productivity with multiple tool approach







Example:
Diameter: _____2’600 µm
Thickness: _____300 µm

$$\frac{38\ s}{25\ tools} = 1.5\ s/hole$$

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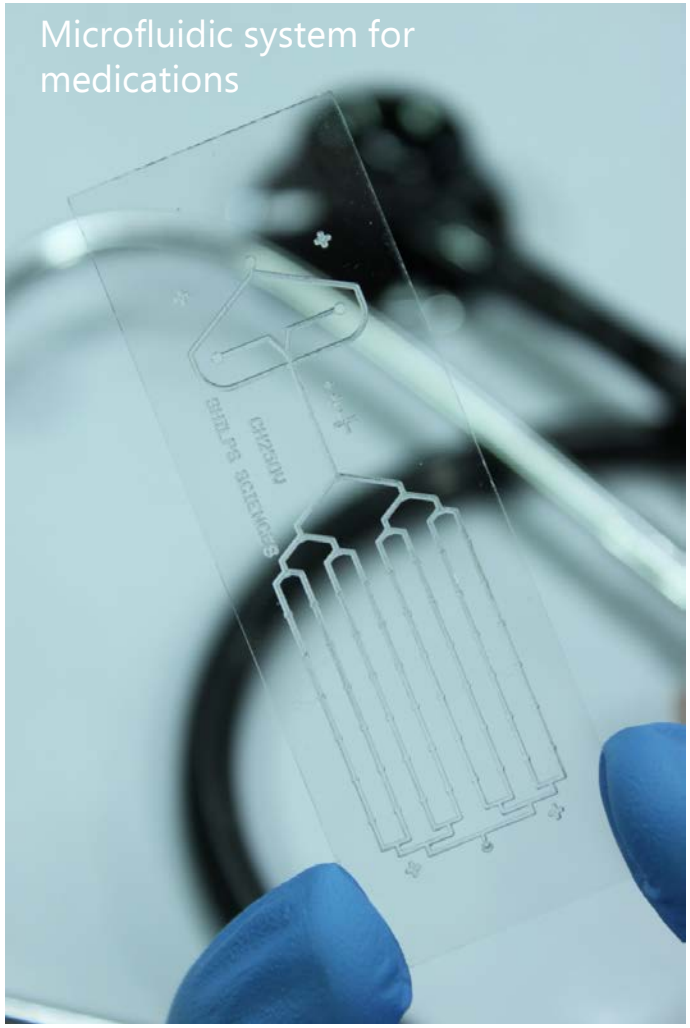
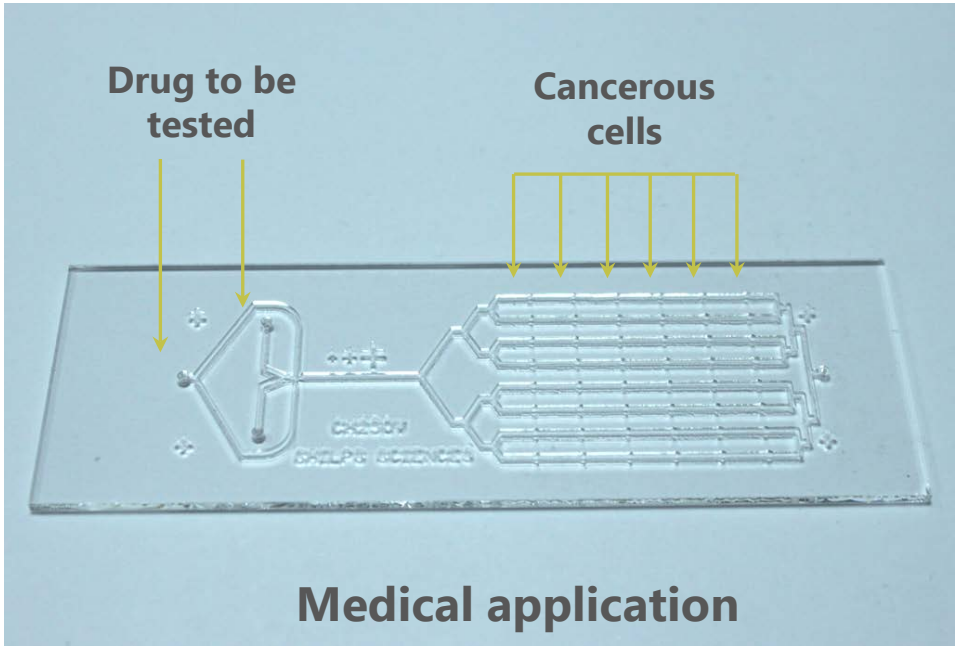
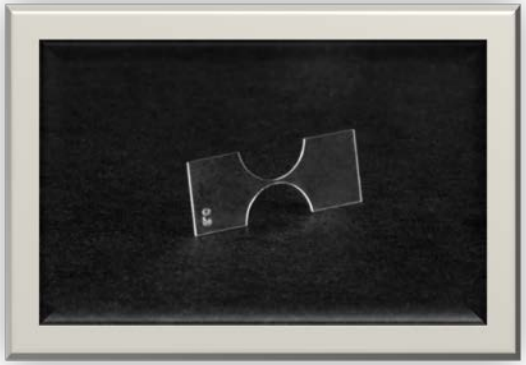
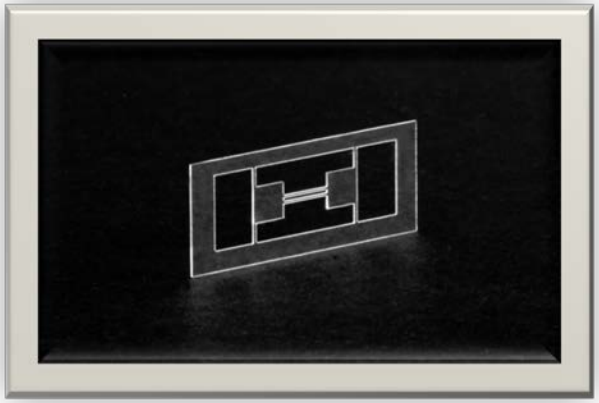
Lab on chip for high speed diagnostic





Samples





Modular machine concept

POSALUX - 4 Technologies

µ-Machining

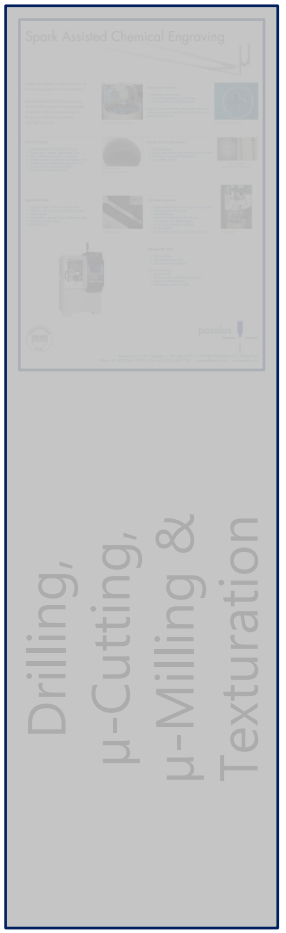
µ-Drilling & Routing

Milling

EDM

µ-Drilling & µ-Milling

SACE



Drilling, µ-Cutting, µ-Milling & Texturation

Femto-LASER

Femto for µ-Drilling, µ-Cutting & Ablation

Posalux Femto Laser

After a long and successful history on EDM and µ-Machining technologies for robust industrial applications targeting:

- Micro machining of special and stressed parts
- Stable and repeatable Quality
- Accuracy for mass productions
- Mass-production with flexible and versatile possibilities

Posalux focus on **Femto Laser Technology** for high precision **µ-Machining** since 2011

First serial Femto Laser machines are in production since end of 2014 and work 24/7

Posalux Femto Laser

Posalux made the choice to:

- **develop niches applications** which require a high level of skills
- build **long term industrial partnership** with our customers

Posalux **is not an integrator** of Laser equipments, we **develop industrial processes** to meet **Customer Quality requirements**.
For this, measurement equipment as **Gauges, SEM, Flow-bench** are available @ Posalux to document the manufacturing processes

Posalux build and continues to build **partnership with key actors in Industrial Femto Laser applications**

- 2 suppliers/partners for Femto Laser sources *(less than 300 fs)*
- 2 suppliers/partners for Precession heads

Laser Sources

- LIGHT CONVERSION (LT based + WW) _____ *More than 3 years*
- AMPLITUDE Systèmes (FR-US based + WW) _____ *More than 2 years*

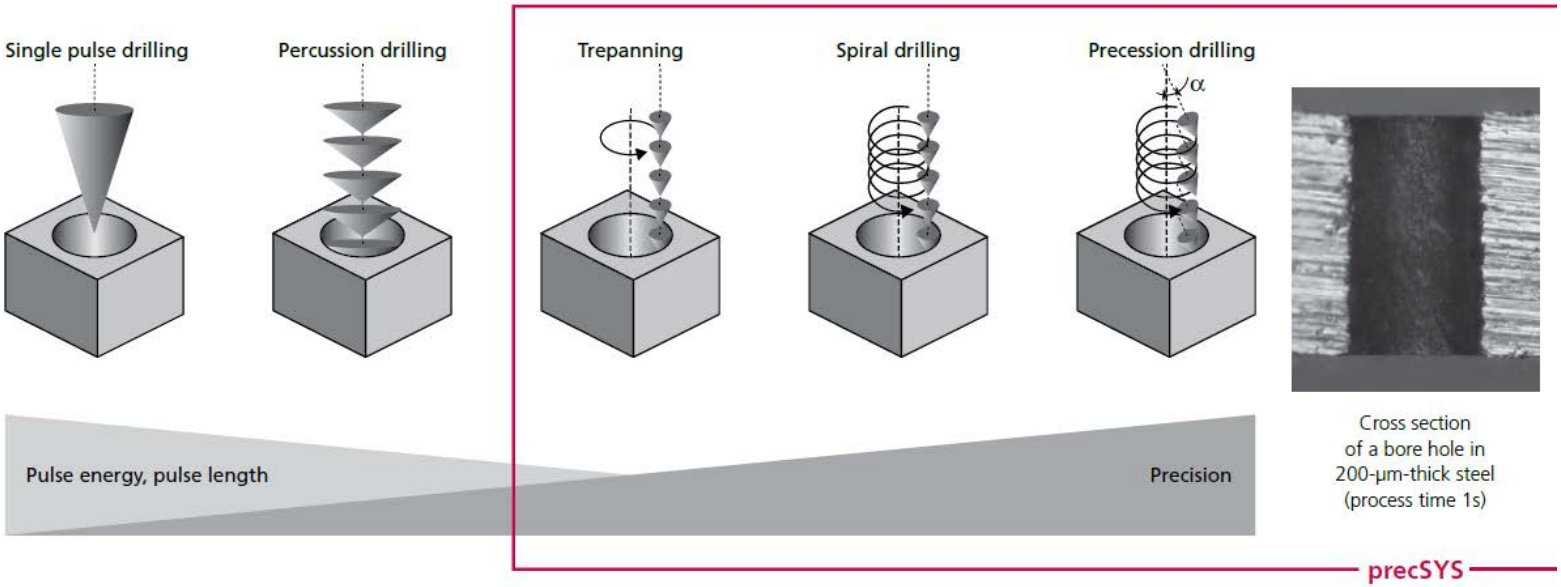
5 axis Precession Head

- SCANLAB (GE based + WW based) _____ *More than 3 years*
- CANON (WW based) _____ *More than 1 year*

Precession Head SCANLAB - precSYS

Flexible 5-axis micro processing

- The possibility to position the laser beam in 5 axis (x, y, z, α, β) offers highest flexibility for process development
- Typical applications: Drilling, Ablation, Structuring, Cutting



Source: SCANLAB GmbH

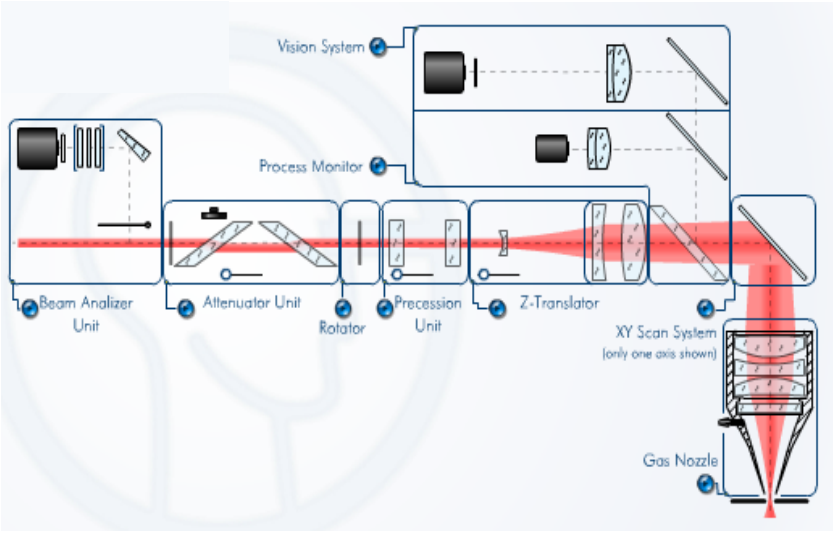
Technology

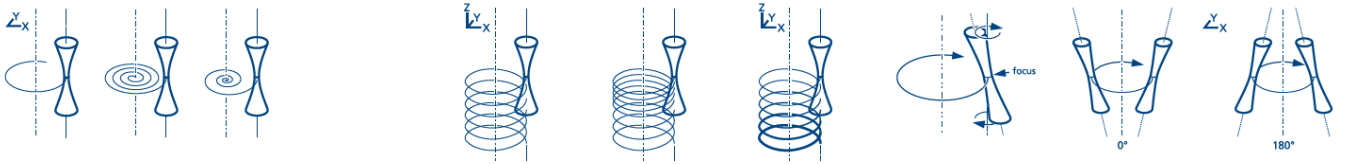
Precession Head

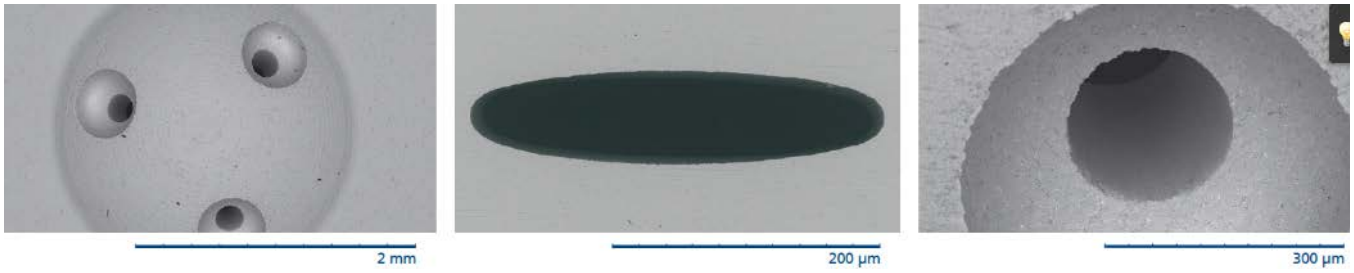
PERFORMANCE

DRILL PARAMETER	TYPICAL VALUE
Hole Diameter Ranger[1]	50 µm-500 µm
Material Thickness[1,2]	~ 1 mm
Cycle Time[3]	~ 2 seconds/hole
Taper Angle Range[1] (full angle)	Pos. & neg. to 10°
Hole Circularity	> 95 %
Surface Quality (inside wall)	R_a < 0.1 µm
Diameter Resolution	< 1 µm
Diameter Repeatability	< 0.4 %
Hole Position Accuracy[4]	± 1 µm

[1] Please inquire regarding features outside this range.
[2] Maximum material thickness is dependent on hole dimension.
[3] Cycle time quoted for 200 µm diameter hole in 200 µm thick 440 stainless steel.
[4] Hole position repeatability is dependent on overall workstation design and quality.







Precession Head

CANON

- Partnership **since 1 year**
- Joint-development **of Customer Applications**
- **Started important customer project** beg. of 2016 for Green Wavelength Applications
- **4 serial machines in production** by end of 2016 with nIR Canon heads

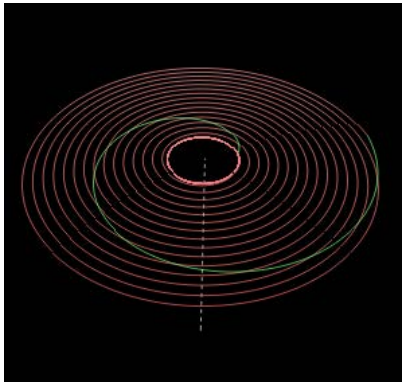
X、Y、Z、θx、θy scan

CANON precession head MA-501 is manufactured with original CANON components (electronic, optics, encoder, scanner, ...)

