posalux®
SWISS MADE

ASTT
Association Suisse de Traitement Thermique des Matériaux

ASTT 27.11.2015

Agenda

Day 27.11.2015

1.	09:30 – 09:35	Welcome & Introduction
2.	09:35 – 10:30	Posalux Technologies
3.	10:30 – 11:45	Plant Tour
		Engineering, Facility, Da Vinci Center
4.	11:45 – 12:00	Discussions

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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 technologies.

Global presence:

- 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 assure the long-term success of Posalux
- Foster national and international collaborations with Universities and Universities of applied sciences to increase the speed of innovations

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
- 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 automotive 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 - 6 Technologies

Micro Drilling & Routing

Milling machining

LASER Femto

LASER Microjet

EDM Machining

S.A.C.E.

POSALUX - 6 Technologies

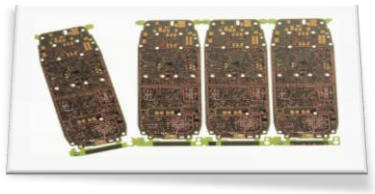
2D Micro drilling and routing

Specifications

- Hole diameter of 75 microns
- Hit rate: 1200 hit/min/spindle
- Accuracy +/- 25 microns
- Axes acceleration up to 4g
- Diameter/depth ratio 1/10
- 12 spindles per machine
- 12000 tools embedded

Applications

- Dedicated to non ferrous material
- Printed circuit board (PCB) ➔ epoxy-glassfiber
- Watch industry ➔ brass
- Aerospace industry ➔ aluminium



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2D Micro 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 6000 tools
- UR3600: 2 or 3 stations,2 to 6 spindles, up to 3600 tools
- MONO: 1 station, 1 or 2 spindles, up to 2000 tools

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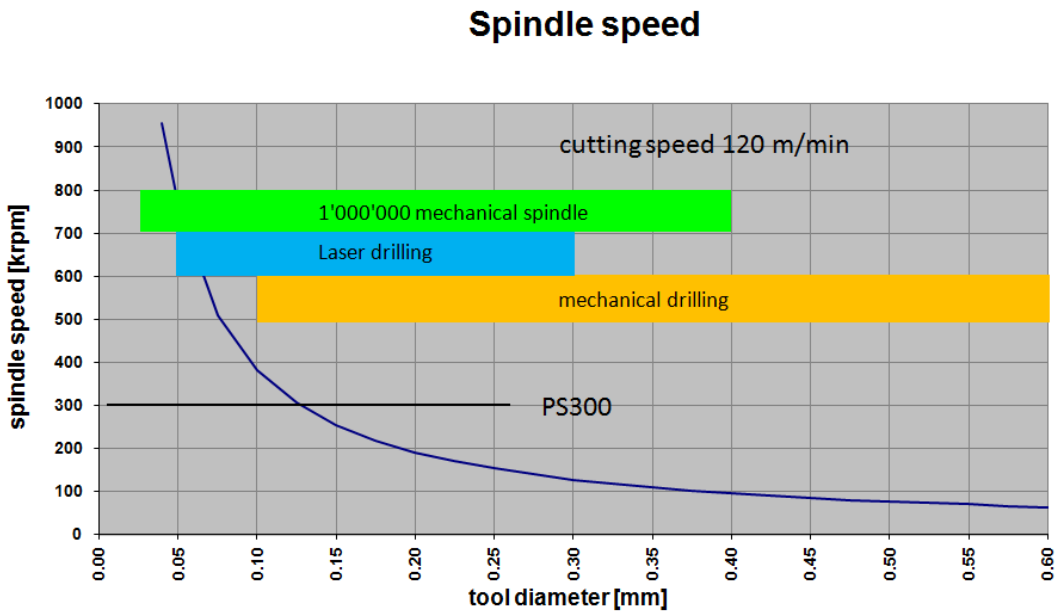
The 1 million rpm drilling spindle

- Spindle speed : 0 - 1’000’000 rpm
- Drilling diameter range : 0 – 0.4 mm
- Clamping device: passive system without collet
- Motor: synchronous motor
- **Patented**



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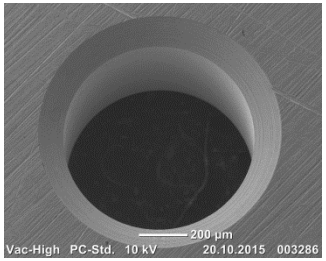
Micro drilling-routing Mono-E

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
- 2000 tools embedded

Applications

- Dedicated to non ferrous material
- Watch industry ➔Brass
- Medical ➔Titanium, Aluminum



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High precise drilling-routing Mono-E

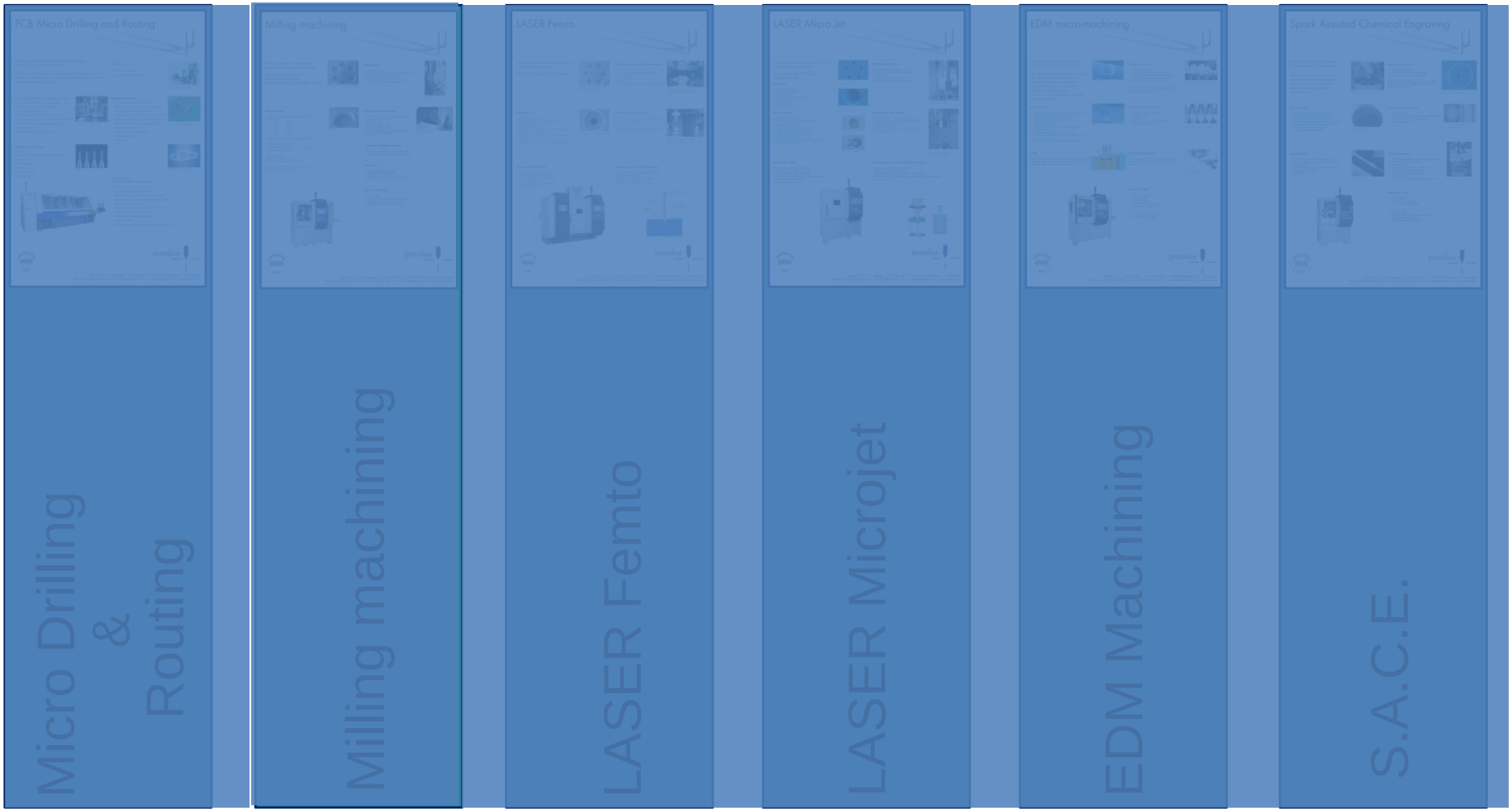
Technology

- 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 2000 tools
- Automation: individual loader with 8 stacks

POSALUX - 6 Technologies



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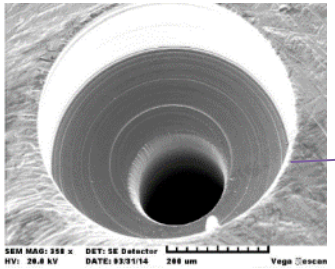
Micro Milling

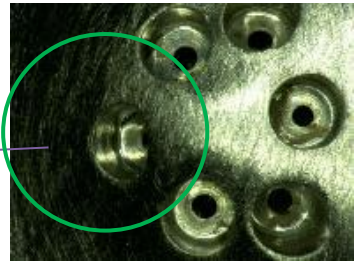
Specifications

- Micro Milling for hardened material < 67 HRC dia.0.3 to 0.6 mm
- High productivity (6 step-hole and 2 marks < 13 sec)
- Vibration reduction during milling process
- Cutting force optimised
- Tool life optimised
- Dedicated to customer application

Applications

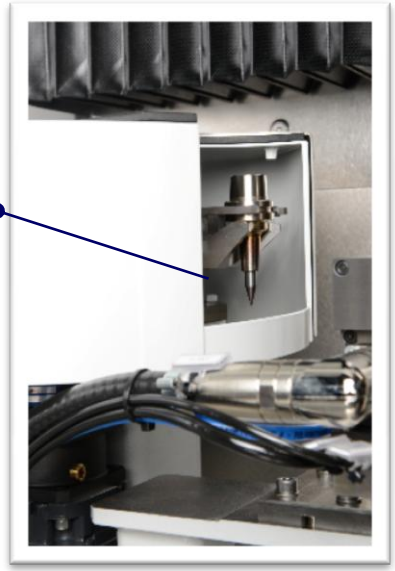
- Dedicated to hardened ferrous material
- Stainless steel
- Titanium
- Automotive and Medical



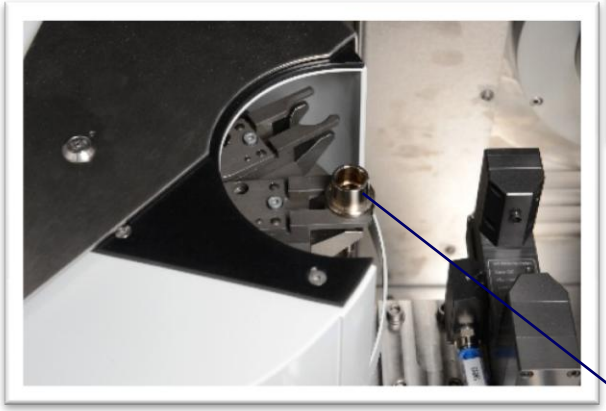


Micro Milling

Tool Changer
(12 positions)



Complete Milling process



100% Laser checking of tools

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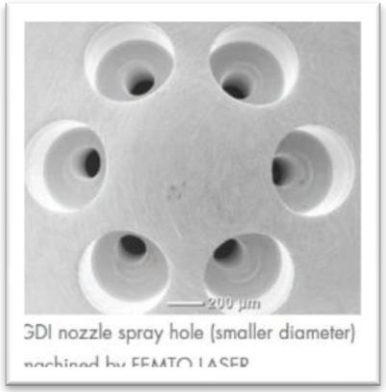
POSALUX - 6 Technologies