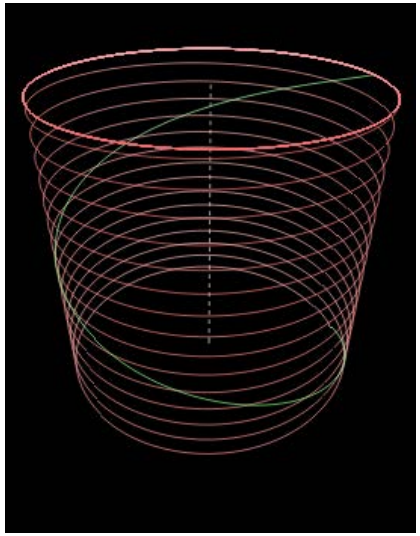
Modeling Approach

There are various ways to drill a hole, but all strategies are always based on a combination of basic movements

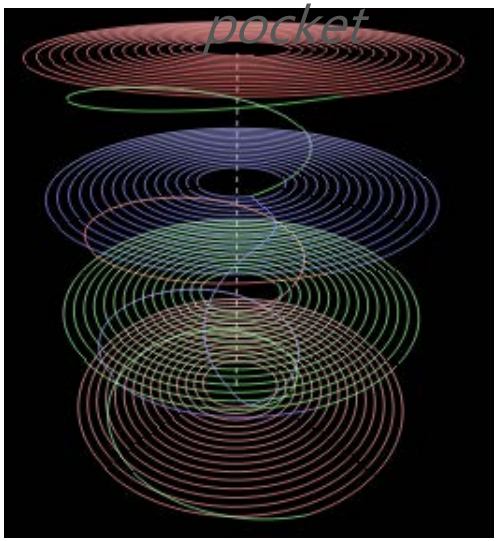
spiraling



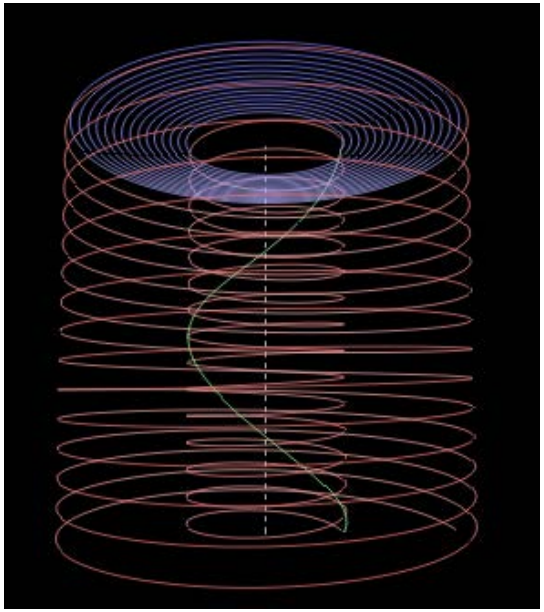
helical



spiraling by pocket

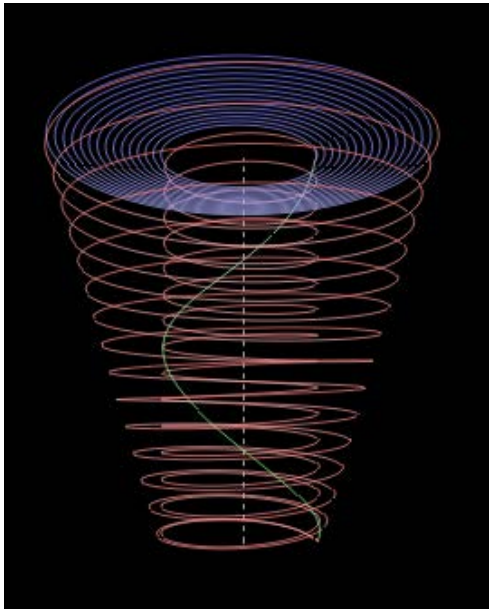


Drilling strategy



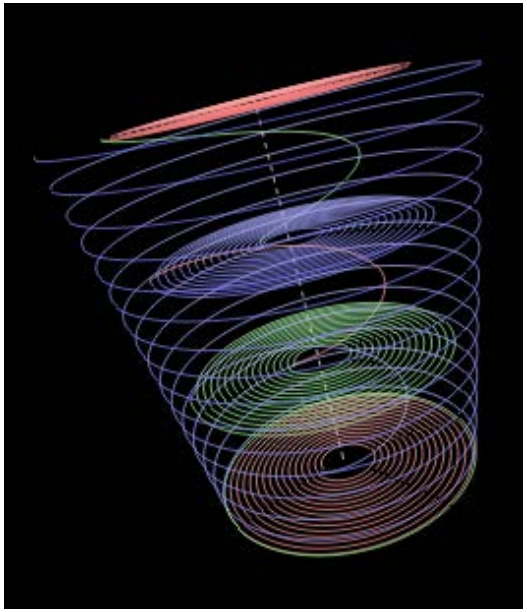
Peckhole :
- helical

Precession hole :
- helical sprialing



Peckhole :
- helical

Precession hole :
- conical helical spiraling



Peckhole :
- spiraling pocket

Precession hole :
- Conical helical spiraling

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LASER FEMTO Applications






Dedicated team of 5 Engineers for process development and support of customer ramp-up phase

Available equipments for these activities:

- ⇨ 2 demonstrator machines
- ⇨ 1 "mono" **serial machine**
- ⇨ 1 bench on active table
- ⇨ 4 precessions heads, 4 Femto Laser sources

Werth Fiber probe measurement equipment, **SEM**, accurate **microscopes**, Hydraulic **flow bench** (to 200 bars, R&R = 10%), **Confocal Laser 3D** surface finish measurement (Oct. 2016)

POSALUX Metrology

Equipments

WERTH – VIDEO CHECK IP400

LEITZ – PMM 12106

SONPLAS oil flow bench

IMPEX MICROVISION PRO X3

Taylor Hobson

KEYENCE – Confocal Laser 3D

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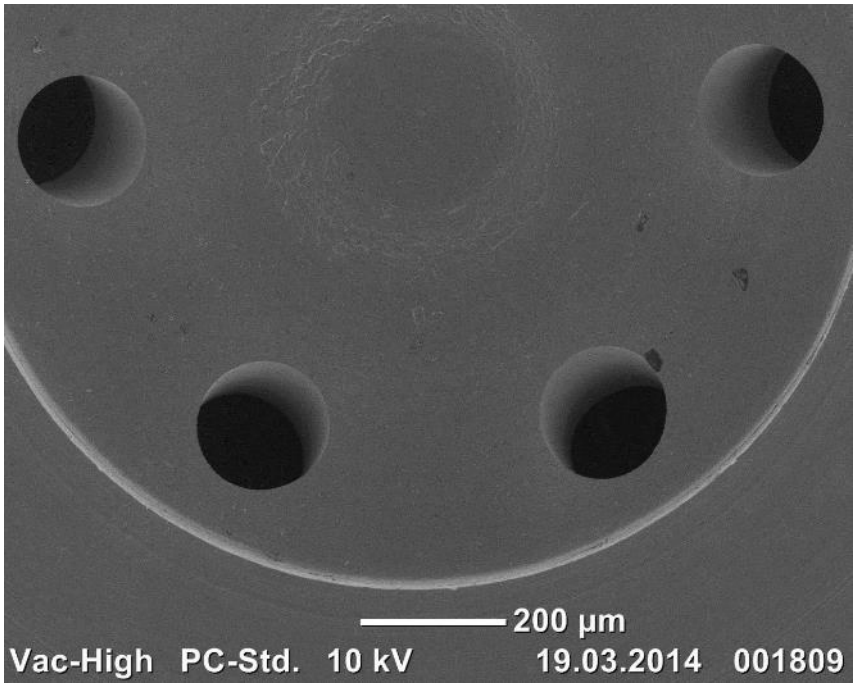
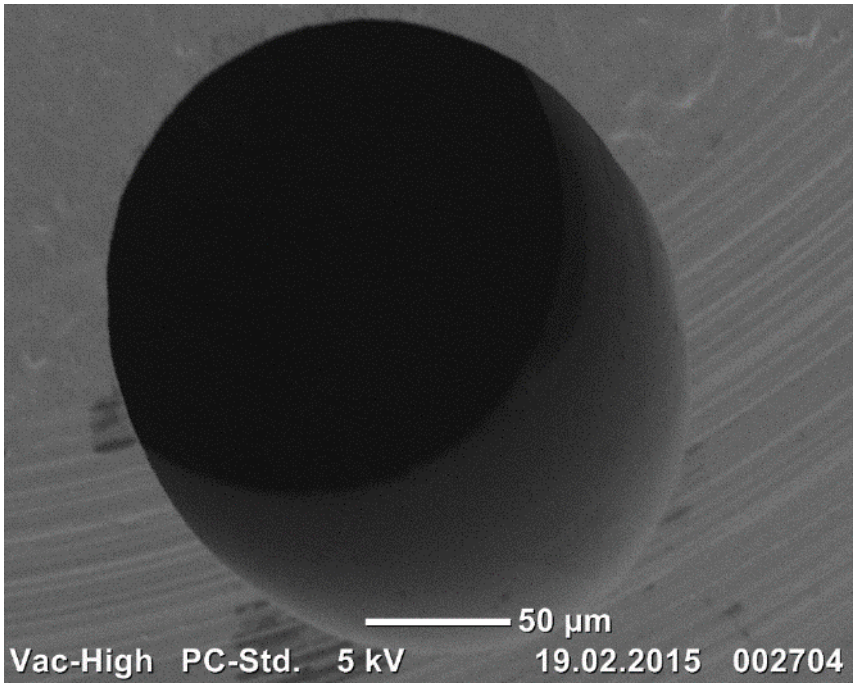
Industrialized processes

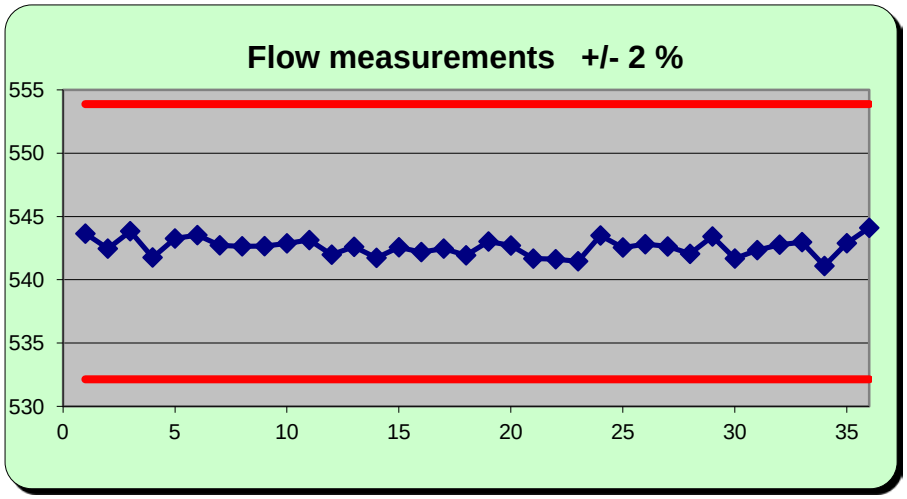
Gasoline Injections orifices





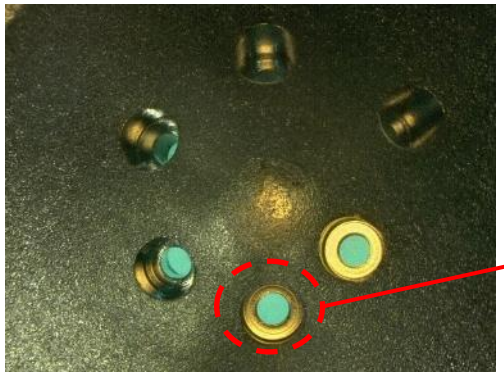
Industrialized processes

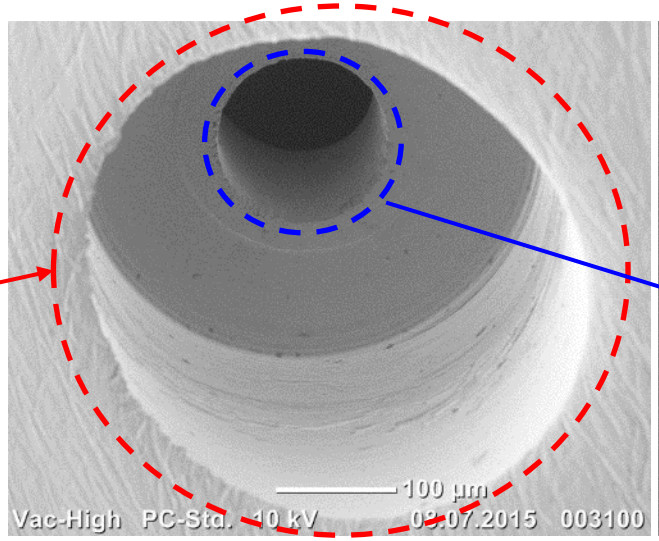
Gasoline Injections orifices

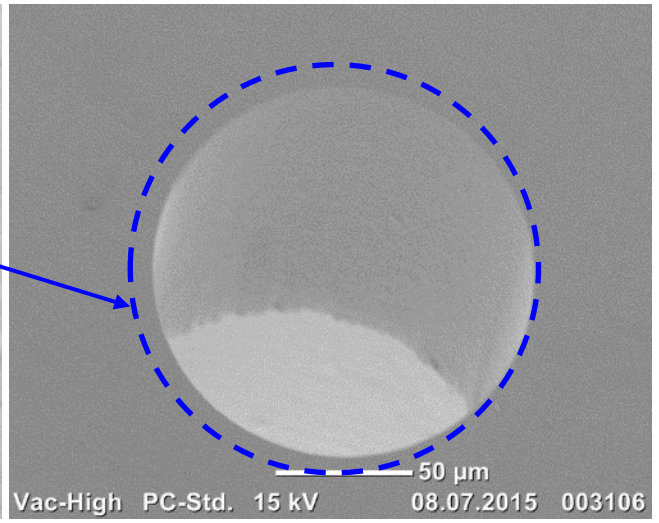


Orifice diameter = 140 µm

Cp	**5.10**
Cpk	**4.91**

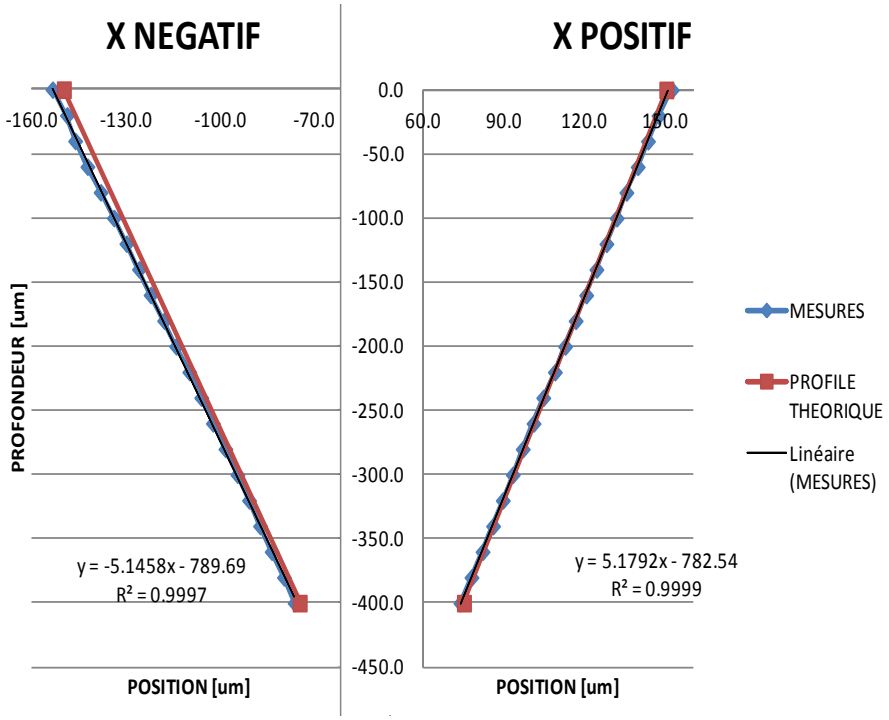


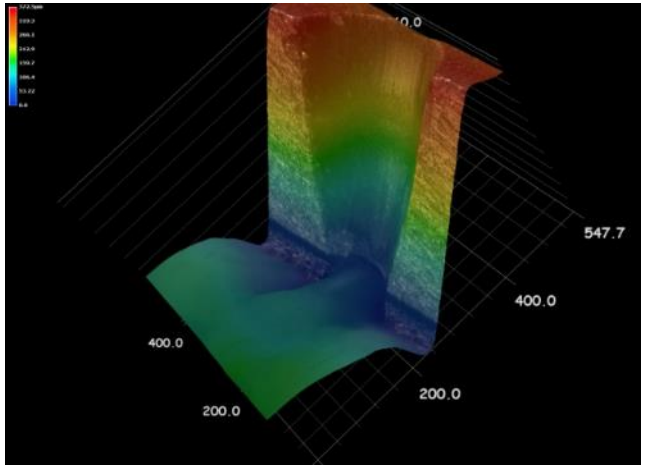


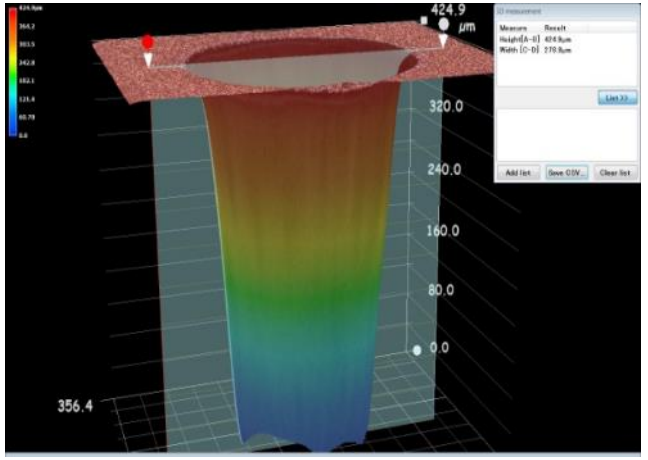


Tapered hole drilling

-15° to +23° in Steel







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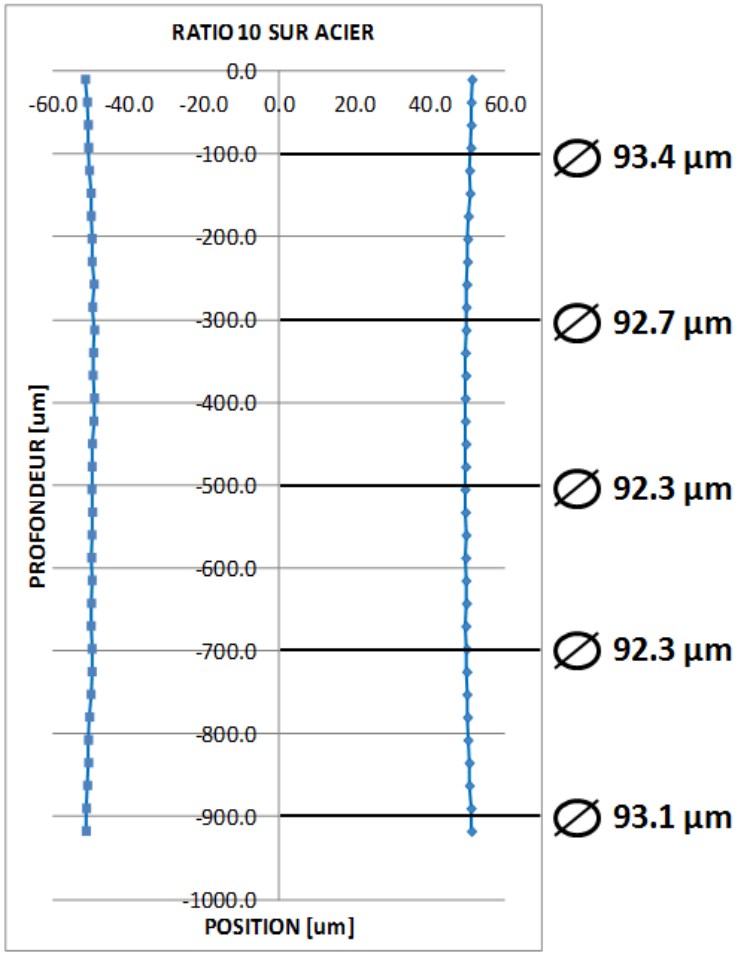
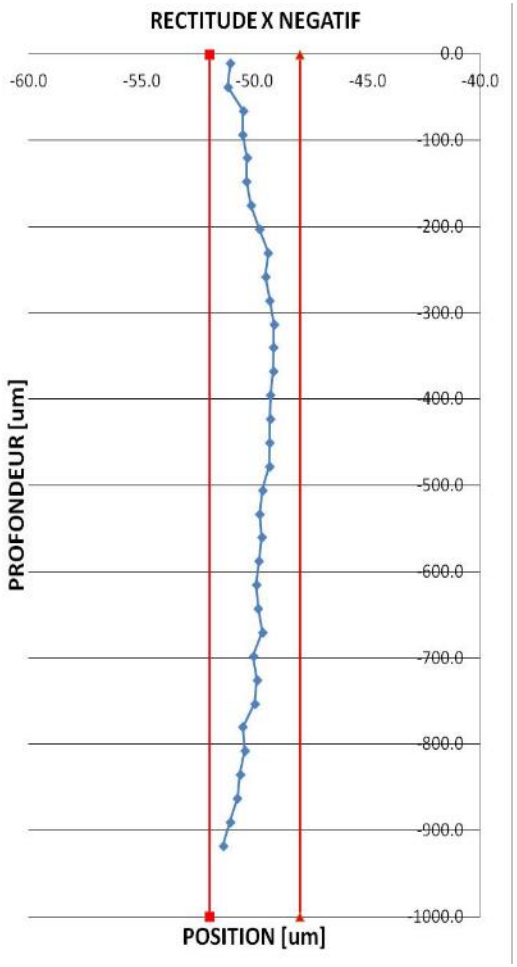
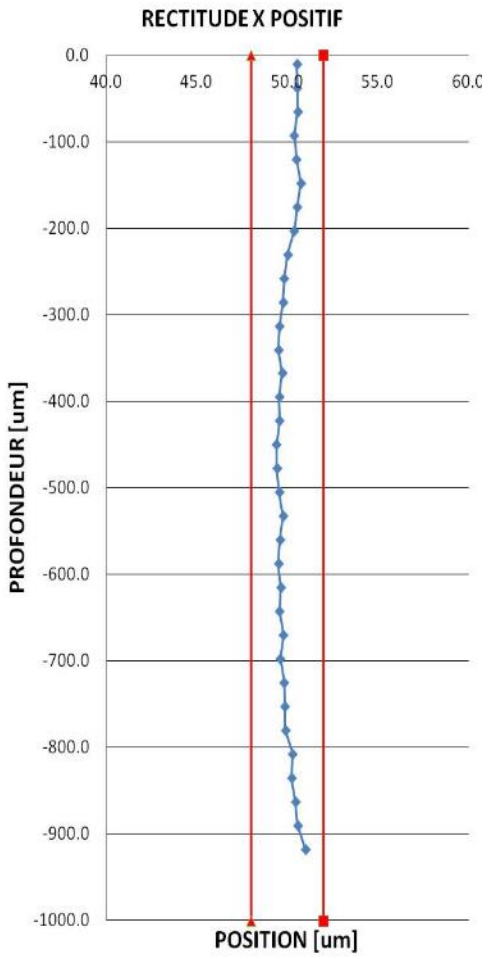
Hole drilling

Steel Ratio 1:10







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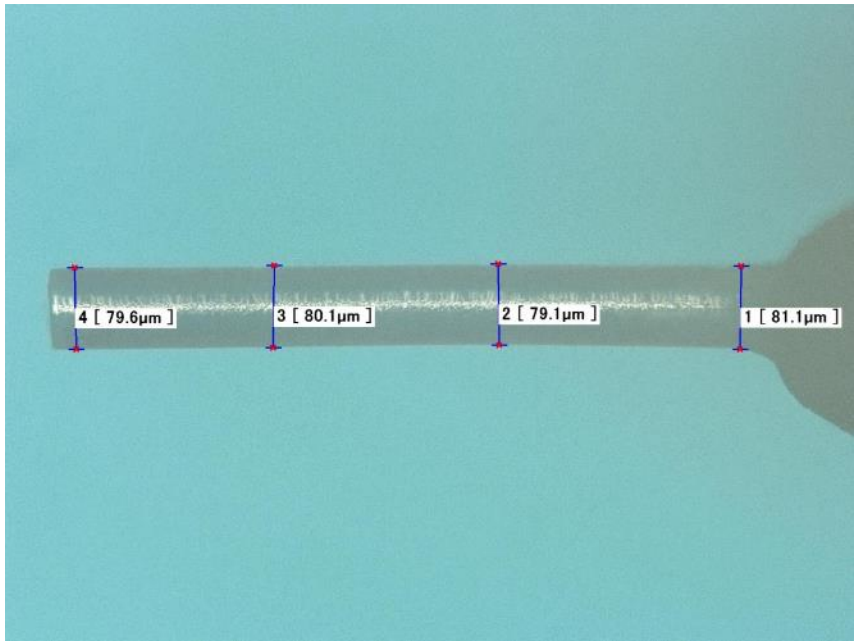
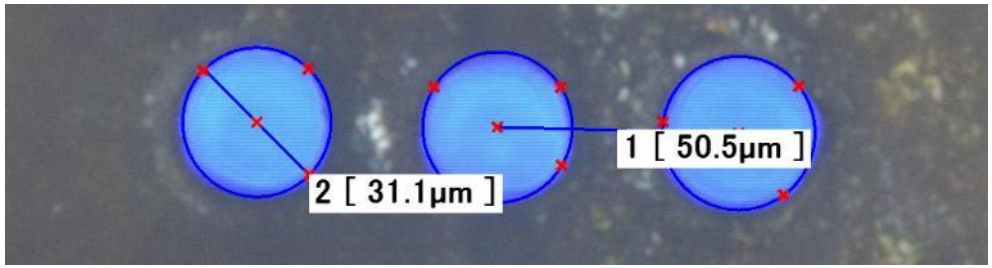
Deep hole drilling

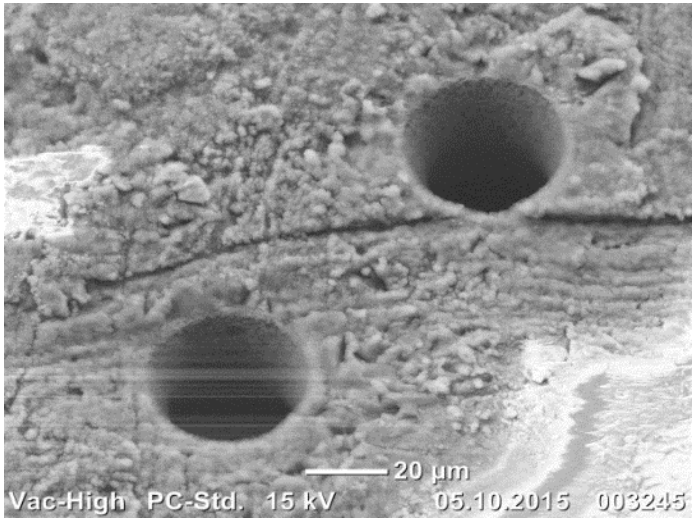


Steel : Ratio 1:10

∅ 80 µm, depth = 800 µm



Peek : Ratio 1:15

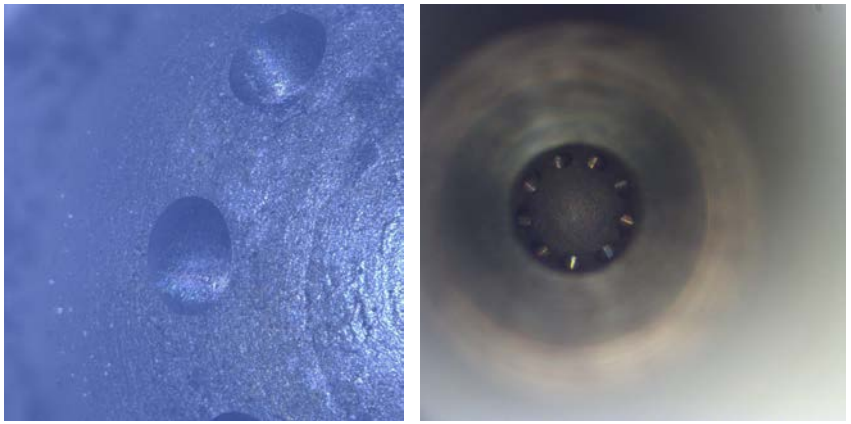


Diesel Injector drilling

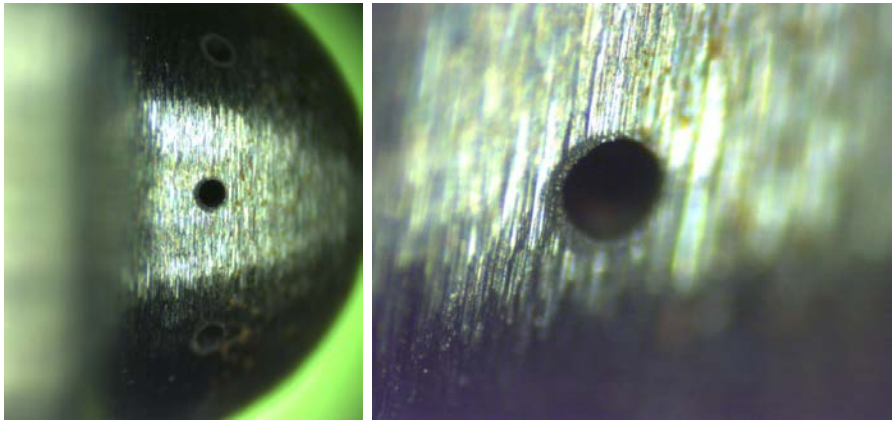
backwall protection

- 9 spray holes
- K factor 2 +/-0.5
- Thickness : about 1.1 mm
- Raw material : 34033 h-13
- No damage, no “injury” coming from the beam, inside the micro sac.
- Flow stability @ +/-2%, Cp > 1.6
- **Life of the backwall protection > 1000 holes**

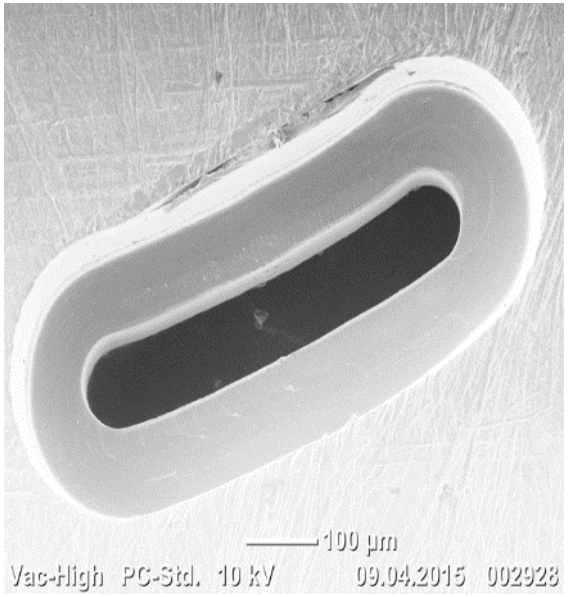
Diameter surface OD: 0.203 mm

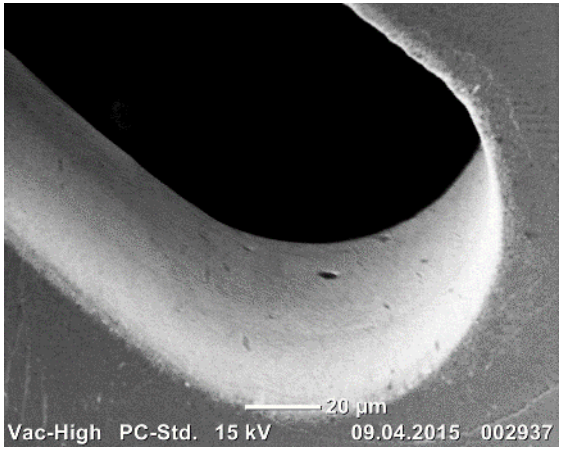


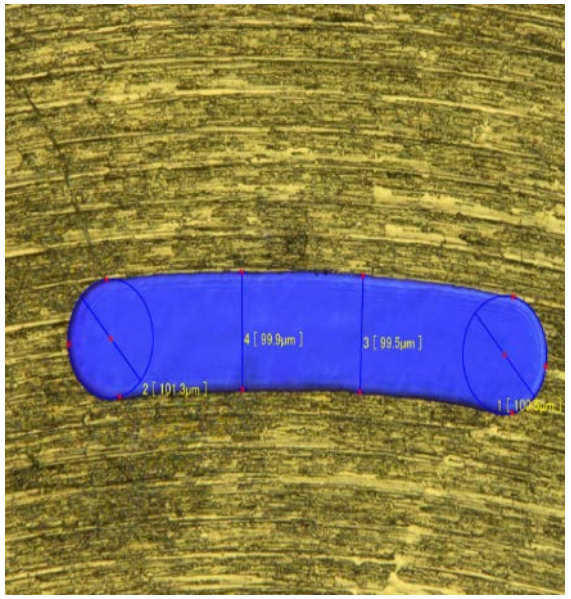
Diameter surface ID: 0.181 mm



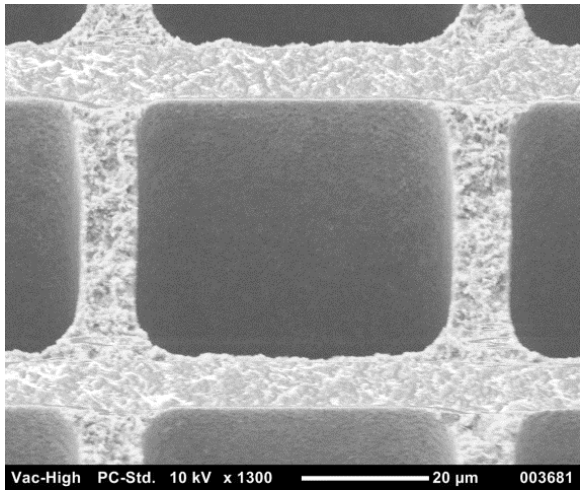
Machining and cutting “oblong shape” Steel







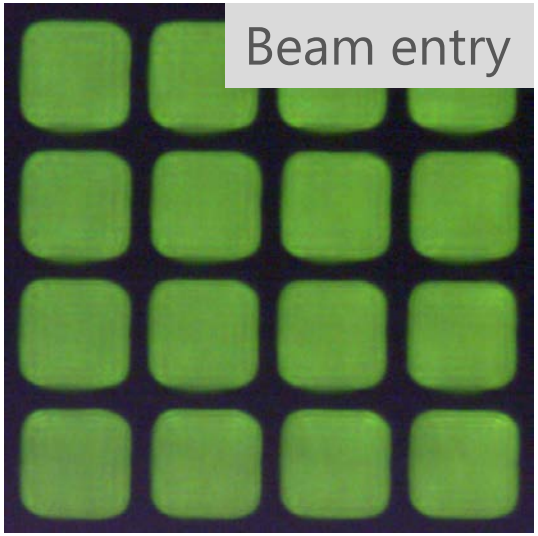
Machining of square holes : Ceramic Al_2O_3

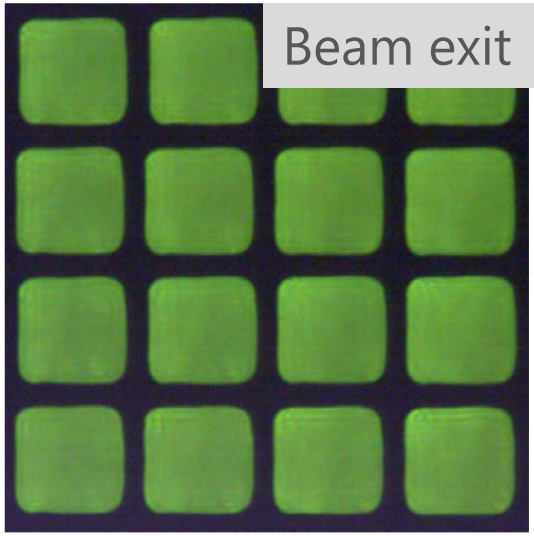


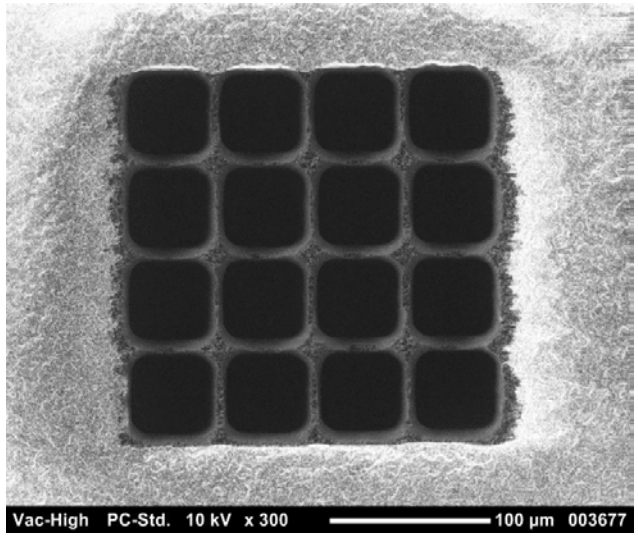
Square holes 50 µm x 50 µm x 500 µm, pitch 60 µm

Radius ≈13 µm (radius of the beam at focal point)

Process cycle time per hole: 15 s
(not optimized)