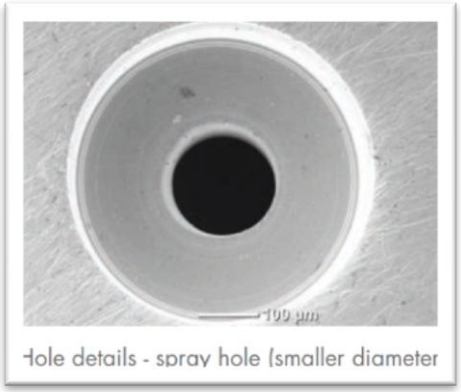
Micro drilling and cutting with FEMTO Laser

Micro Machining

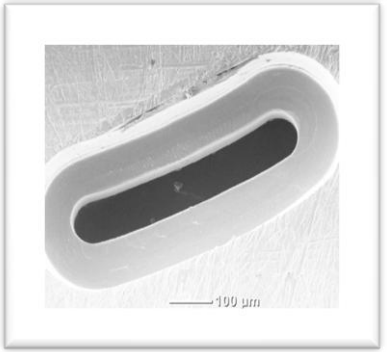
- Hole diameter down to 90 µm
- Wall thickness / hole diameter ratio up to 10
- High positioning accuracy
- High productivity: less than 1,4s / hole
- Excellent flow stability in +/- 1%
- Excellent surface roughness Ra 0.05 µm (like polished)
- Tapered holes + 23° or - 15° full angle
- Flexibility in circular hole shapes machining (ellipses)



GDI nozzle spray hole (smaller diameter)

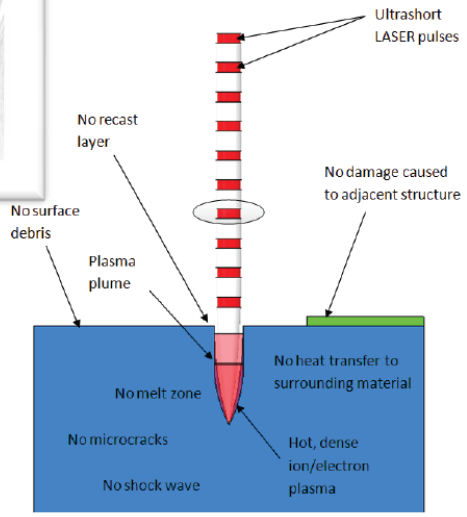


Hole details - spray hole (smaller diameter



Advantages of FEMTO Laser machining

- Heat affected zone avoided due to cold ablation
- No deposits, no recasts
- Machining of a wide range of materials
- Cutting function (ablation) available
- Depending on application: no needs of amount process



Micro drilling and cutting with FEMTO Laser

LASER source and galvohead specifications

- Femto source down from 230 fs to 10 ps
- Various harmonics available (wave length): nIR, Green, UV
- 5 axis galvohead
- Optional: Vision system, Beam focus analyser
- Pulse energy up to 200 µJ (10W)
- Pulse frequency: 1 Hz – 2 MHz


2 localisation systems for hole positioning

LASER head / part load-unload automation

Specific devices and solutions

- Automatic loading / unloading specific solutions
- Camera for step hole positioning
- Focal length measurement
- Dust extraction

Microfor HP1 FEMTO LASER

- Mass production one head LASER machine
- Machine class 1 (I), LASER class 4 (IV)
- Siemens 840 D sl 4.5 SP2 HMI operate, safety integrated CNC
- Linear axis system allowing high
- Dynamic and accurate motions

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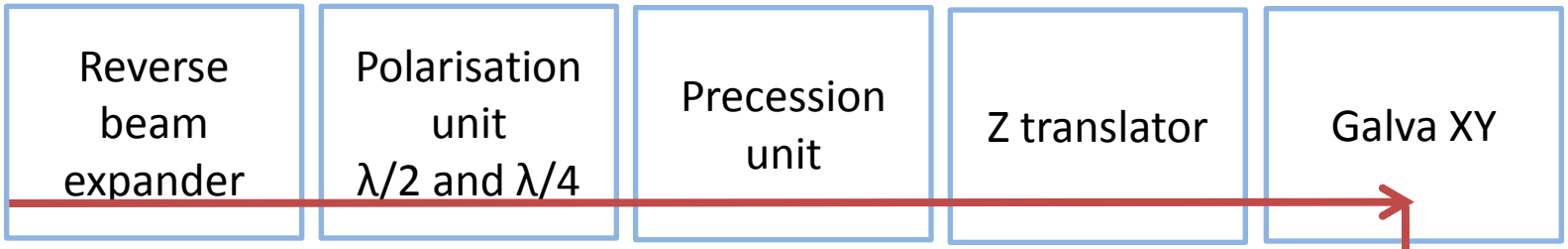
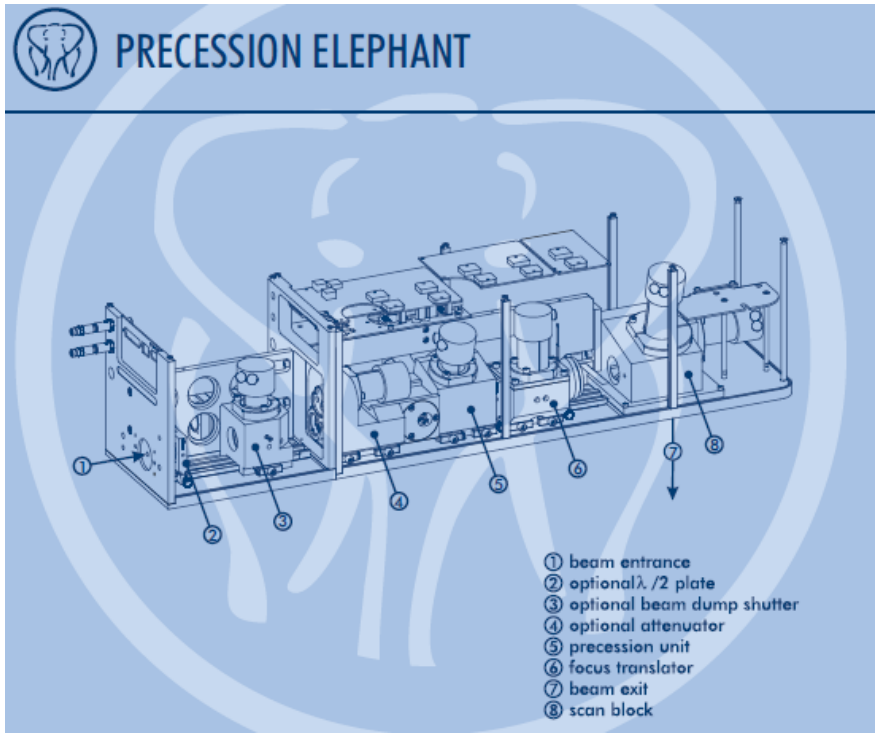
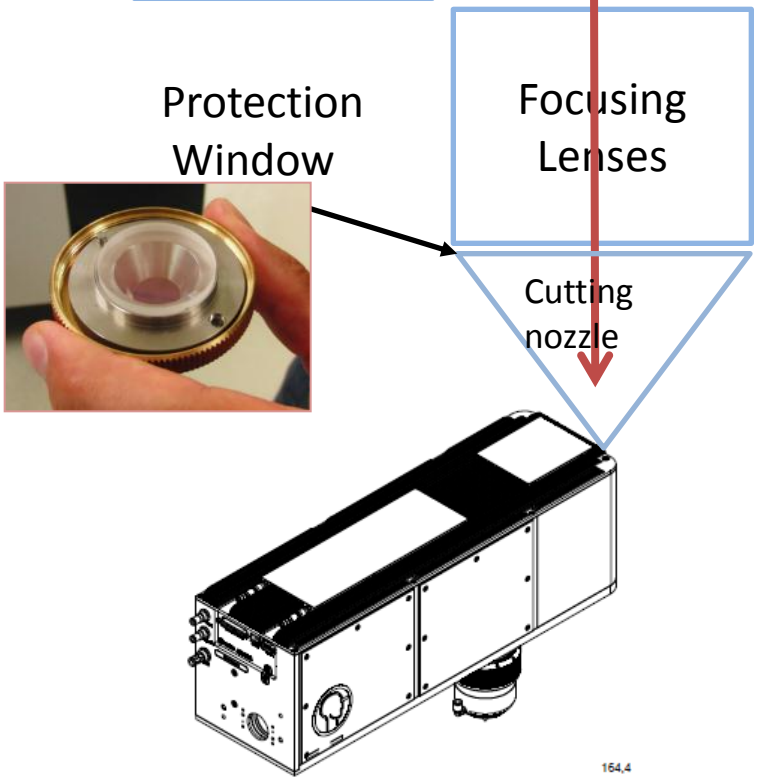
Arges Drilling Head – Elephant 3D





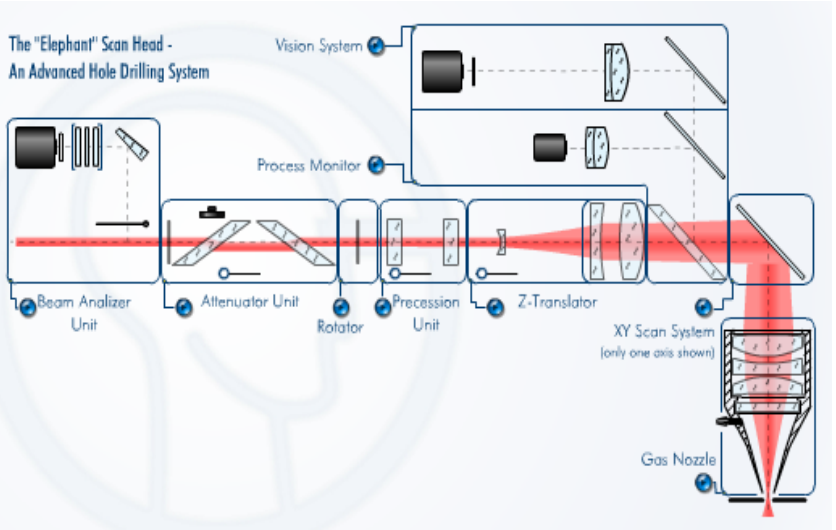


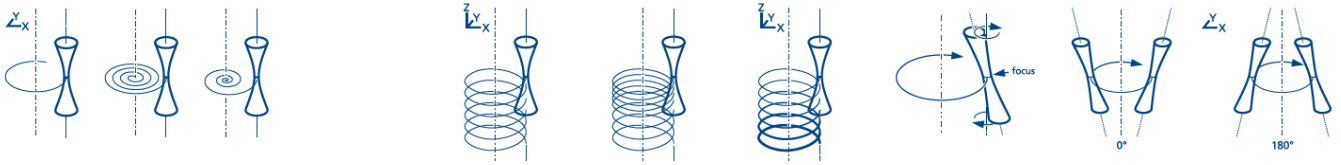
Trepaning with Arges Head

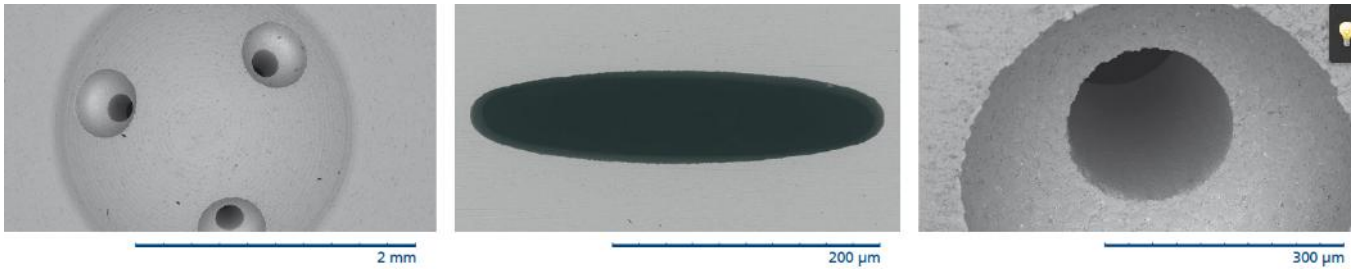
PERFORMANCE

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.