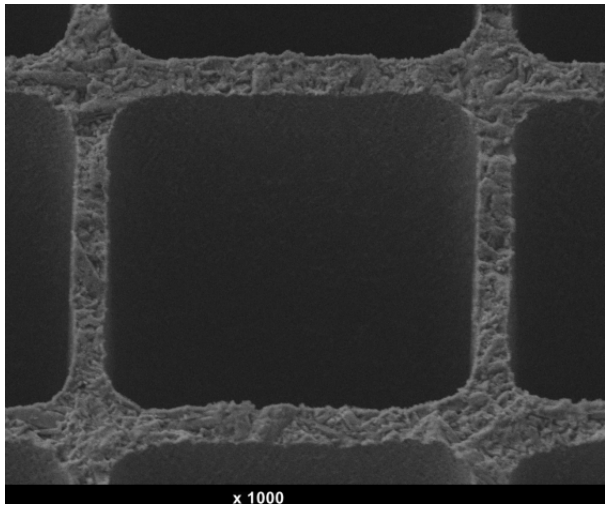


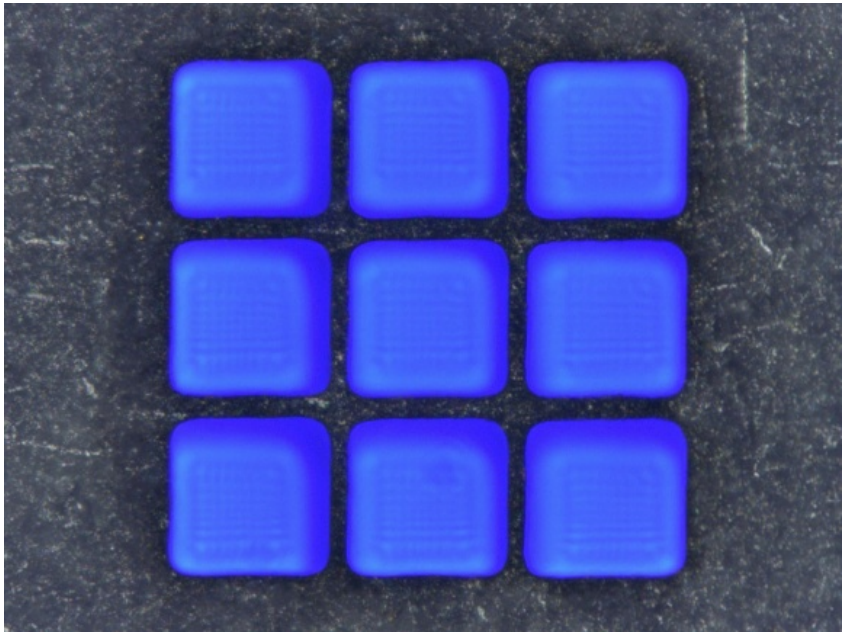


posalux SWISS MADE

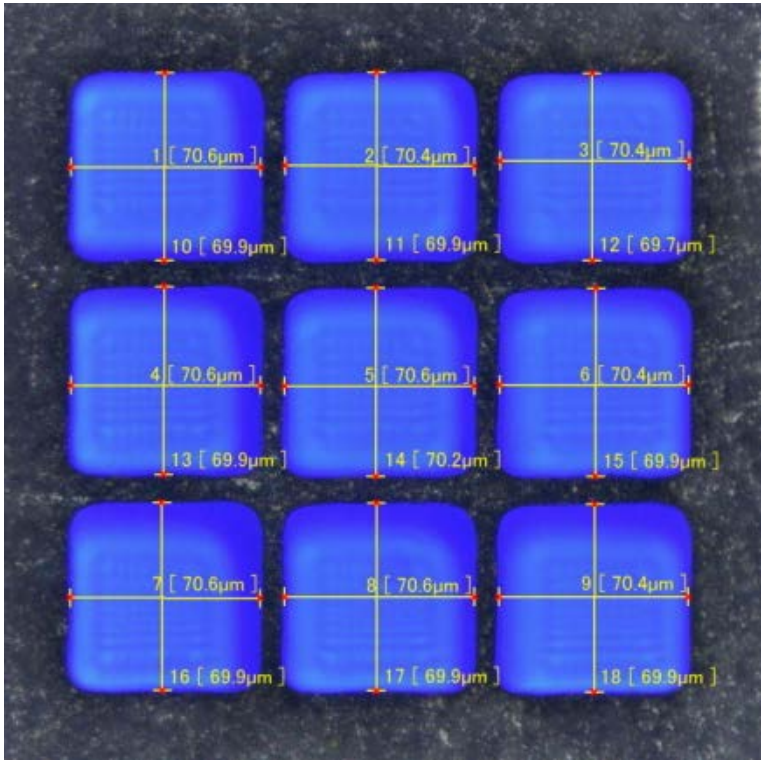
Machining of square holes : Si_3N_4

- Thickness material : 0.32 mm
- Cycle time process per square hole **< 2.4 sec** (not optimized)



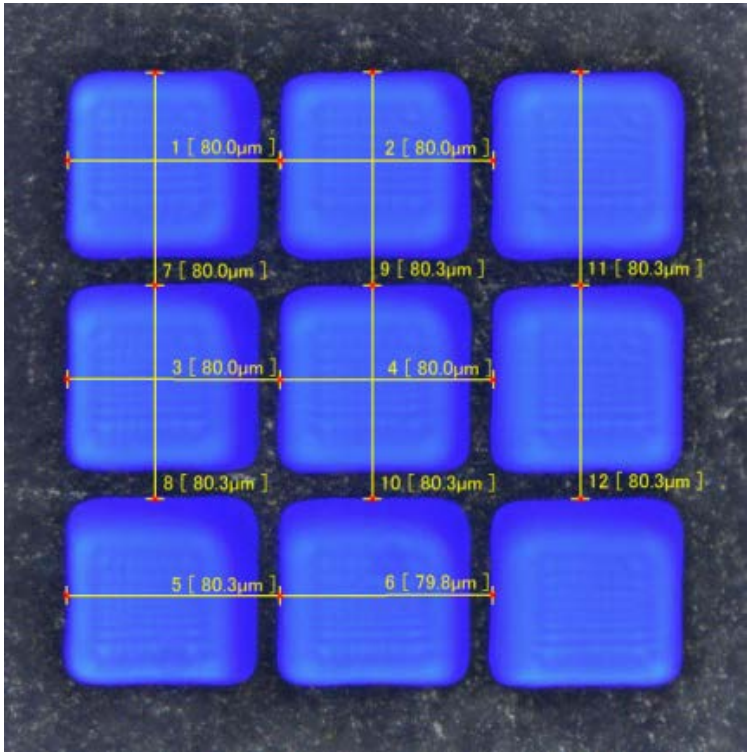


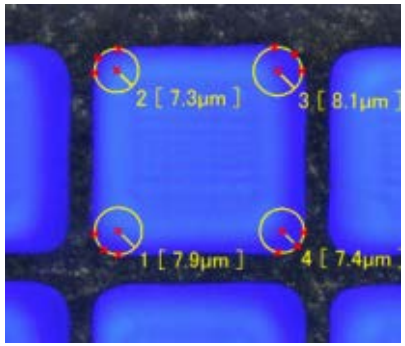
Machining of square holes : Si_3N_4



Square holes 70 µm x 70 µm x 320 µm, pitch 80 µm

Radius ≈7 µm (radius of the beam at focal point)

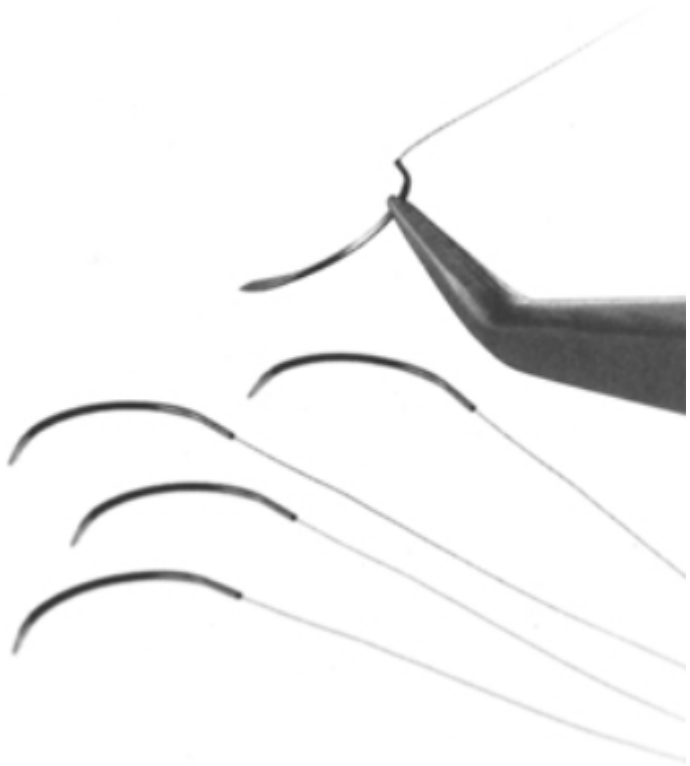




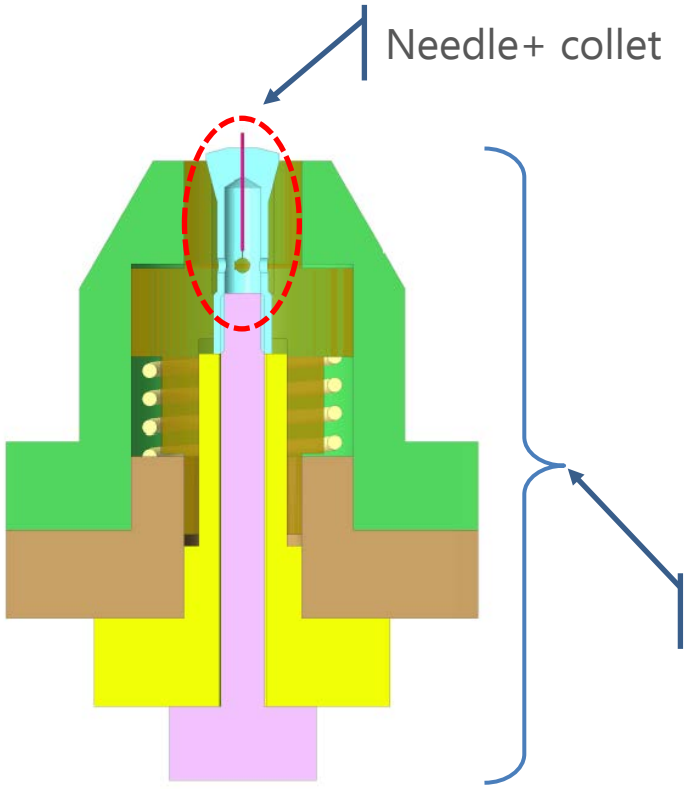
posalux SWISS MADE

Surgical Sutures Needle drilling with Femto Laser

Drilling of a blind hole with a taper at entry . Diameter / Length Ratio 1:9
Hole diameter down to 60 mm



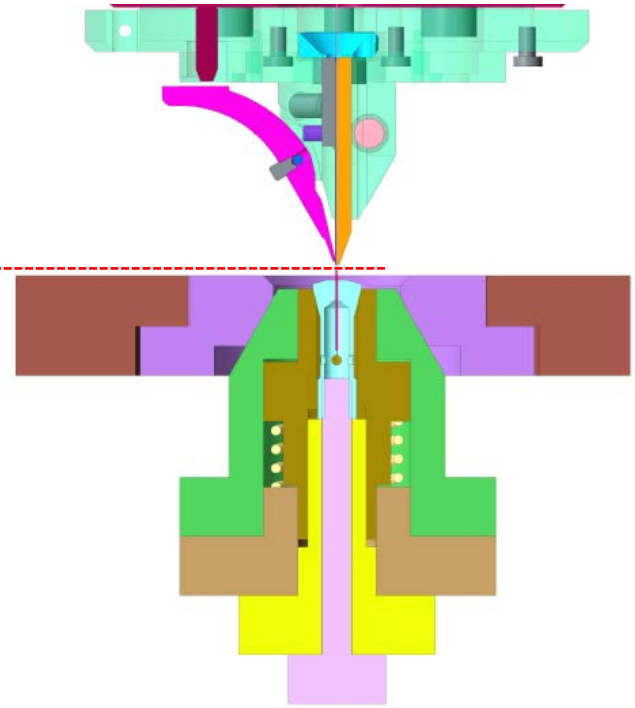
Machine concept : clamping device



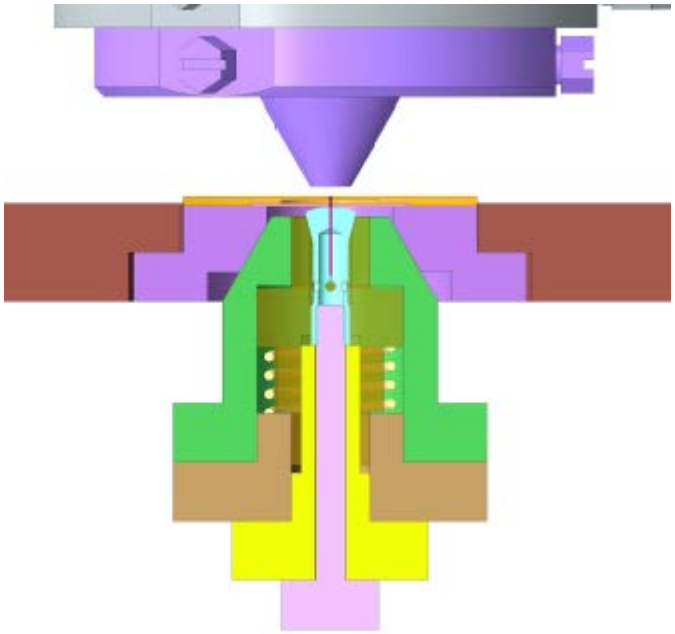
Collet and collet holder build the clamping device which allows to transfer the workpiece to the different process steps.

Machine Concept : cutting and machining station

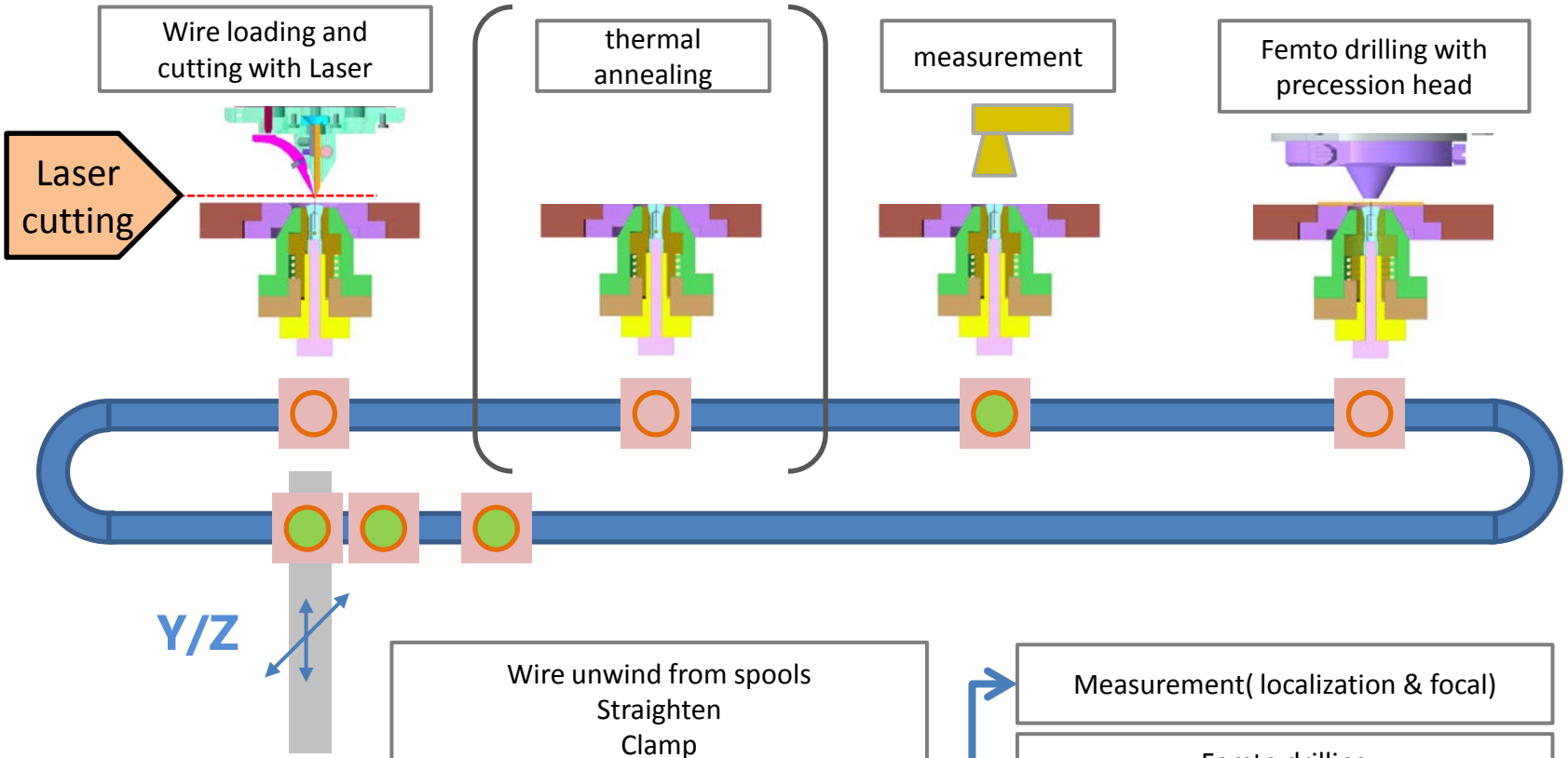
Wire loading
& cutting station



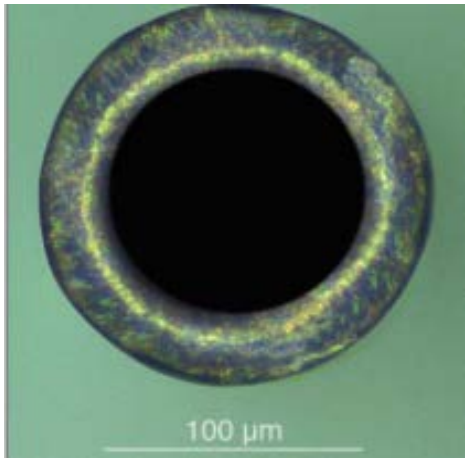
FEMTO drilling

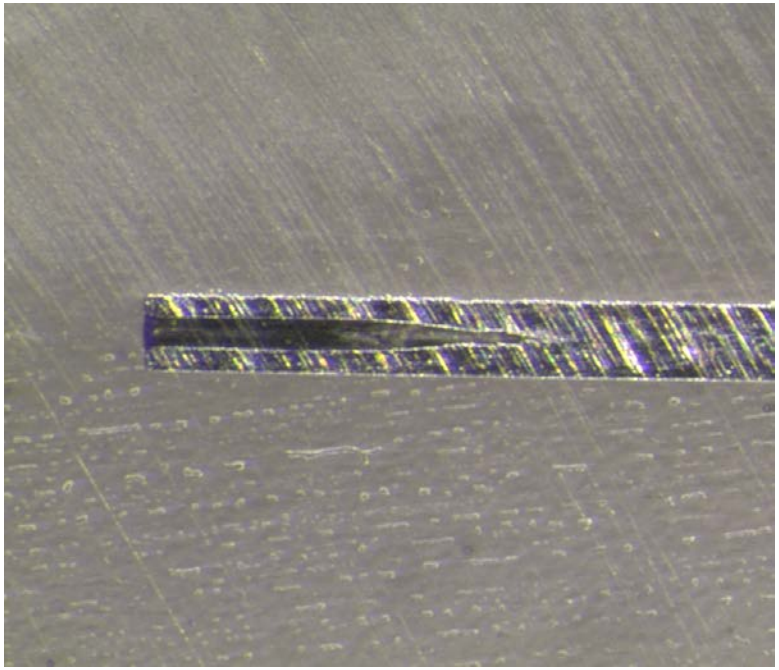


Manufacturing steps



Drilling needle (dia.80 µm)