Watchmaking Applications

Potential applications

- Texturations, engraving, cutting, …
- Silicon, ceramic, glass, sapphire , steels, precious stones,
- All shapes for watchmaking…

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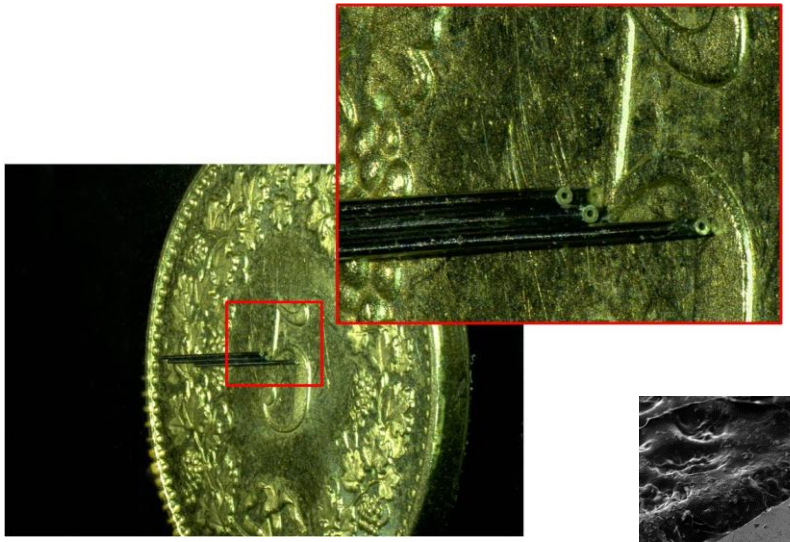
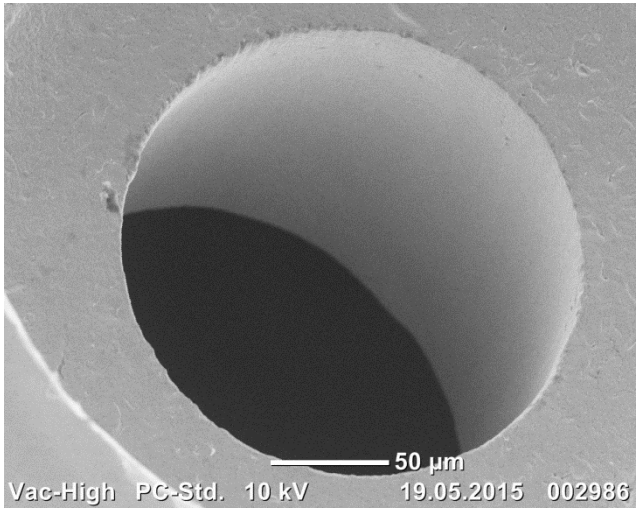
Femto: Challenges Posalux durant les 12 derniers mois

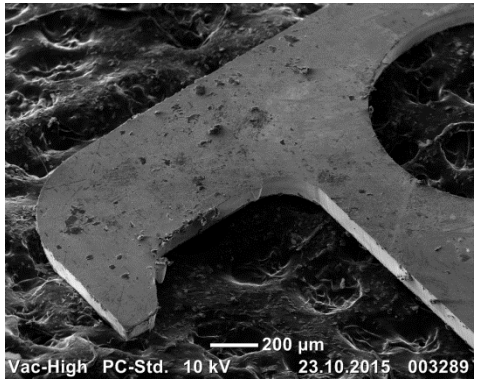
- Circularité ➔ < 1.5 µm ✓
- Cylindricité / Rectitude ➔ < 1.5 µm / pour tous ratio ✓
- Formes entrées / sorties ➔ angle vif, contrôle rayon ✓
- Cônes positifs ➔ jusqu'à + 23° ✓
- Cônes négatifs ➔ jusqu'à – 15 ° ✓
- État de surface ➔ < 50 nm ✓
- Ratio dia/prof ➔ 1:13 (e.g. 30 µm / 400 µm) ✓

Matériaux - validés, expérimentés, testés

➢Aciers d'améliorations, faiblement alliés, inoxydables , trempés et non trempés, les laitons







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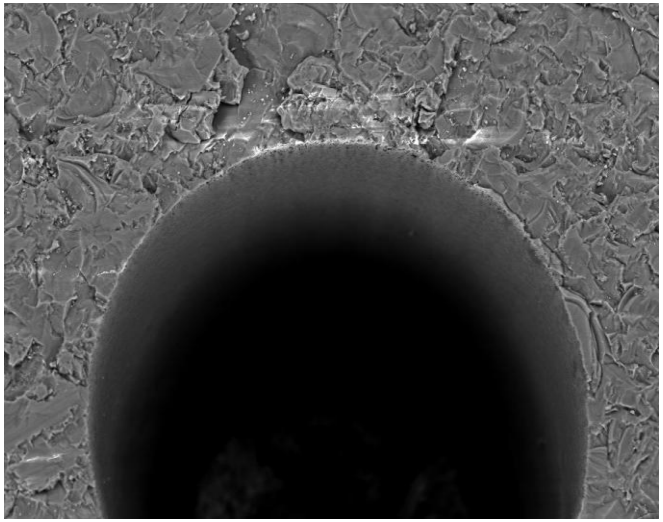
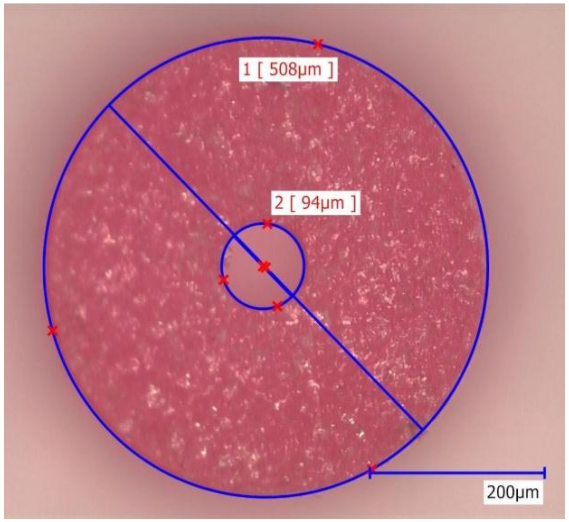
Matériaux - validés, expérimentés, testés

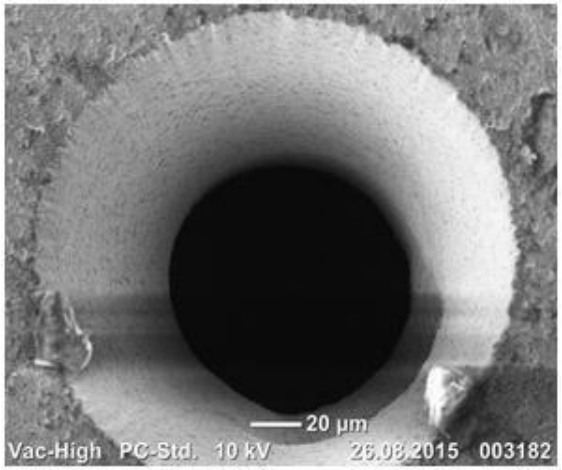
- Rubis

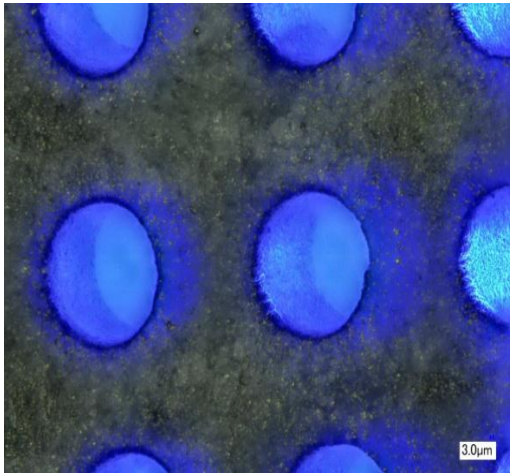




Matériaux - validés, expérimentés, testés,

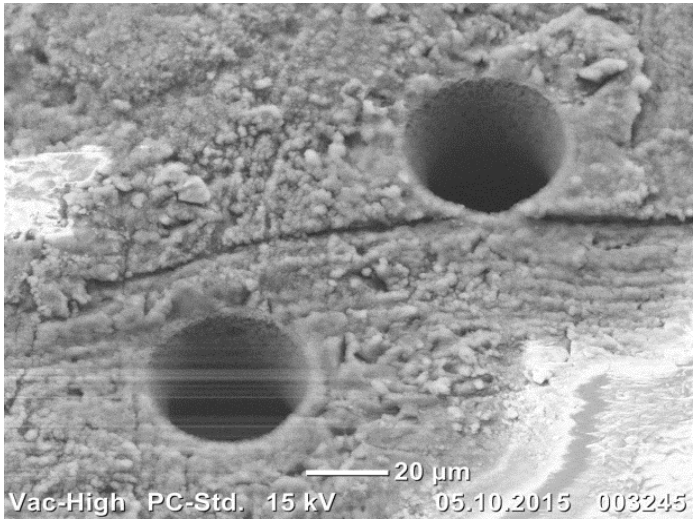
- Céramiques

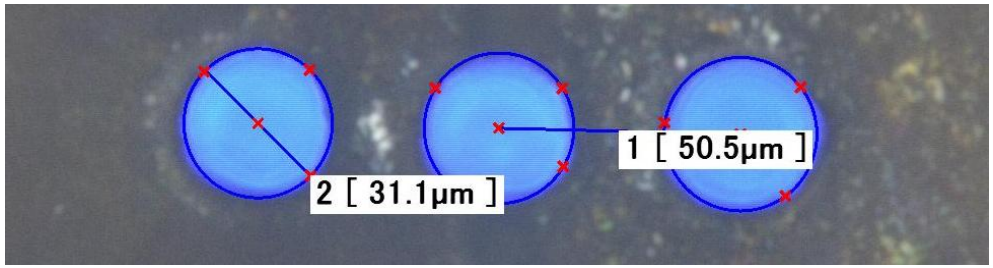




Matériaux - validés, expérimentés, testés,

- Polymères (Peek)