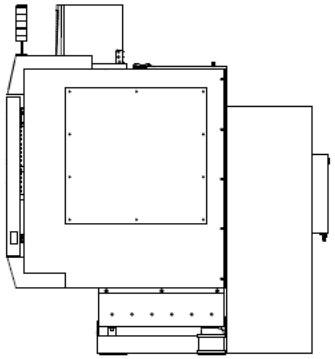


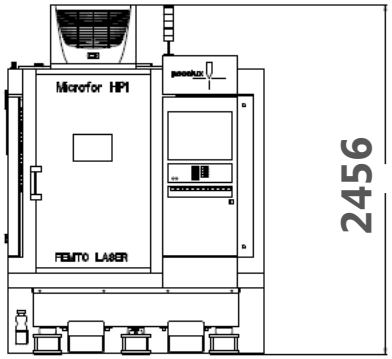
Cycle time

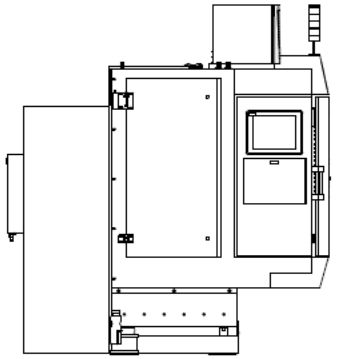
Issue	Value	unit
Process time	5	Sec
Loading / unloading	2	Sec
Total cycle time	7	Sec
Parts / min	8.14	Pces/min
Parts / hour	488.6	Pces/h
Capacity / year	2’814’171	Pces

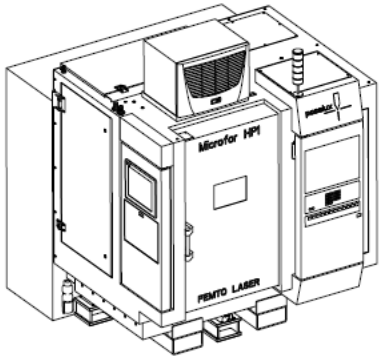
Default value	Value
Stations	1
Hours per day	24
O.E.E	95%
Days / year	240

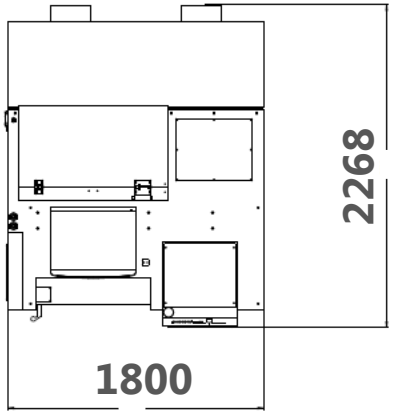
Machine layout











POSALUX FEMTO LASER MACHINE

Conventional Ruby Machining Operations

1

Raw stone sawing

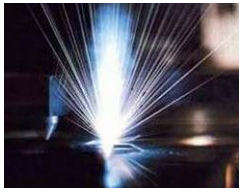
2

Half moon wafer sawing with calibrated thickness

3

Small pads sawing

4



Pre-hole drilling with fiber laser

5

I.D. enlarging

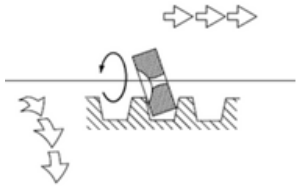
6

O.D. turning

7

Recess machining

8



Olive cut machining

9

Final faces polishing

Femto Laser Ruby Machining Operations

1

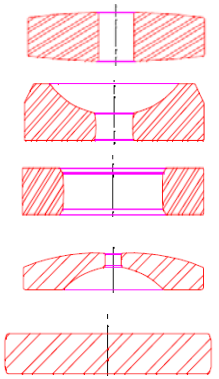
Raw stone sawing

2

Half moon wafer sawing with calibrated thickness

3

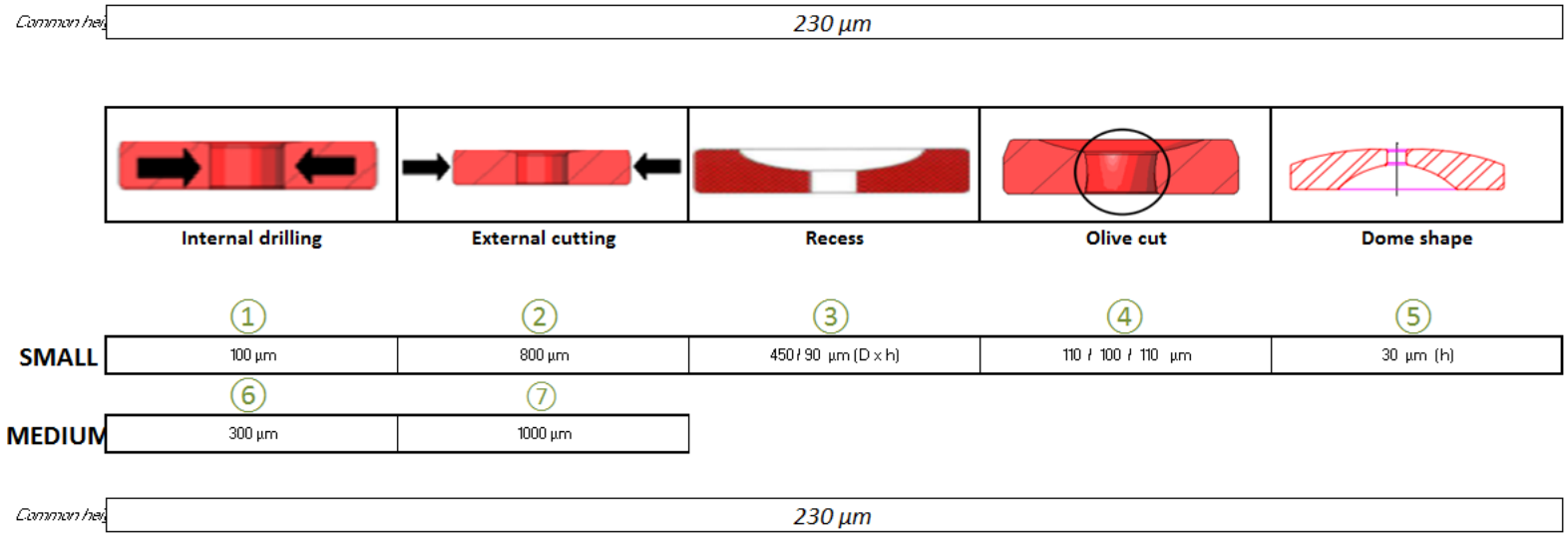
- I.D machining
- Recess machining
- Olive cut machining
- Dome shape machining
- O.D. machining



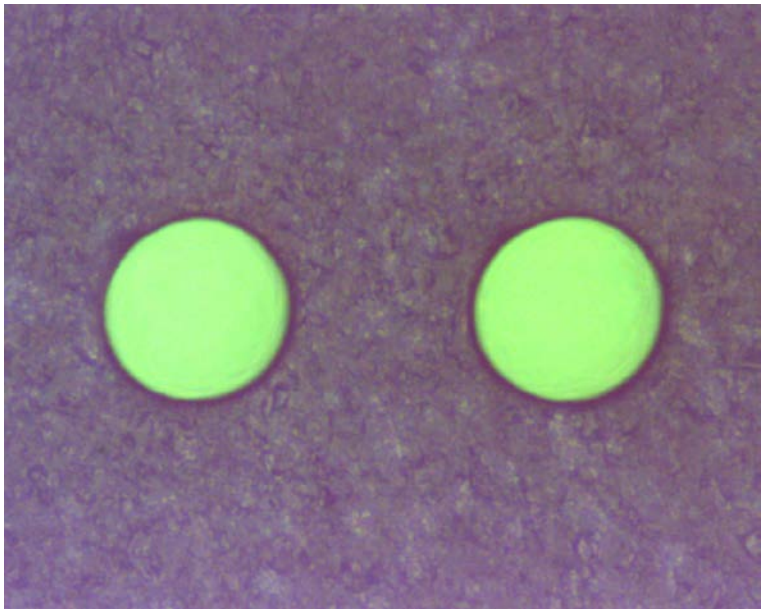
4

Final faces polishing

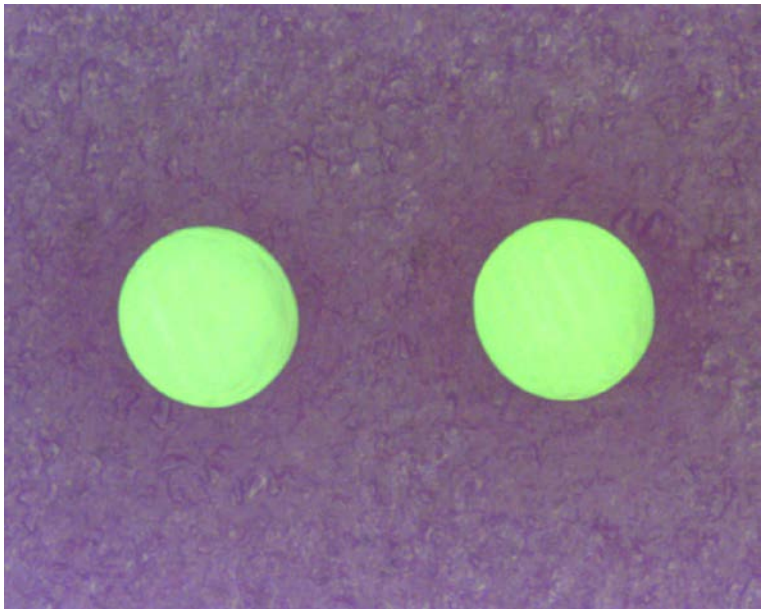
Feasibility issues



Hole diameter 100 µm

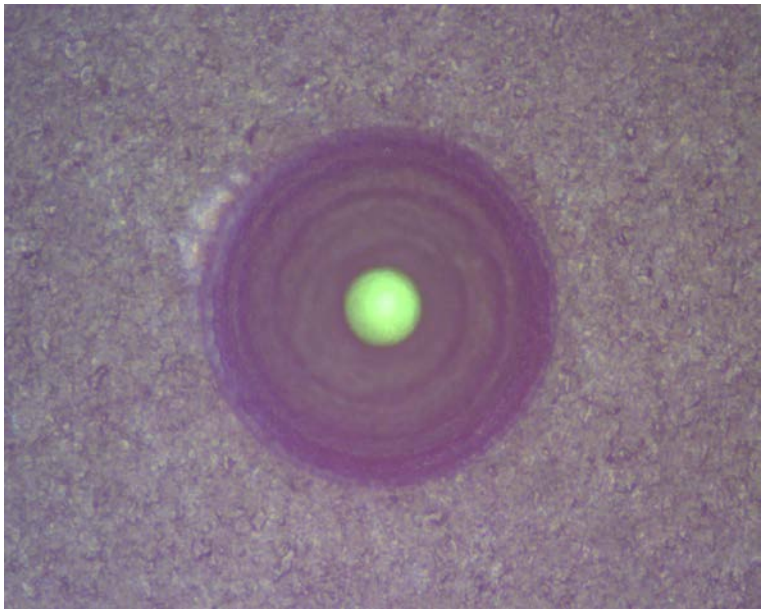


Entry diameter
Dia. 100 µm
Circularity < 2 µm

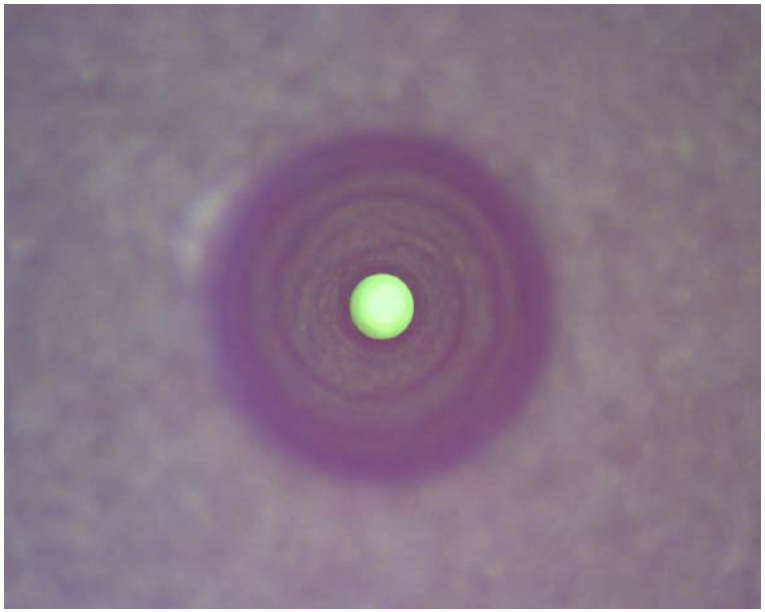


Output diameter
Dia. 100 µm
Circularity < 2 µm

Recess diameter 450 µm x 90 µm(D x h)

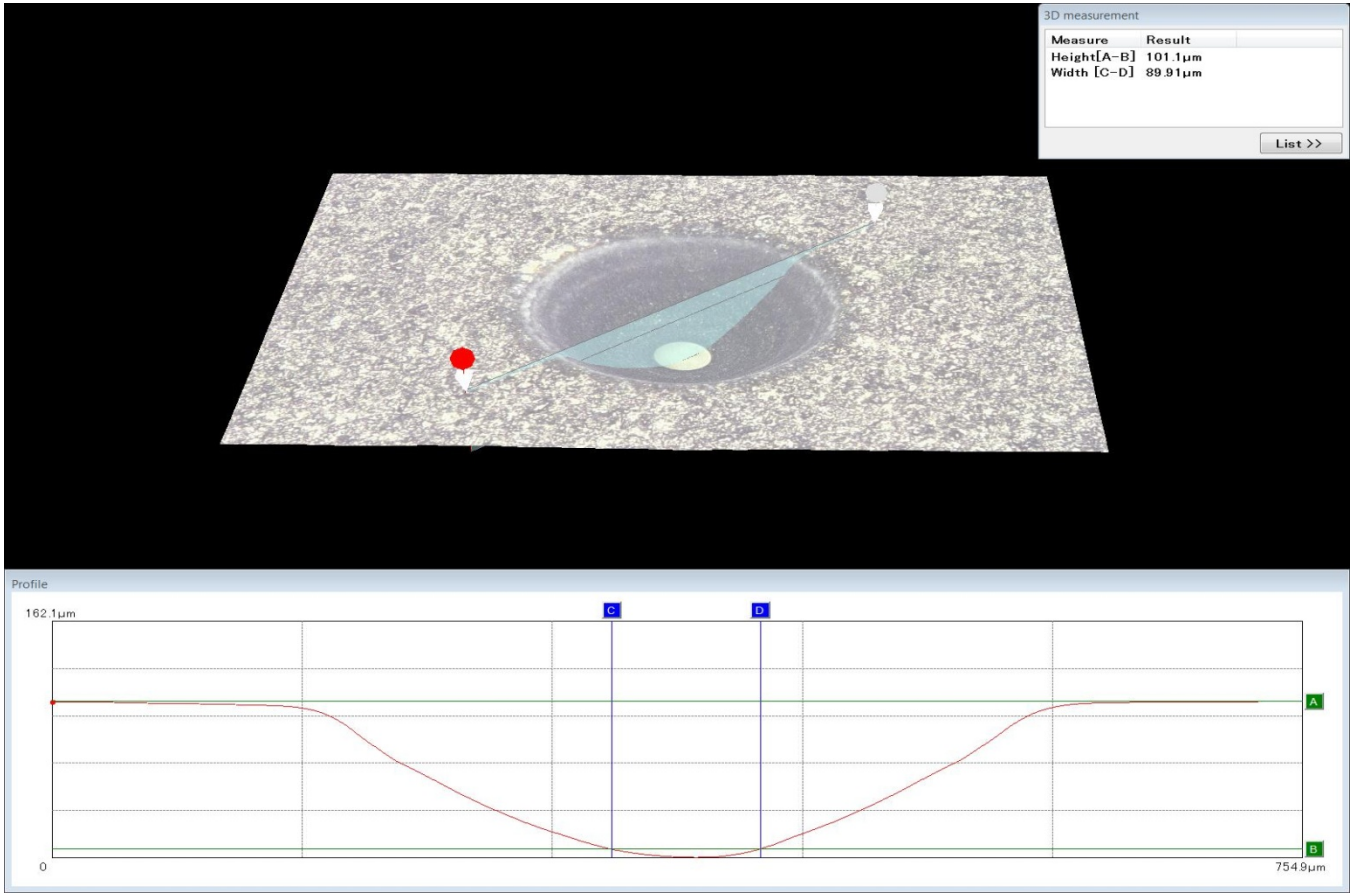


Surface diameter
Dia. 450 µm
Circularity < 5 µm



End recess
Hole entry dia.100 µm

Recess diameter 450 µm x 90 µm (D x h)



Olive cut (footprint Measure)

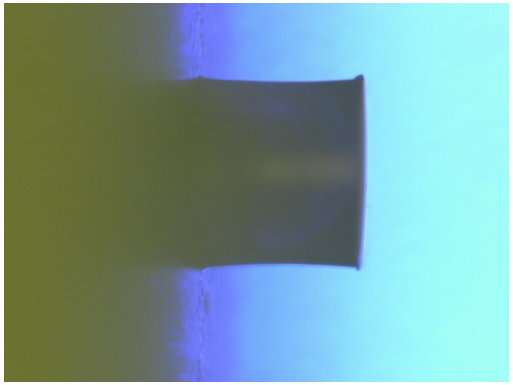
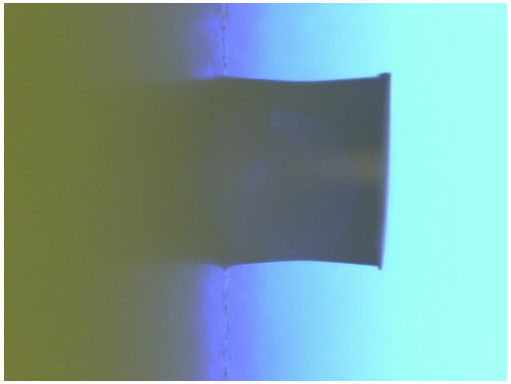


Figure 1: molded prints of shape 1) and 2) of a 300µm hole



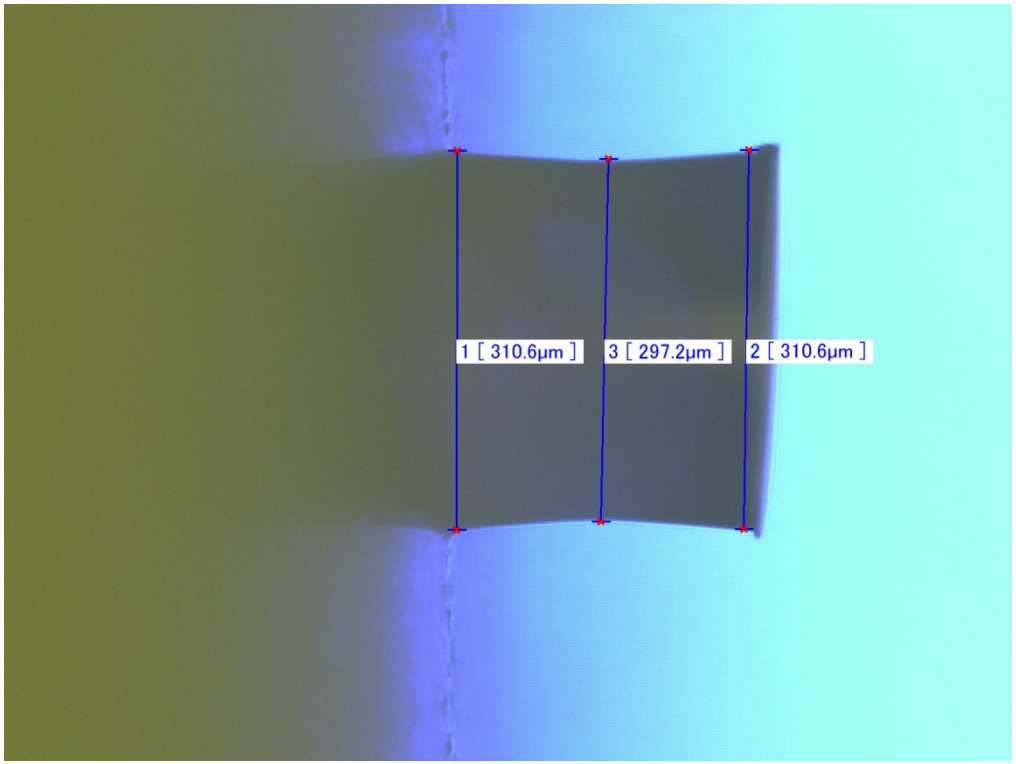
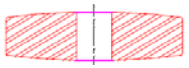
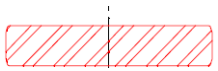
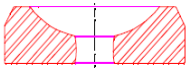
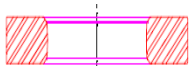
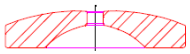


Figure 1: measurement of the molded prints 2)

Ruby Machining Achievement

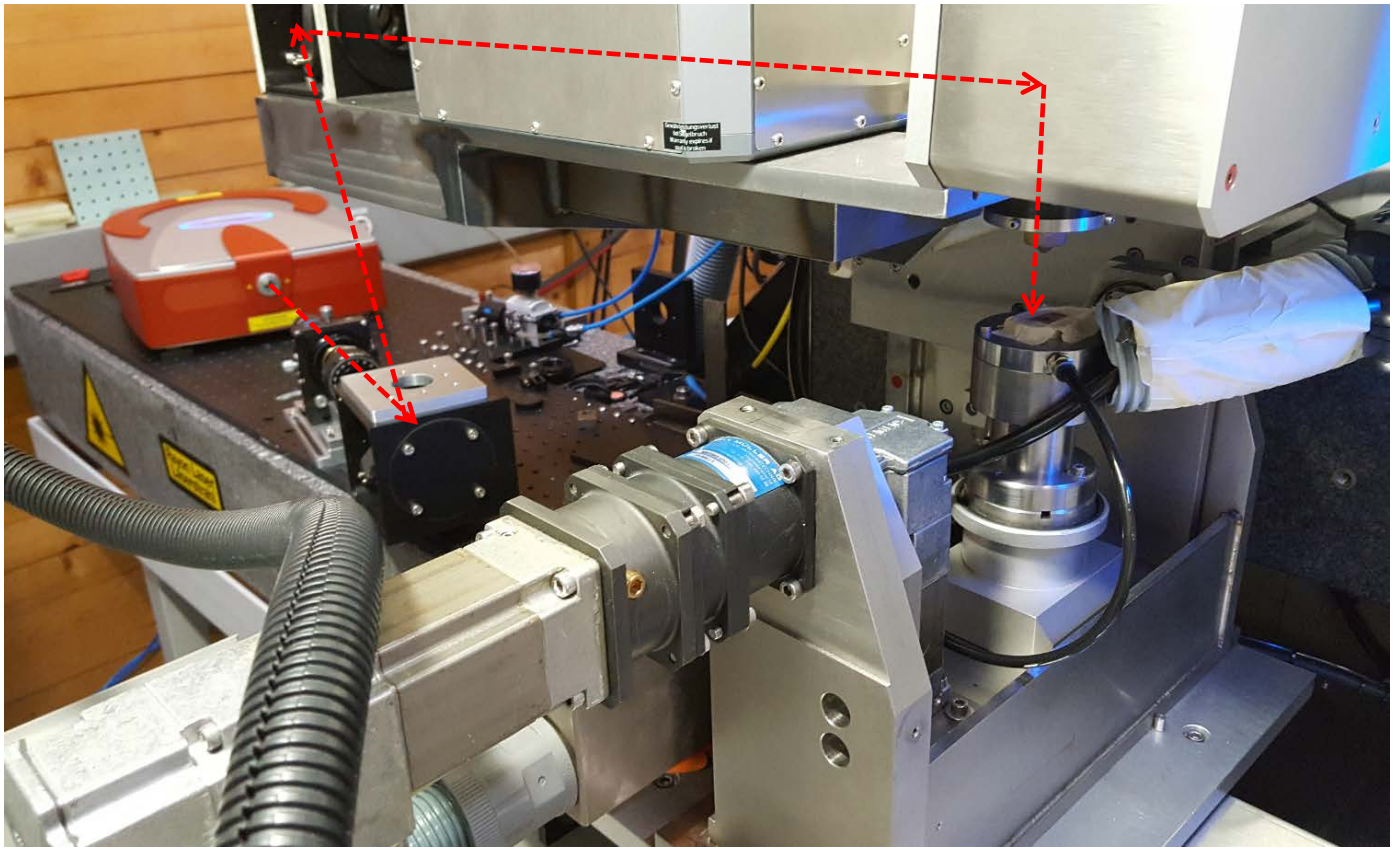
	Operation	Tolerance	Cylindricity	Circularity	Roughness Ra	Concentricity
	I.D. Ø 100µm	± 2 µm	1.5 µm	2 µm	0.1µm	3 µm
	O.D. Ø 800µm	± 2 µm	2 µm	2 µm	0.1µm axial 0.2µm radial	3 µm
	Recess 450 / 90 µm (D x h)	± 5 µm	n/a	5 µm	0.27 µm	3 µm
	Olive cut		n/a	n/a	0.1 µm	n/a
	Dome shape	n/a	n/a	n/a	0.27 µm	n/a

Ruby Machining Cycle Time

Operation	Cycle Time (sec)
I.D. Ø 100µm	2
O.D. Ø 800µm	5.4
Recess 450 / 90 µm (D x h)	2.1
Olive cut of Ø 100µm (include in I.D)	1
Dome shape	6.5

Cutting : precession and axis machine interpolation

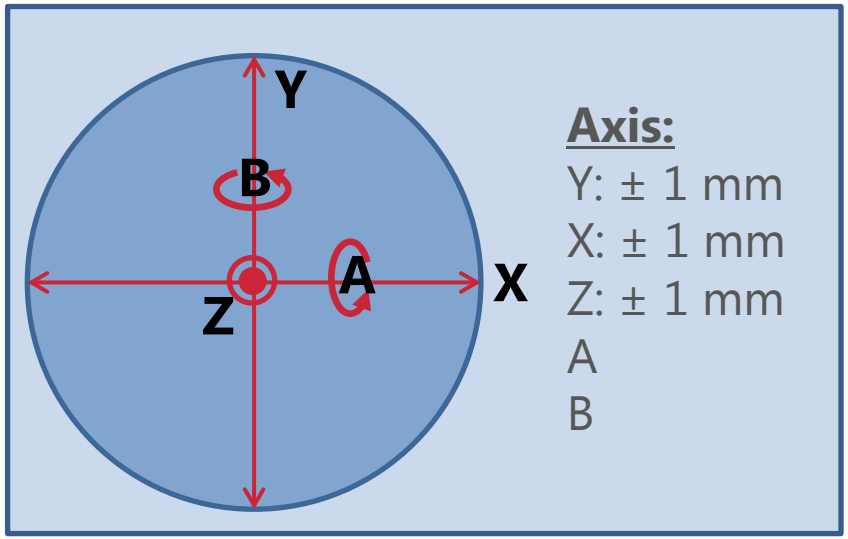
5 Axis machine



Cutting process : precession head

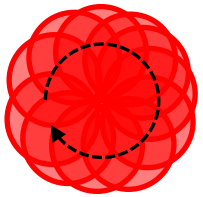
Cinematic:

« precession head and machine »

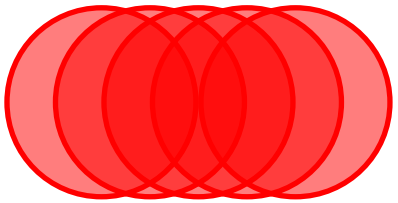


Machine Cinematic: Axis X And Y

1. **Beam spot laser describe a cylindrical trajectory** r=15 µm, ∅= 25 µm, 500 Hz



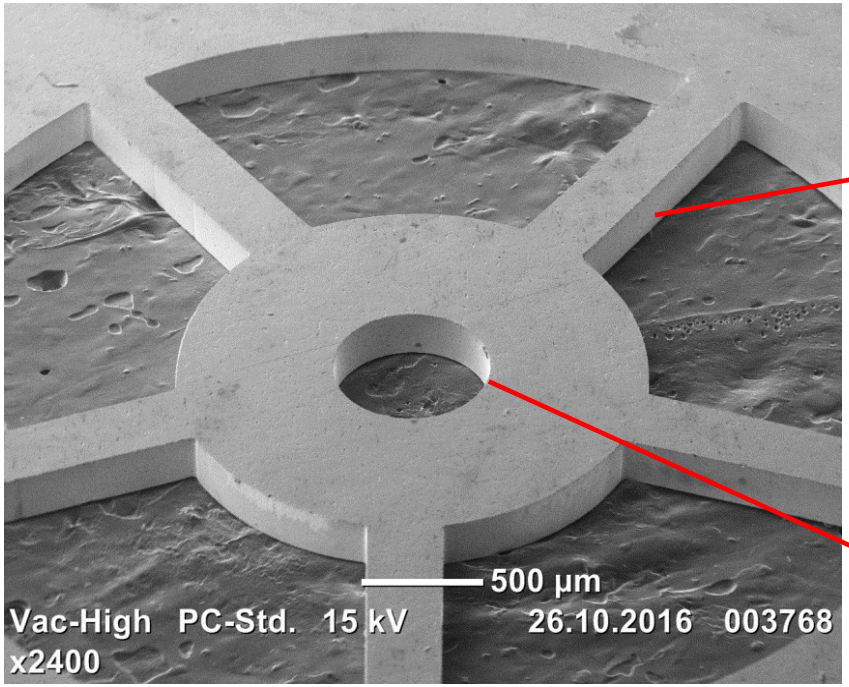
2. **Movement axis combination to obtain a straight line**

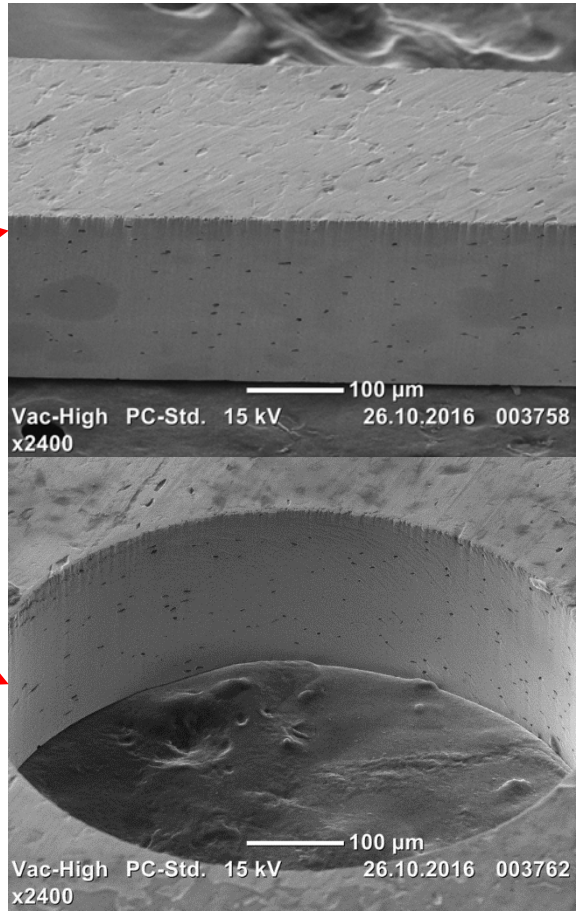


3. **Square Clearance correction with laser beam tilting**

Cutting

Brass and Maillechort





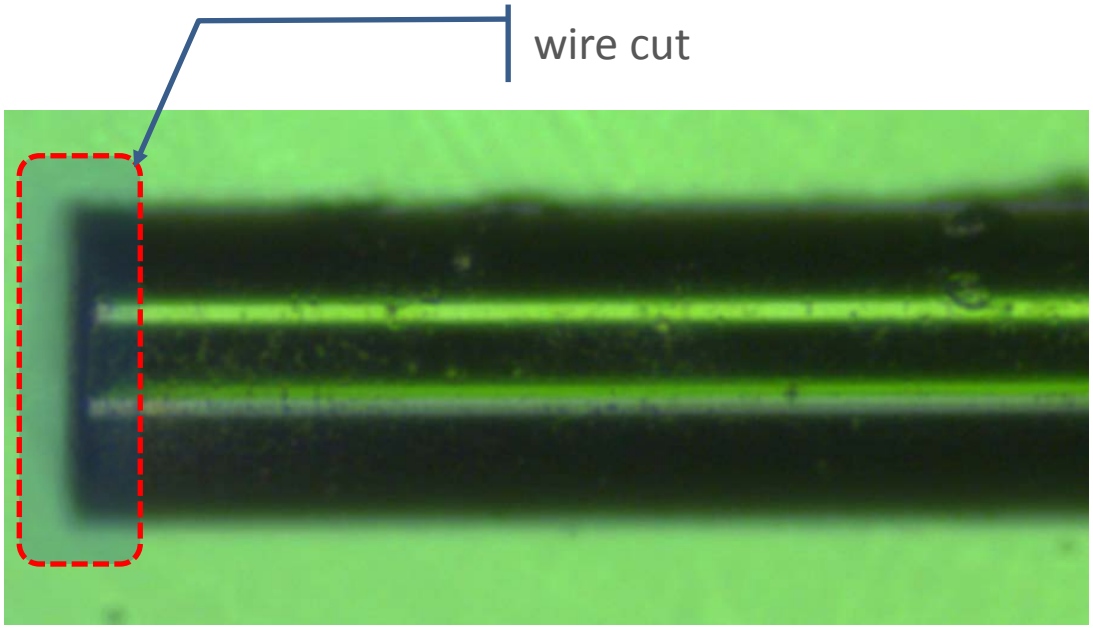
Material: Maillechort, Brass

	Tolerance	Cylindricity	Circularity	Roughness	Concentricity	Orth. clearance
Drlling hole Ø 700 µm:	± 2 µm	1.5 µm	2 µm	0.1µm	< 2 µm	<0.25°
OD cutting Ø 6000 µm:	± 2 µm	2 µm	2 µm	0.1µm	< 2 µm	<0.5°

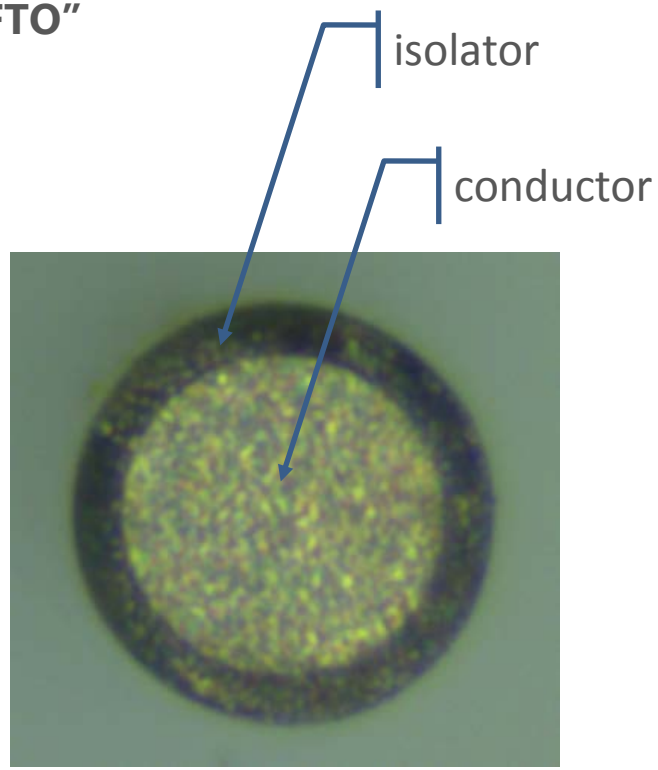
FTO (Femto Turning Outside): : **Laser cutting of BEAM**