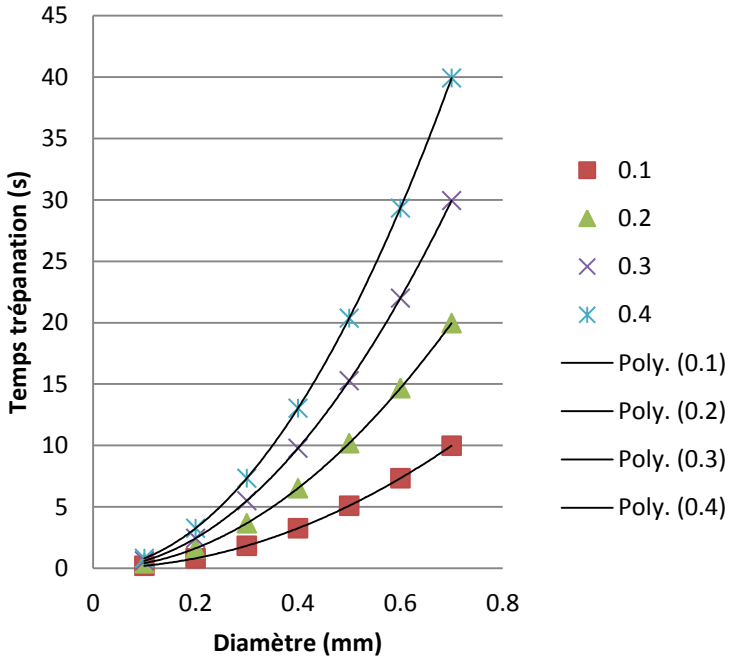


Matériaux – à valider par Posalux

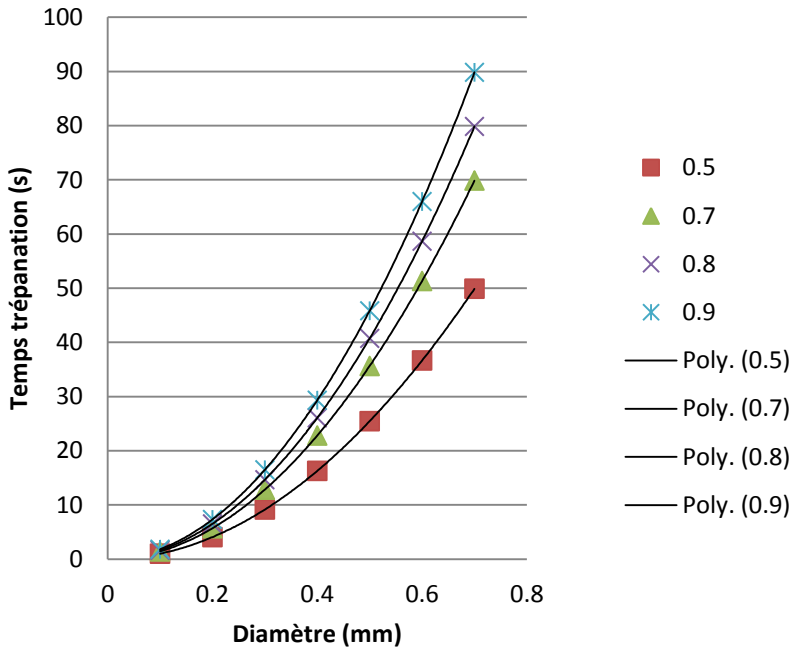
- Nitrure d'Aluminium *(en cours)*
- « Usinage » de revêtements *(en cours)*
- Verre et Silicium
- Saphir
- Autres Polymères, PMMA (plexiglas)
- Matériaux précieux

Usinage - perçage

Temps laser suivant Prof. matière-petite épaisseur



Temps laser suivant Prof. matière-grande épaisseur



Aciers trempés > 750 Hv / Trou ∅200µm / Longueur 300µm
Tolérances 1 µm
➔ Temps de perçage = 1,4 Sec

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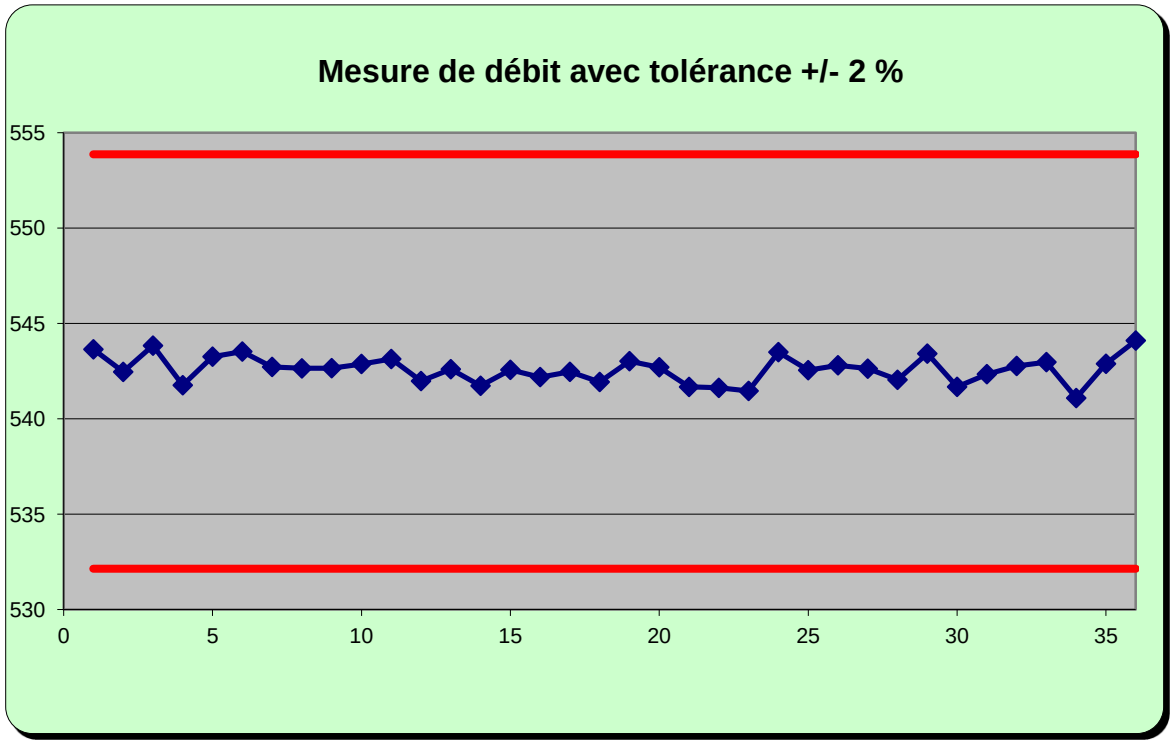
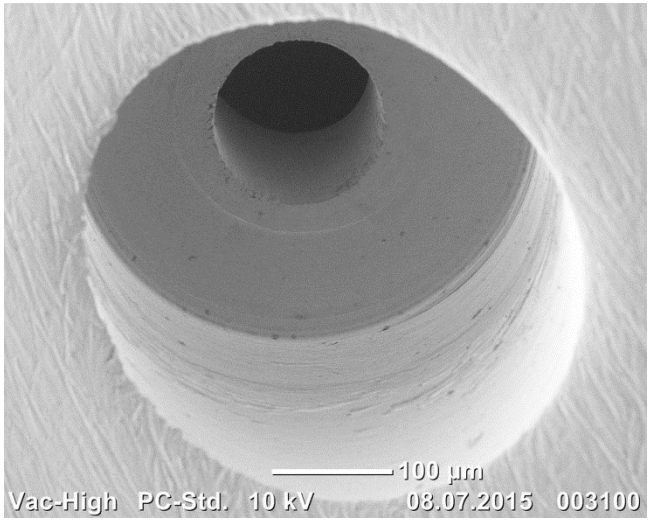
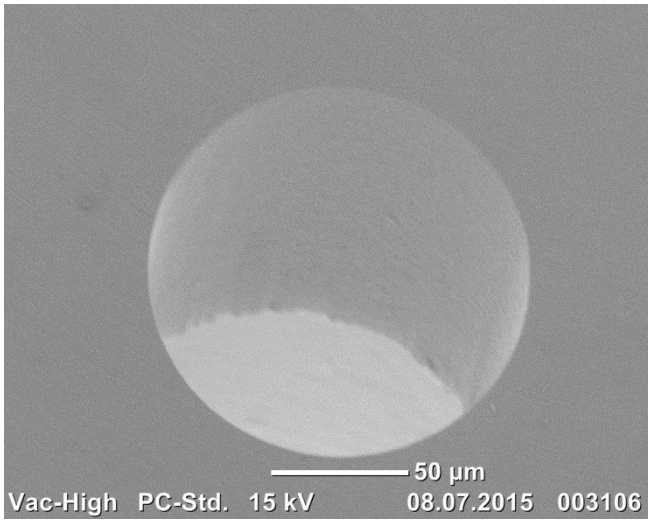
Usinage - perçage dia. 141 µm



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





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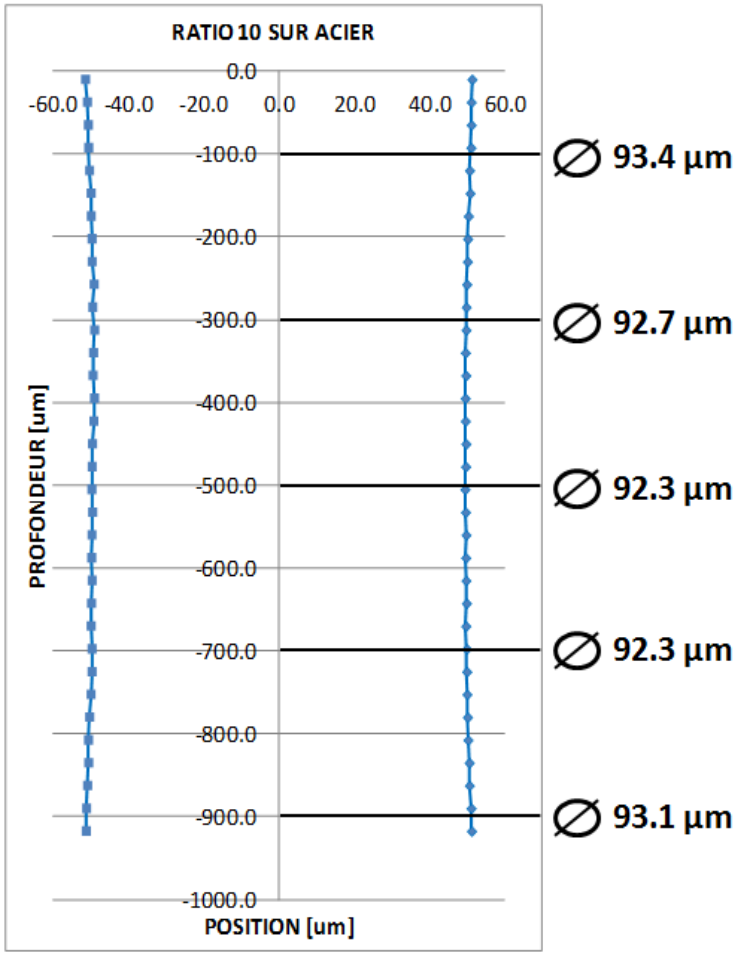
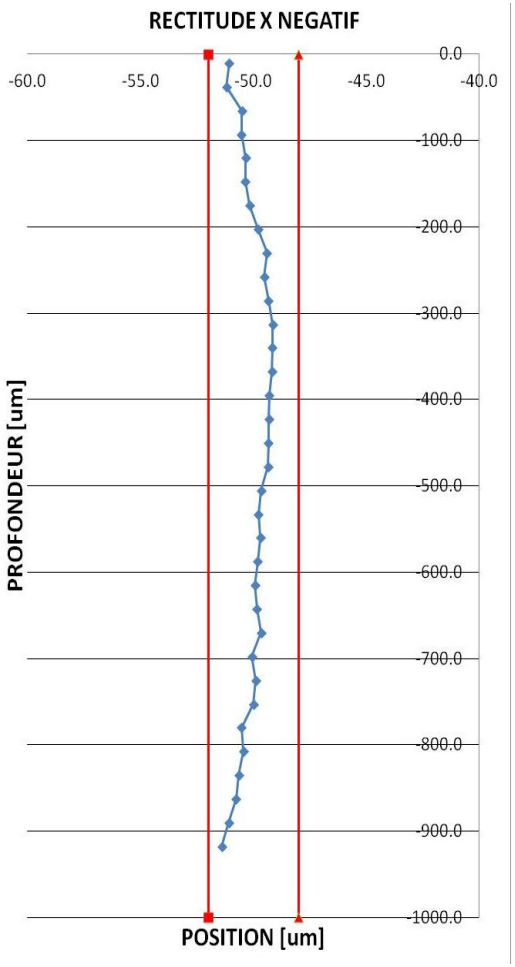
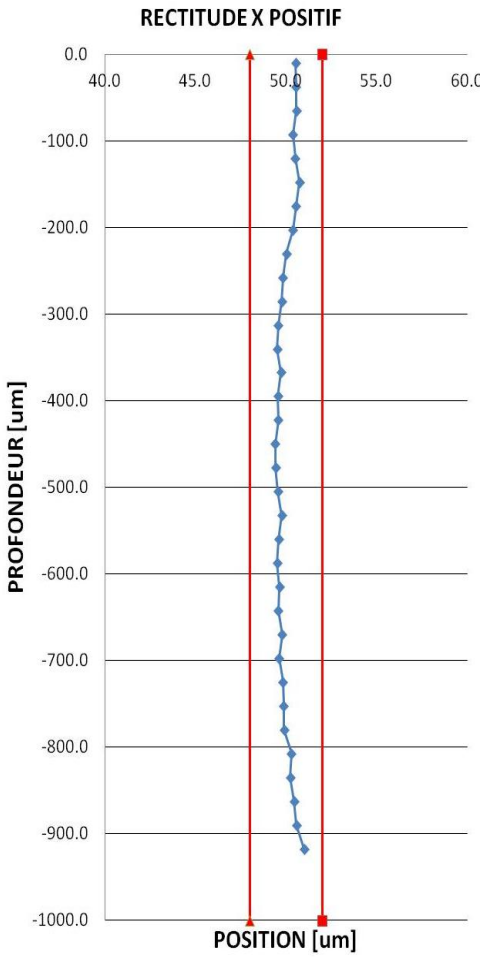
Perçage – Ratio 10 sur acier







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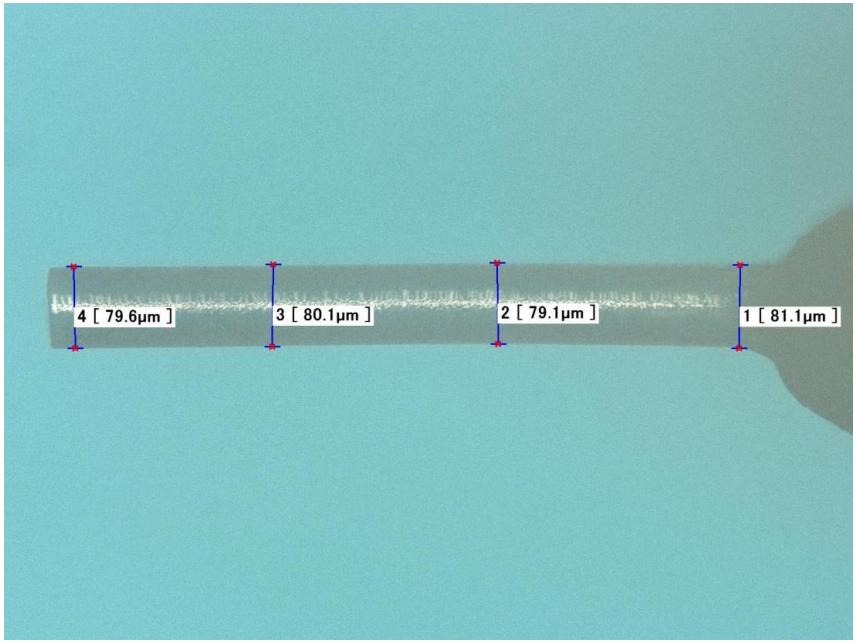
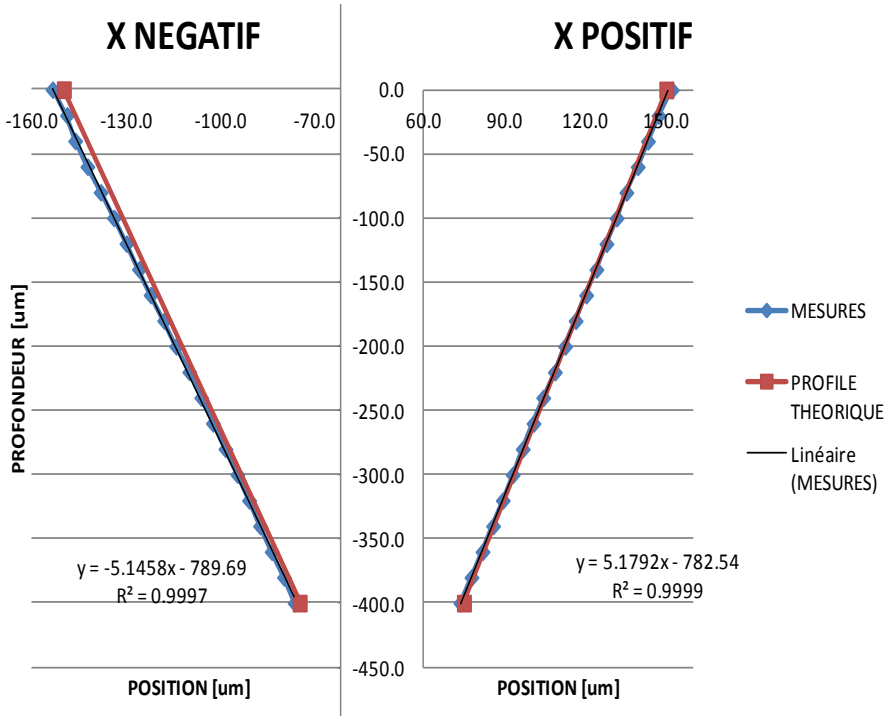
Usinage - perçage