Picture n°3 is a zoom on the cut area of the wire and picture n°4 shows the front view of the cut.
We can notice that the isolator and the conductor are in one layer

⇨ promising base for OD **F**emto **T**urning **O**peration **"OD-FTO"**

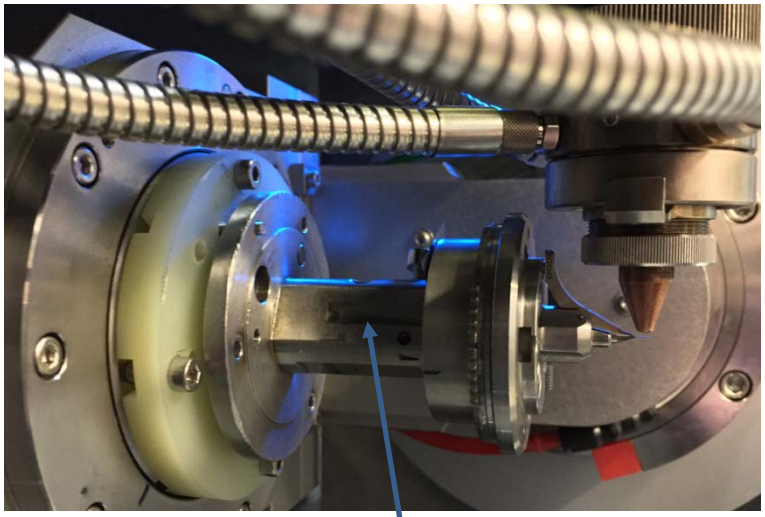


picture n°3



picture n°4

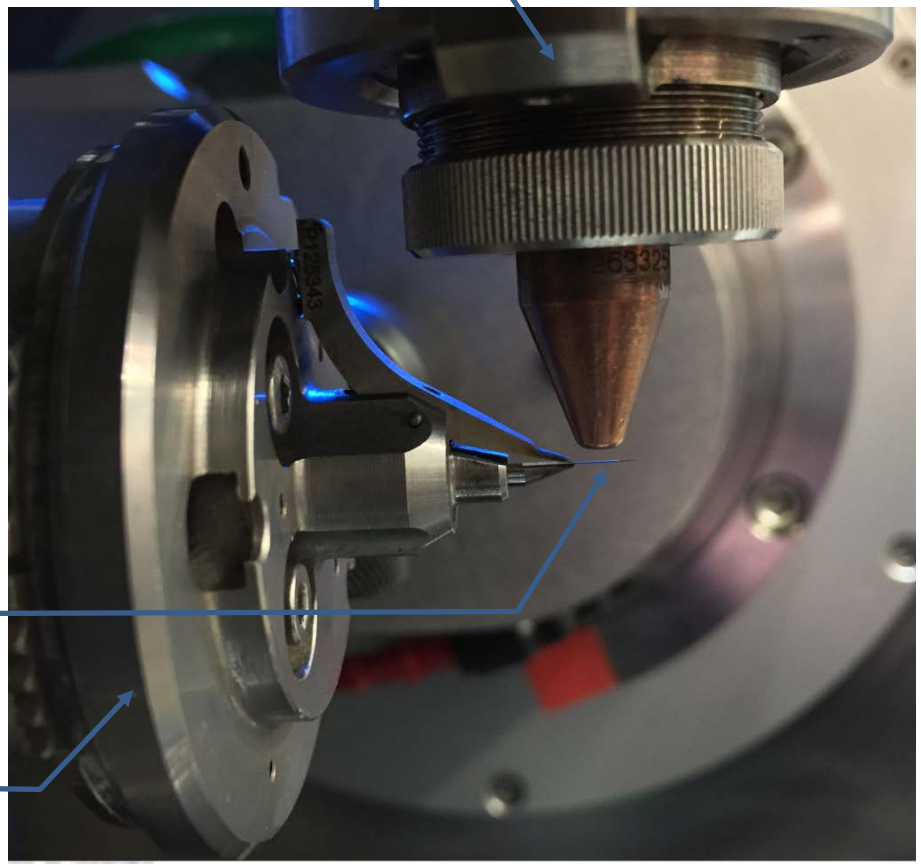
Picture 10 and 11 show the BEAM in current machining position.



picture n°10

Machine C axis

cutting head



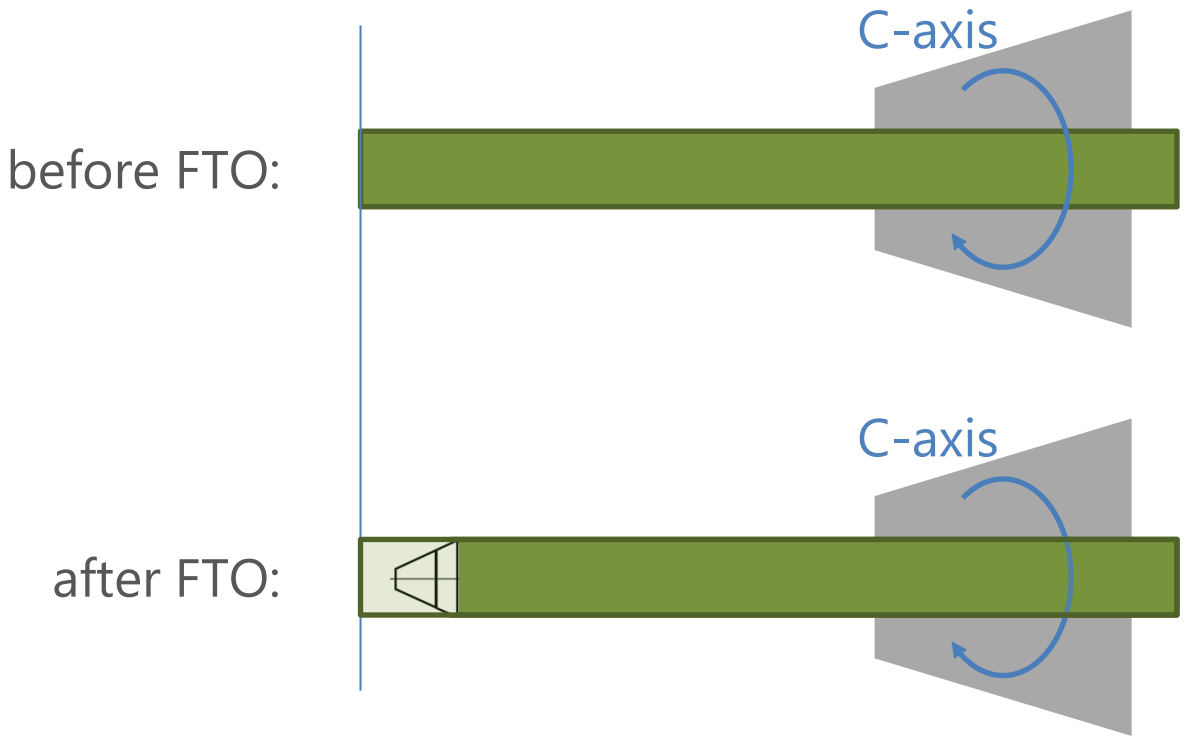
BEAM 3.0 mil

EDM head

picture n°11

Feasibility study:

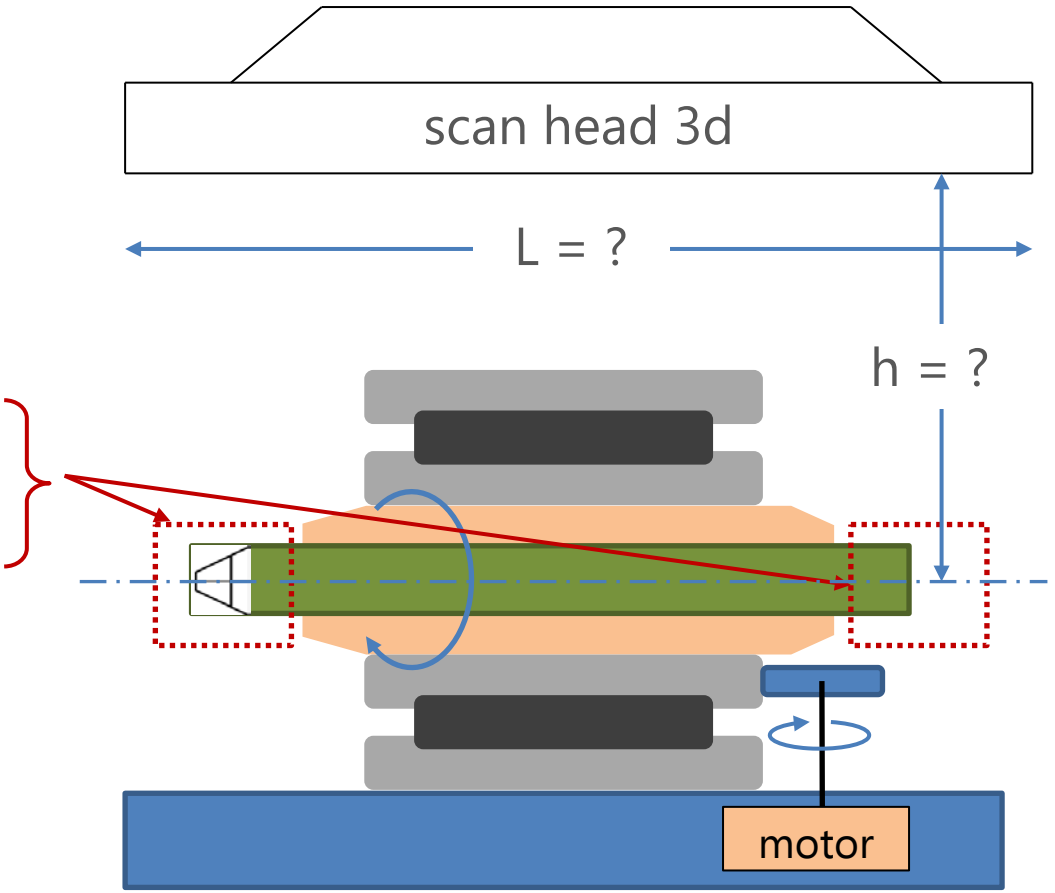
focus on BEAM 1.6 tip (CW50)



Further trials with scan head:

material design

Every beam type has to be machined on both ends.
The industrial process is supposed to put in rotation the BEAM with machining access.

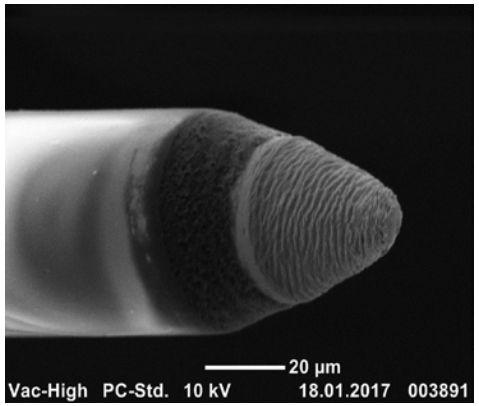


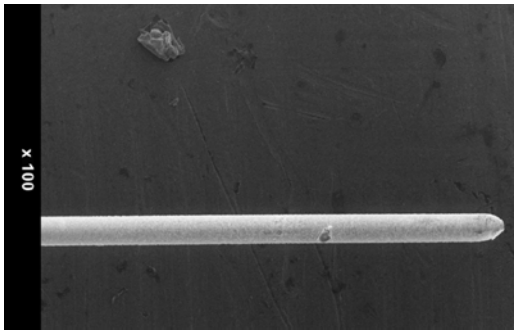
The BEAM length is between:

6.015 ± 0.015 mm (1.6 mil) ≤ **L** ≤ 11.185 ± 0.010 mm (3.0 mil)

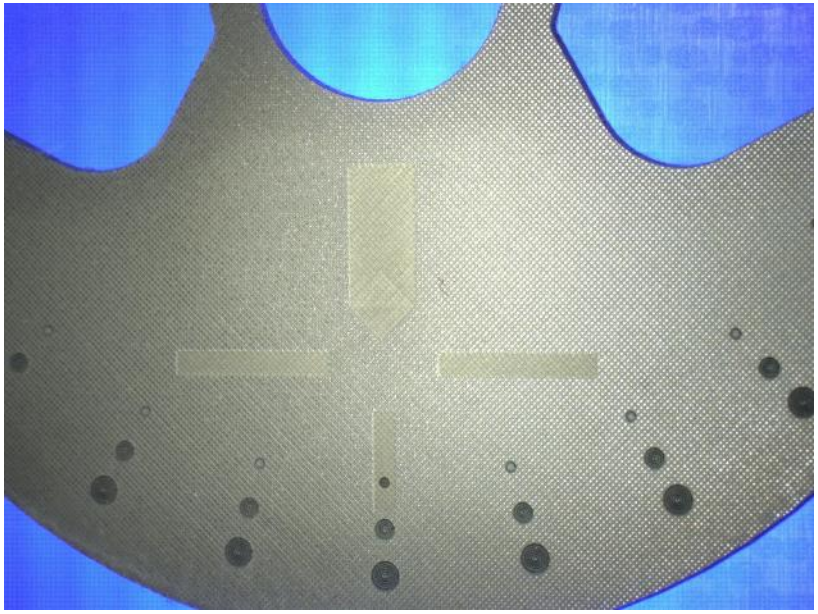
Femto **T**urning **O**utside process

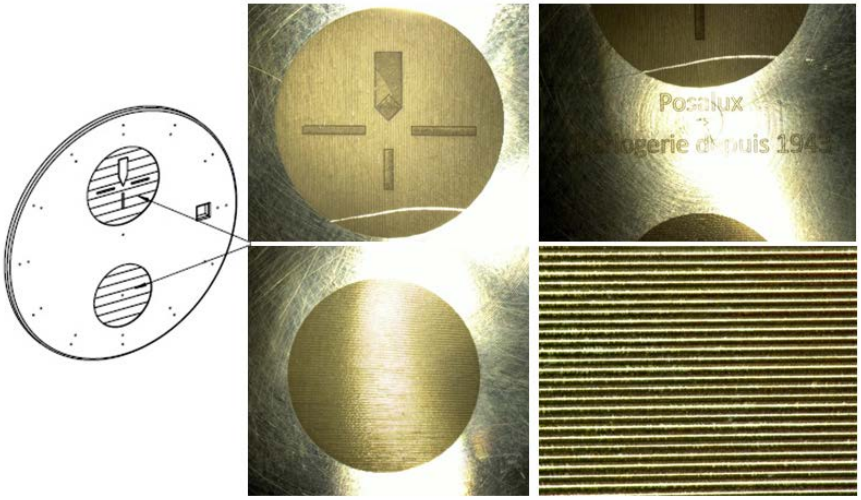
- ✓ Diameter achieved : 50 µ
- ✓ Tolerances achievement +/- 3 µ

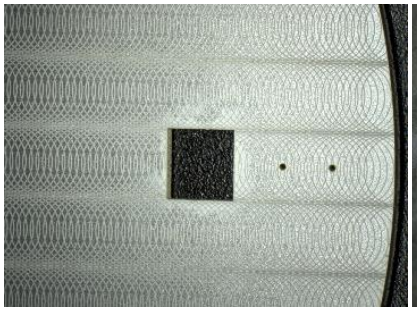


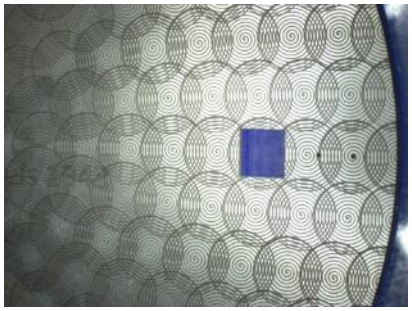


Machining - Engraving – Texturation









Achieved challenges for Femto technology

Roundness	➔ < 1.5 µm	✓
Cylindricity / Straightness	➔ < 1.5 µm / for all ratio	✓
Entrance / Output shapes	➔ Sharpe Edge, Controlled radius	✓
Positive Taper	➔ up to +23°	✓
Negative Taper	➔ down to – 15 °	✓
Surface finish	➔ < 50 nm	✓
Ratio diam./depth	➔ 1:15 (e.g. 30 µm / 450 µm)	✓
Cutting squareness ⊥ clearance	➔ < 0.5°	✓

posalux SWISS MADE

LASER FEMTO Machines

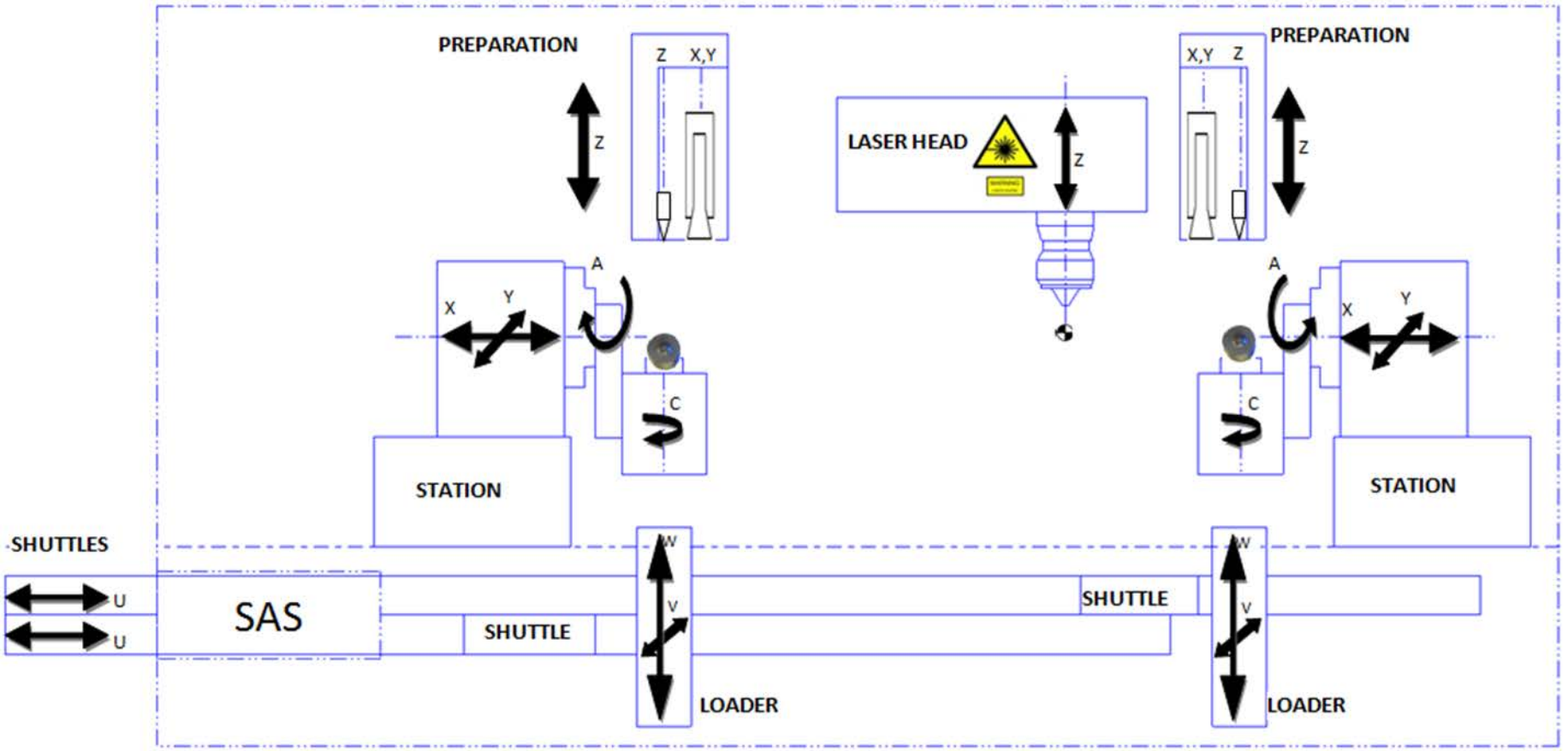




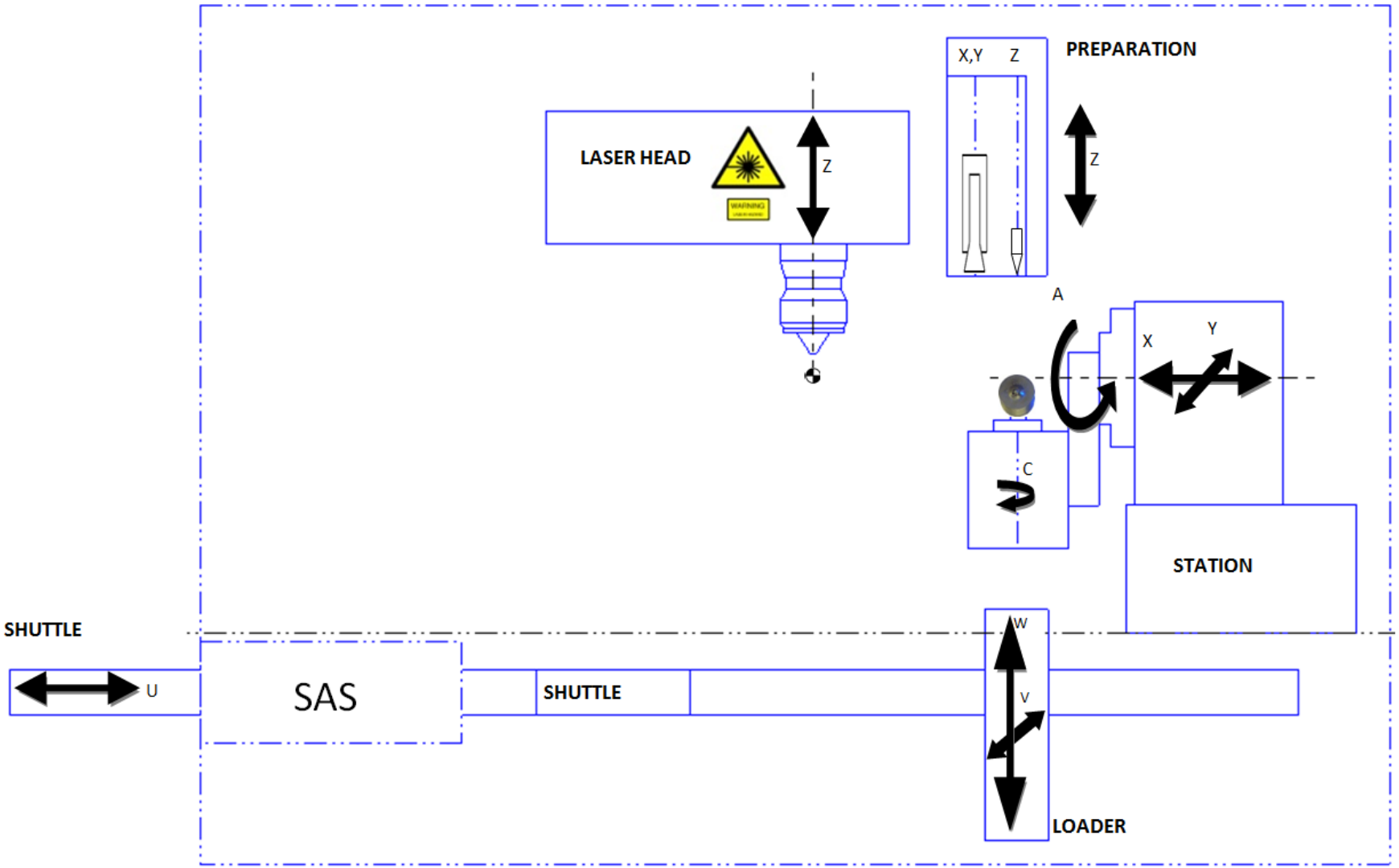

Posalux **FEMTO Machines**

- Design target = maximize **Laser equipments utilizations**
- High accurate and repeatable **5 axis cinematic**
- **High stability,** insensitive to outside vibrations, temperatures, air quality, …. thanks Granit base (8 tons), temperature control @+/- 1°C, overpressure in process area, air filtration for optics in 4 stages (class 1)…
- **Posalux software** design to save all milliseconds
- Big effort for **maintenances** / settings **accessibility**
- Full **automation**

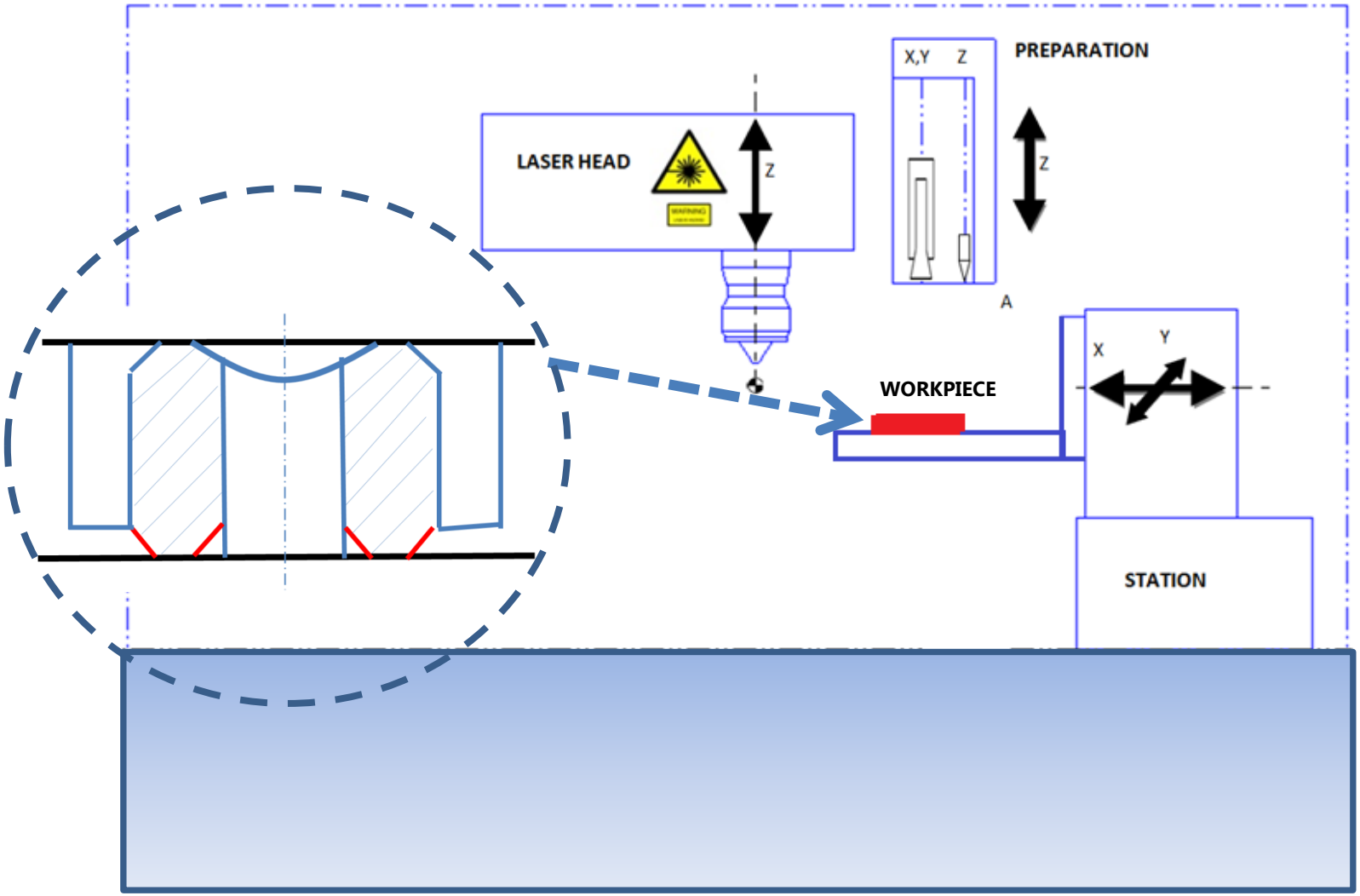
Posalux **Femto Twin** *(standard)*



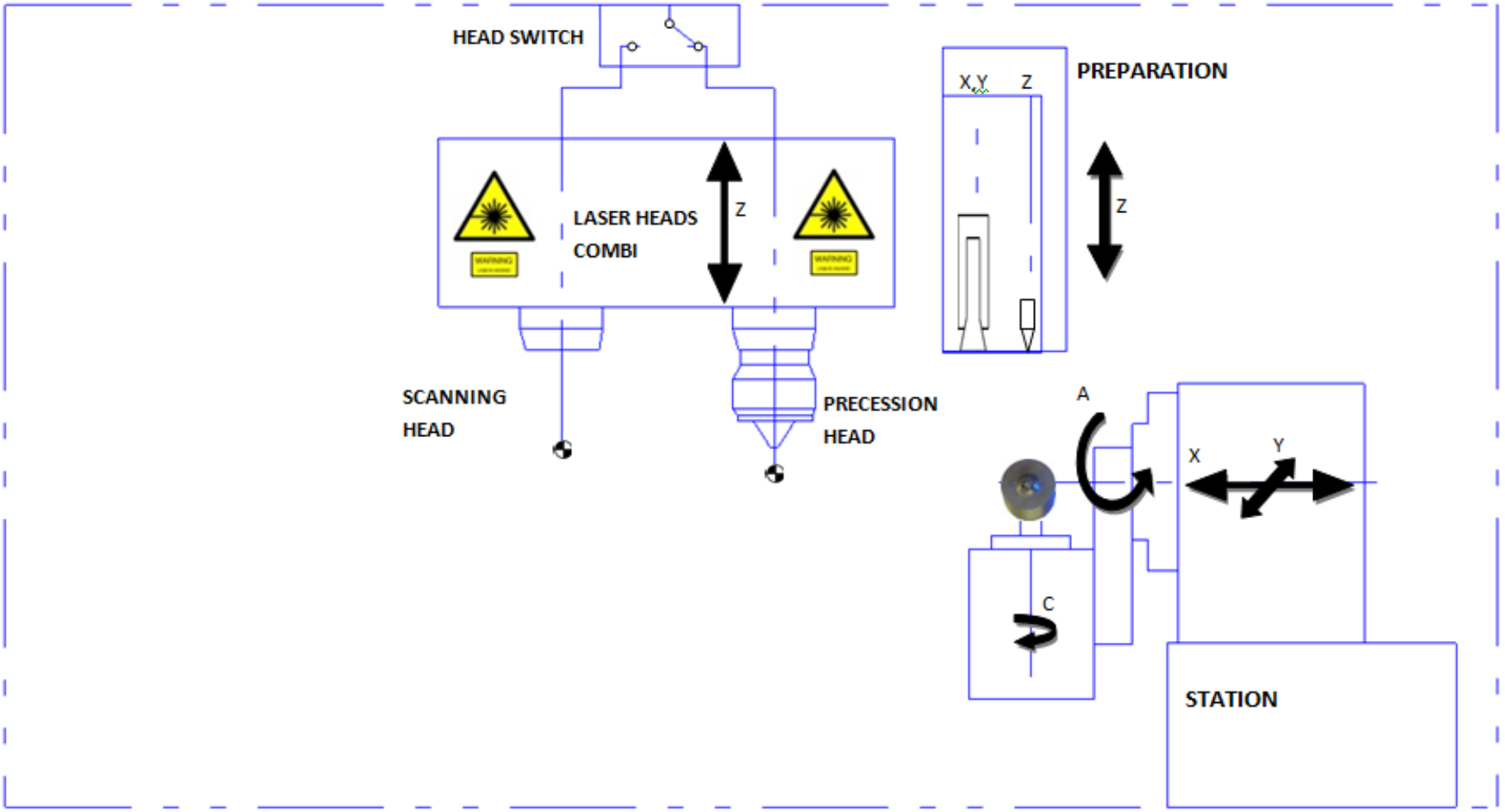
Posalux **Femto Mono**



Layout Femto Laser Mono - Ruby Application

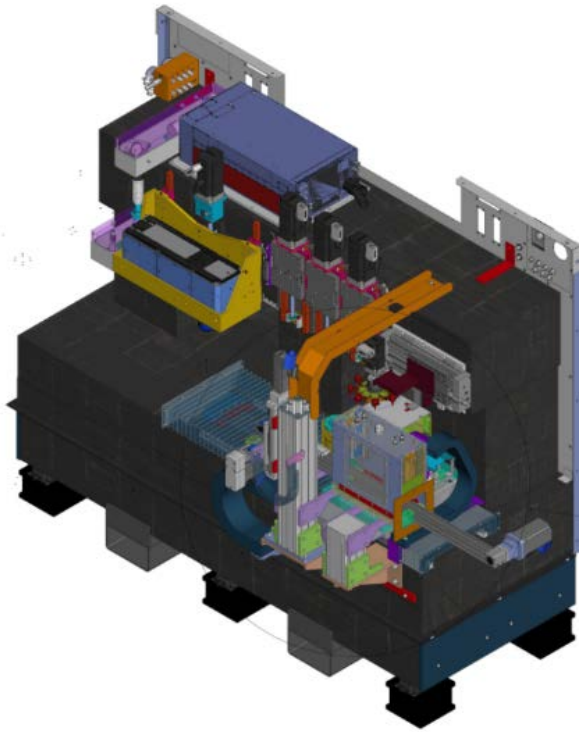


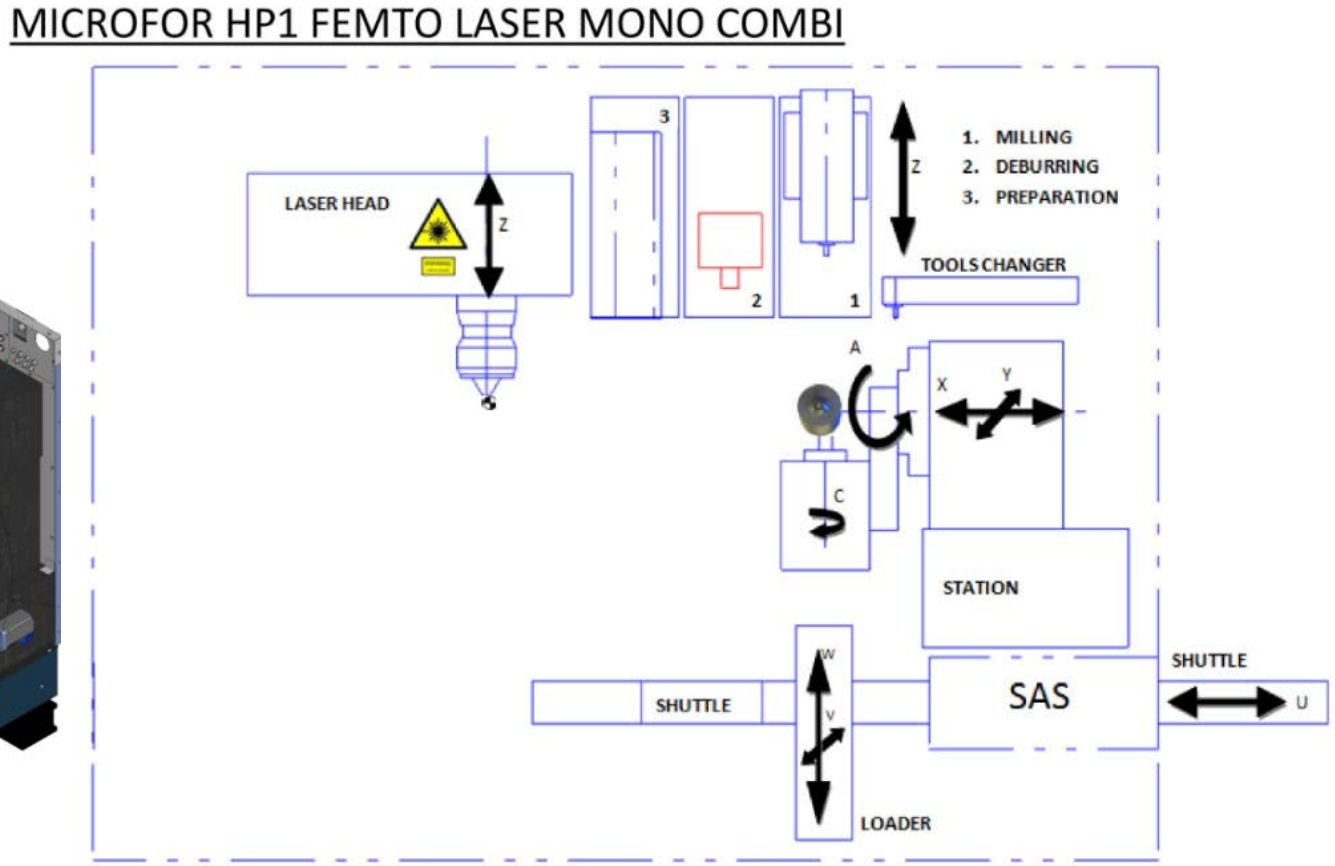
Posalux **Femto Mono Combi**



Concept **Femto Mono Combi 2**

Designed for Milling, Deburring and Femto-Drilling





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