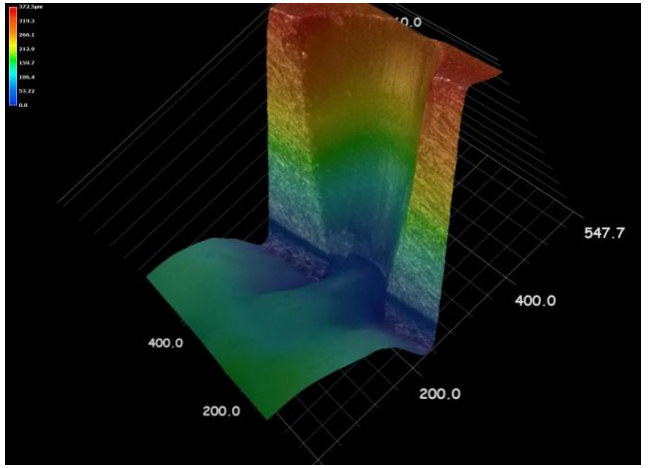
- Trou profond diamètre 80 µm / 800 µm

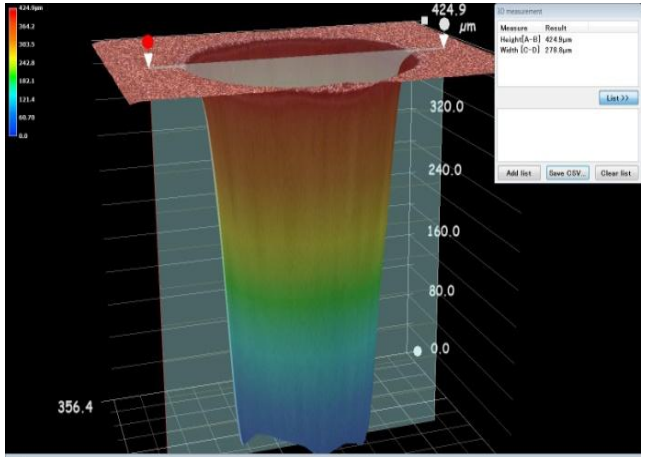


- Aciers Ratio 1:10
- Peek Ratio 1:13

Usinage -Perçage cône +23 ° sur acier

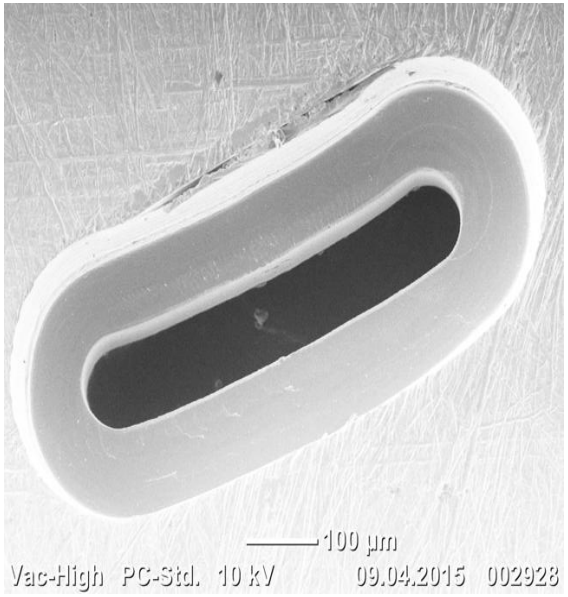


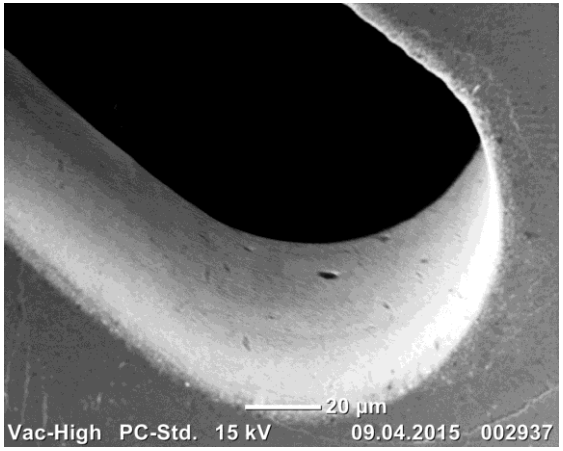




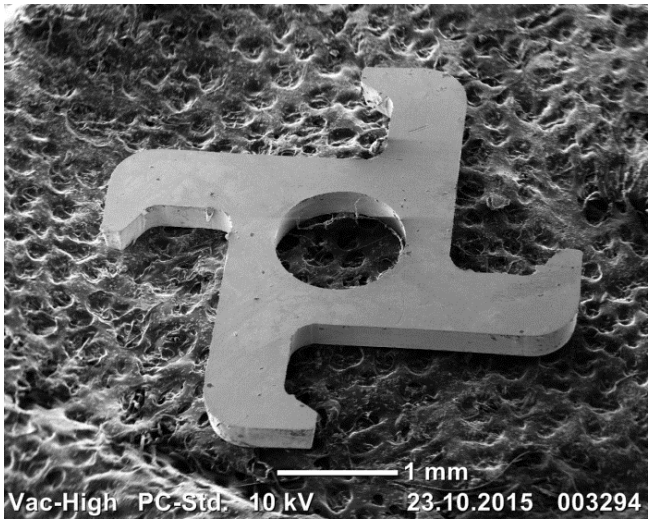
Pour info : Cône négatif -15° atteint

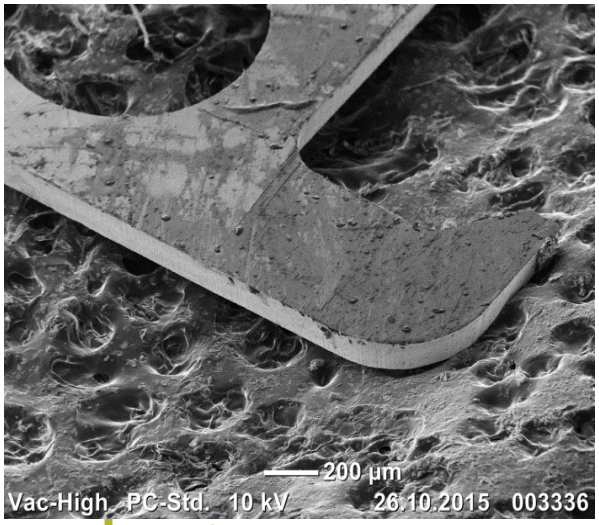
Usinage - découpe forme oblong

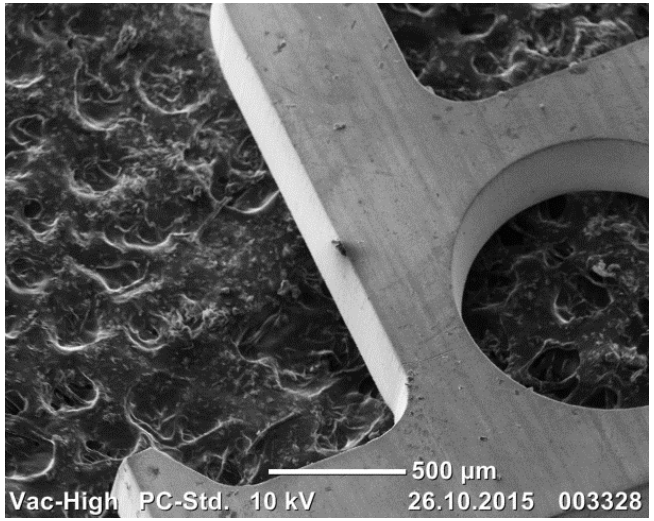




Usinage - découpe exemples







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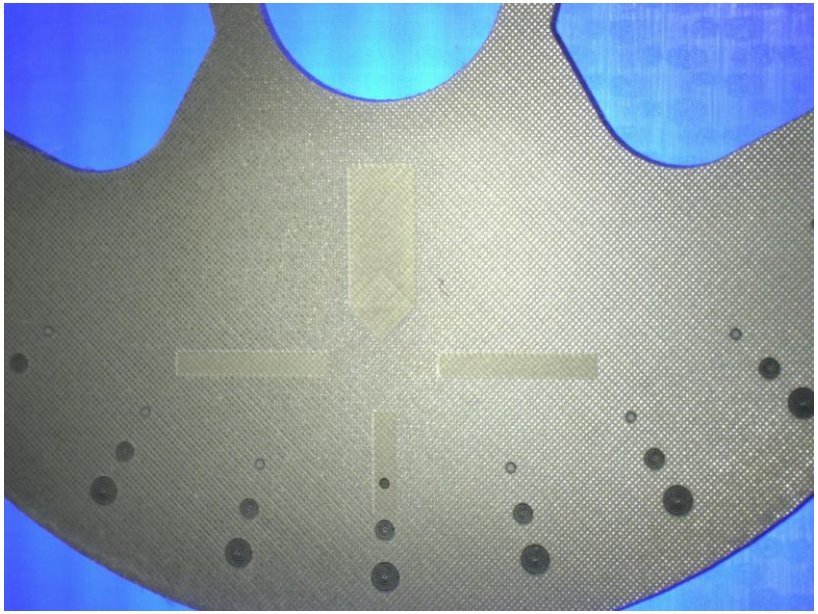
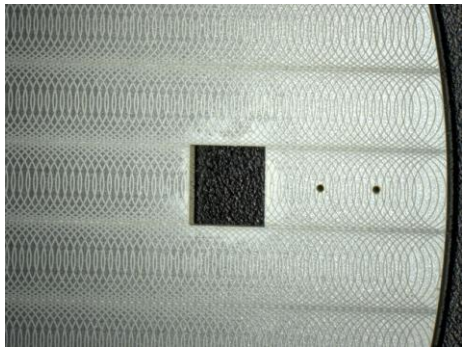
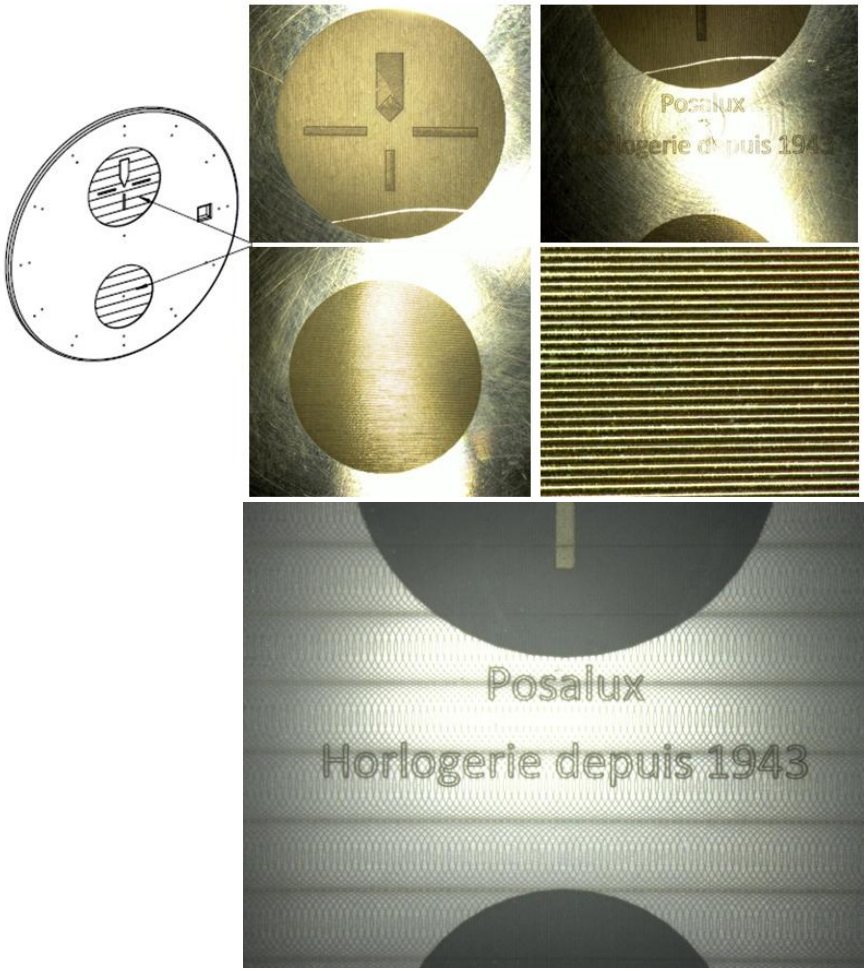
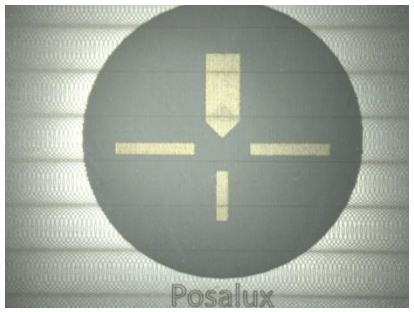
Usinage – gravage / texturation

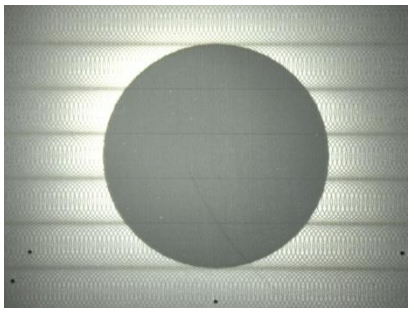


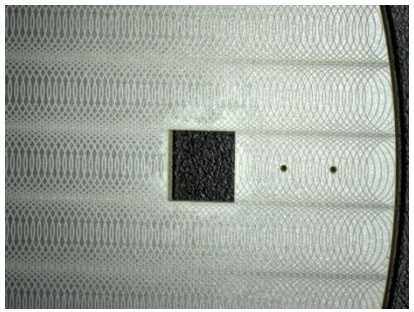


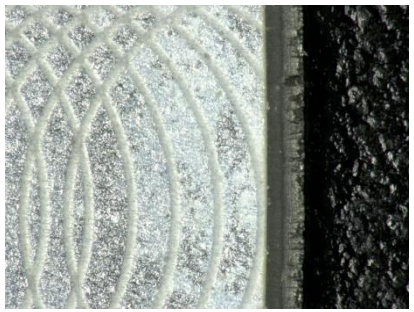


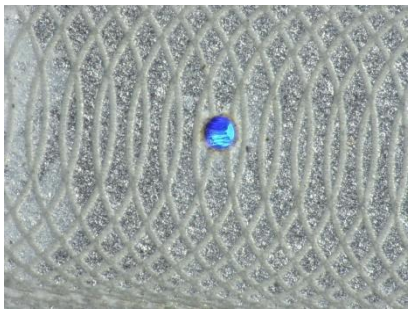
Usinage – gravage / texturation

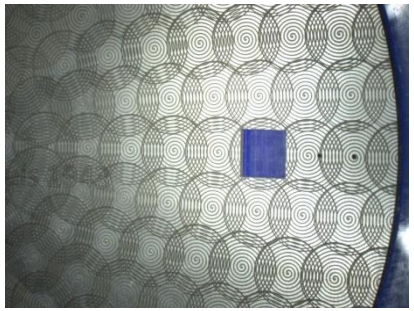


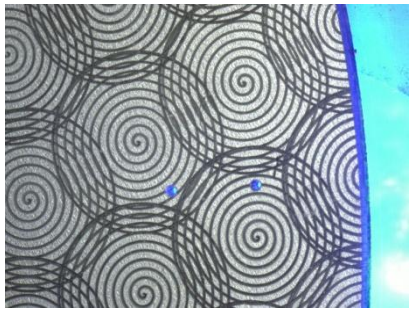












Matière :
Alu
Epaisseur :
0.3mm
Dépouille :
[20;30]µm
Tolérance de forme :
<30µm
Temps de cycle :
>10-12min
(Via 515nm)
Etat de surface :
Ra<0.2

Opérations :
1) Texturation (Cote G et perlage)
2) Marquage (Px et évidemment)
3) Gravage Px
4) Percage
5) Découpe

Concept Femto Mono Combi

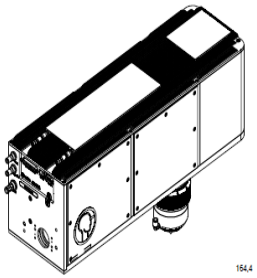
Concept perçage, découpe et scanning

Une source Laser alimentation une tête optique Combi mode :

1 source Laser
1 head switch précis pour commuter sur les 2 chemins optiques
2 optiques d'usinage.

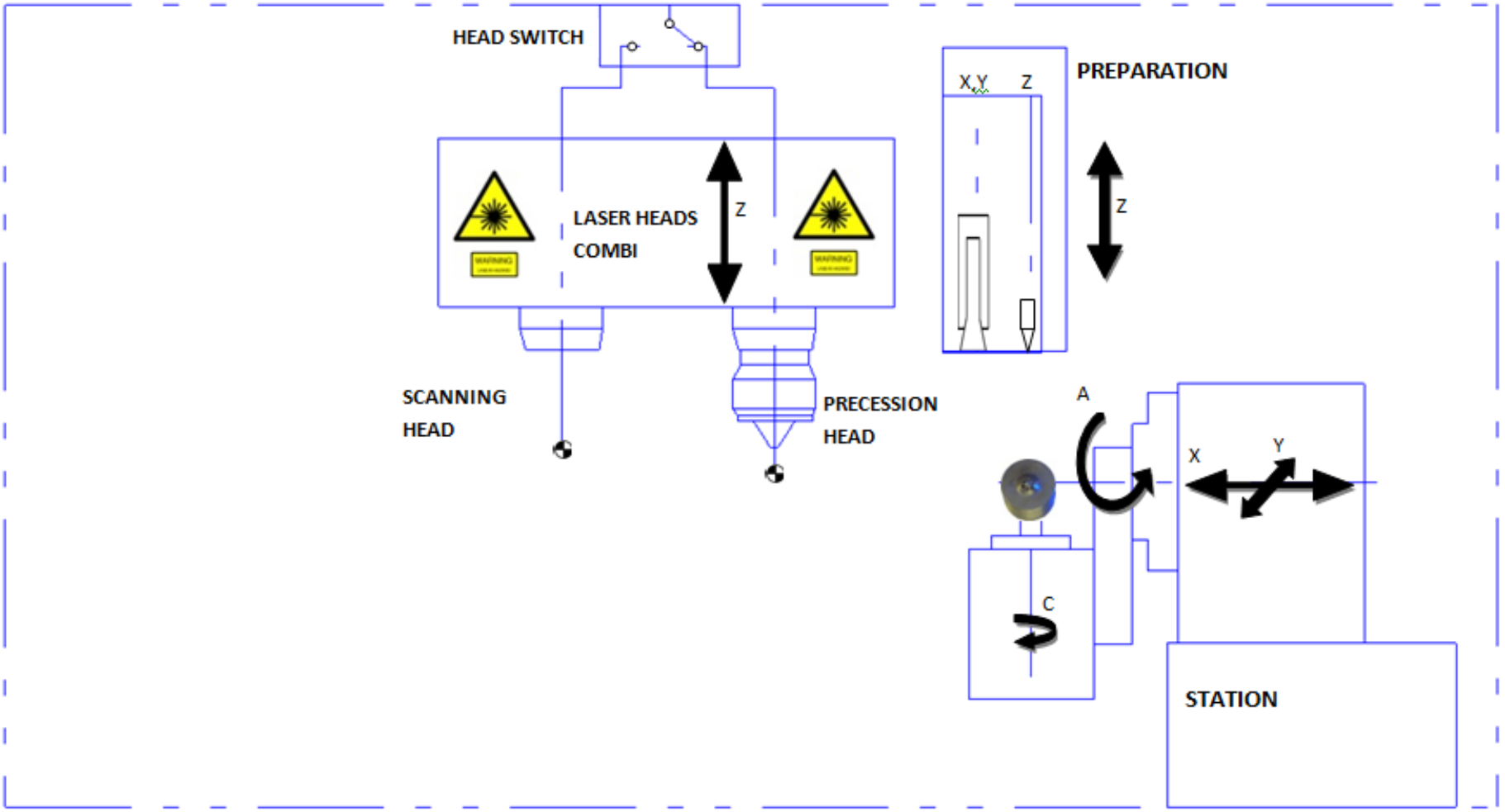
- 5 axes 3D avec système de precession pour la réalisation les opérations de perçages avec formes possibles cylindriques ou coniques positifs ou négatifs.
- 3 D permettant de réaliser les opérations de scanning sur pièces convexe/concave

Femto Mono Combi



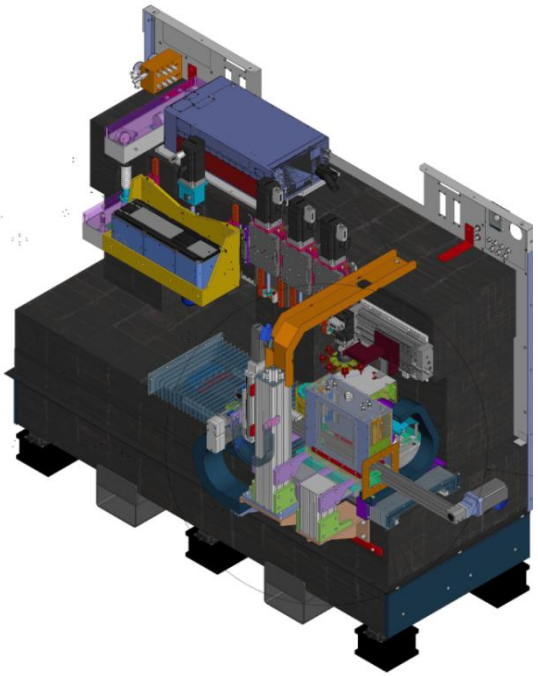
Optical Elephant head Combi (drlling/cutting + scanning mode)

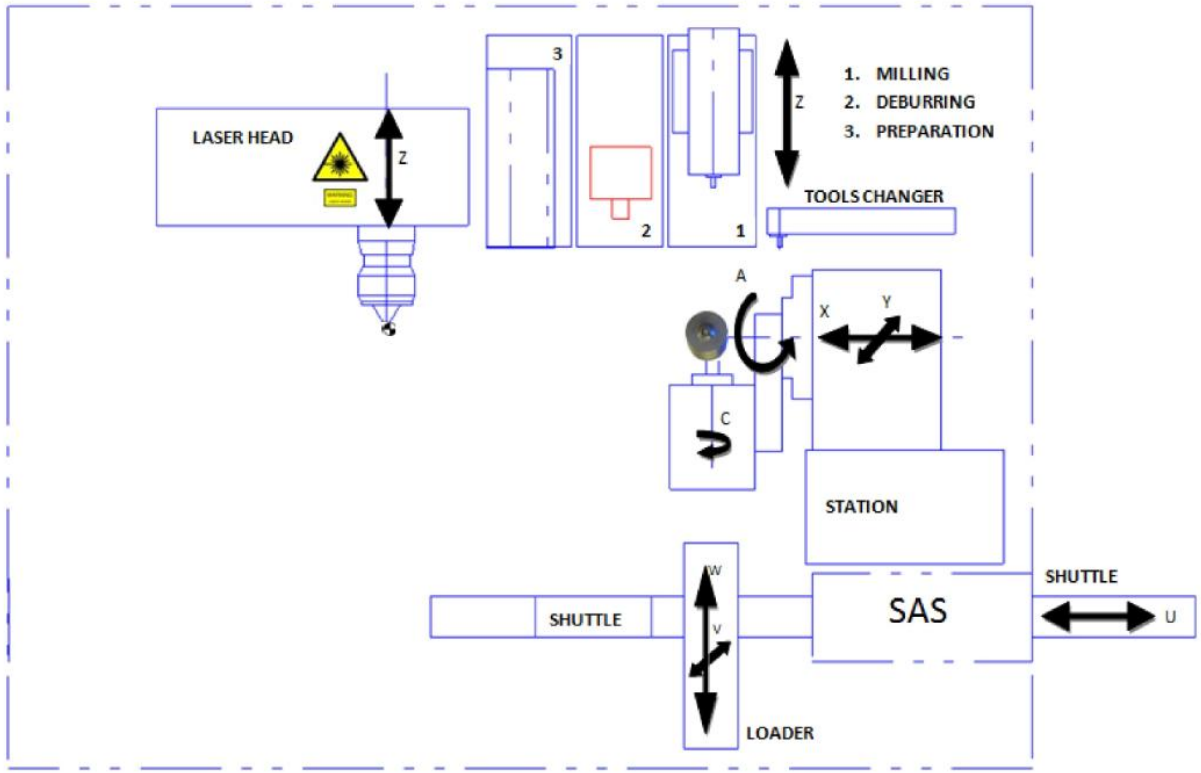
Concept de base Femto Mono Combi



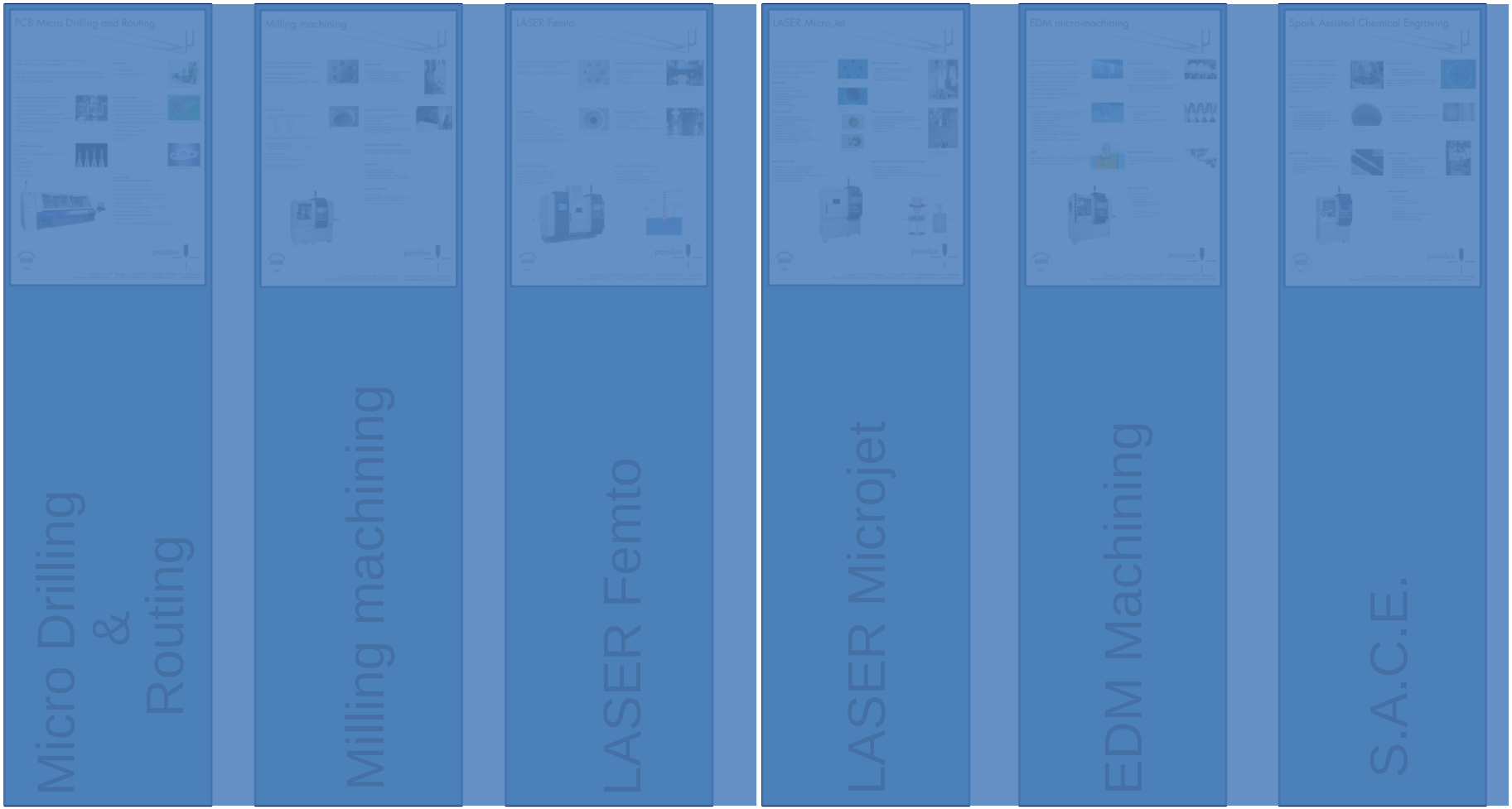
Concept Femto Mono Combi 2

Concept Milling, Deburring and Drilling





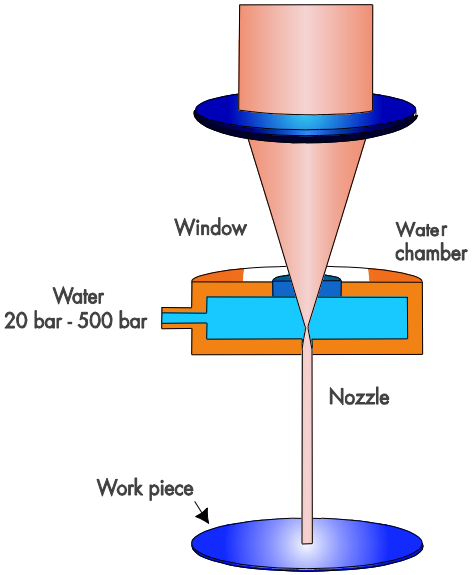
POSALUX - 6 Technologies



Micro drilling and cutting with LASER Micro Jet

Micro Machining

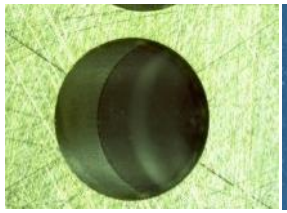
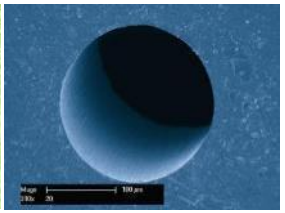
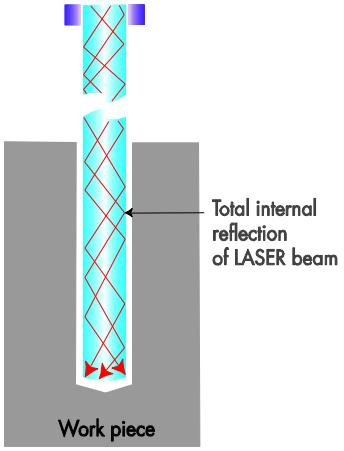
- Hole diameter down to 90 µm
- Wall thickness / hole diameter ratio up to 3.5
- High positioning accuracy
- High productivity: less than 2s / hole (dia.150 µm)
- Excellent flow stability in +/- 1%
- Excellent surface roughness Ra < 0.5 µm
- Tapered holes + or - up to 6° full angle
- Flexibility in hole shapes machining



Applications

- Dedicated to ferrous or no ferrous material
- Automotive industry: Gasoline Direct Injection
- Watchmaking Industry:cutting and finishing holes (steel, silicon,)



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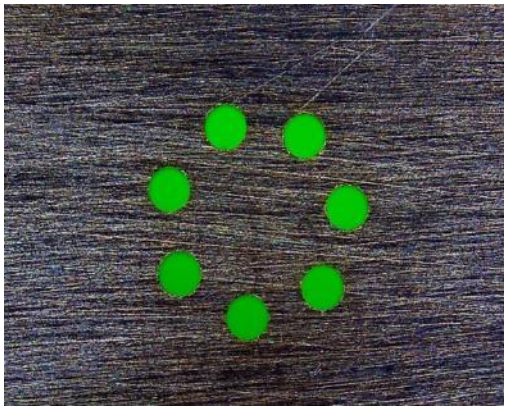
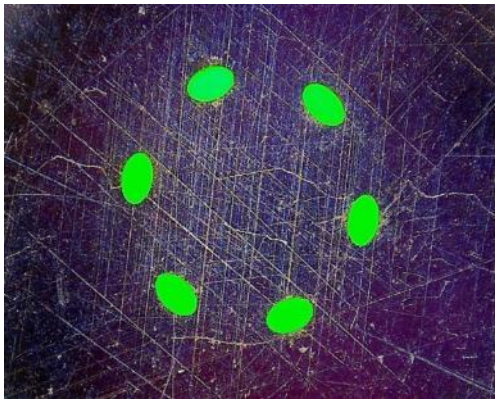
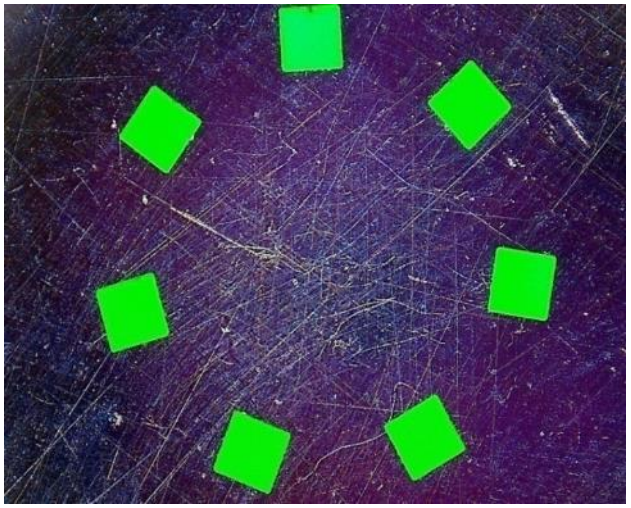
LMJ – various holes and shapes possible







Micro drilling and cutting with LASER Micro Jet

LASER head specifications
- Integrated LASER beam alignment device
- Coupling unit to combine the LASER beam with the water jet
- Vapors fume & dust extraction depending on customer parts and alloys
- Head with coupling unit (top) Clamping fixture (bottom)

Specific devices and solutions
- Automatic loading / unloading specific solutions
- No 'backwall' issue with dedicated clamping fixture
- Camera for step hole positioning
- High pressure deburring
- Hole shape device "A-AXIS" +/- 3° (+/- 100 µm/mm)
- Washing station

Head with coupling unit (top)
Clamping fixture (bottom)

Microfor HP1 LASER
- Mass production one head LASER machine
- Machine class 1 (I), LASER class 4 (IV)
- Available with Nd YAG or fiber LASER
- Siemens 840 D sl, HMI advanced, safety integrated CNC
- Linear axis system allowing high dynamic and accurate motions

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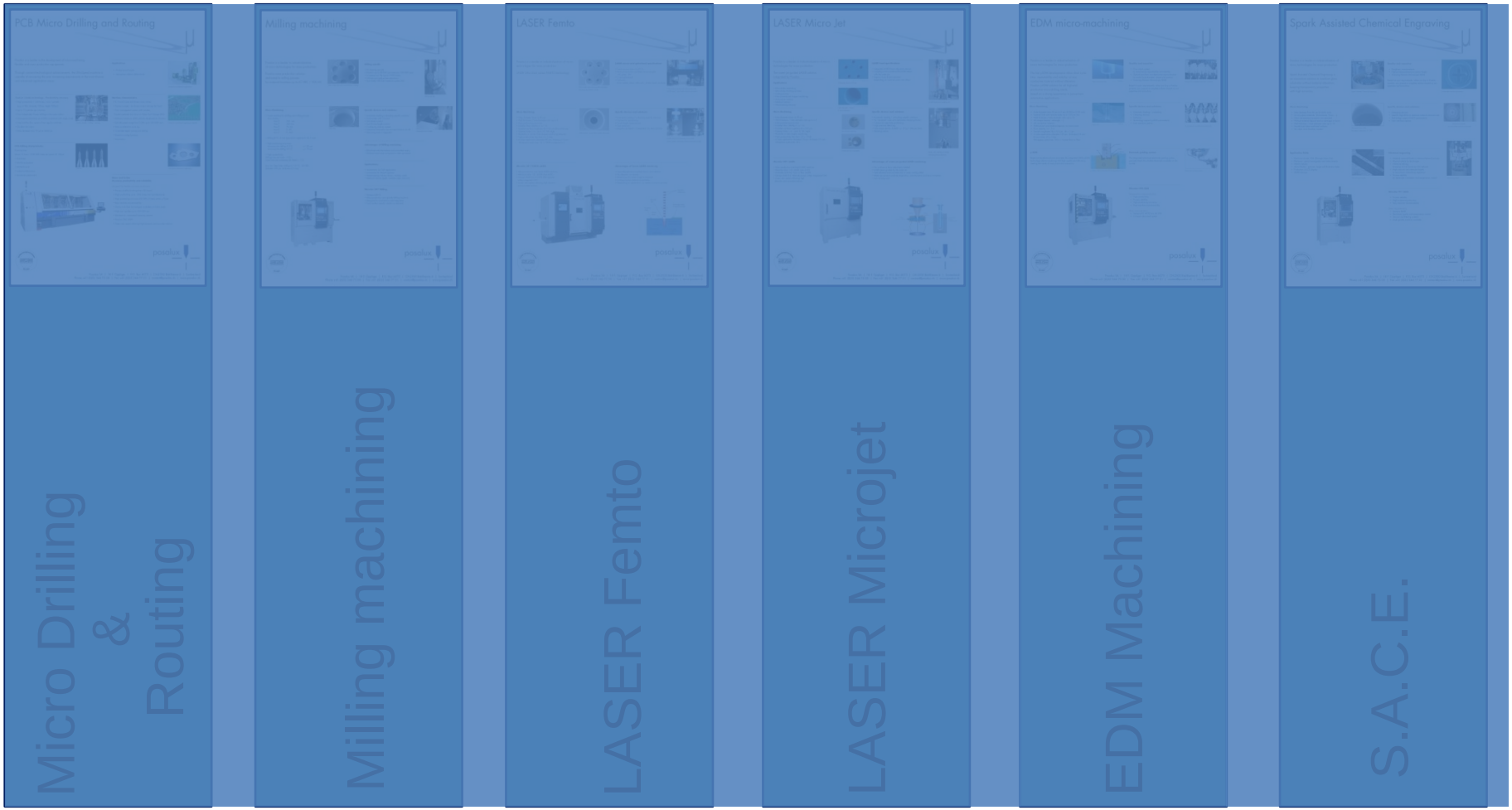
POSALUX - 6 Technologies

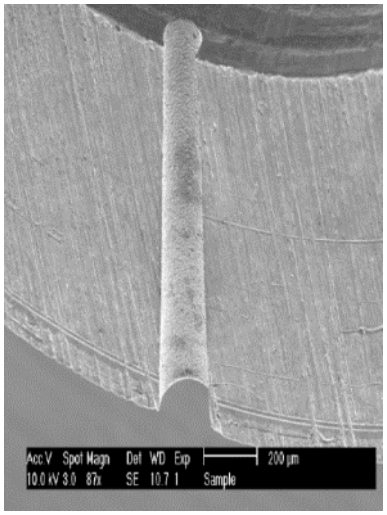


Micro drilling with EDM

Specifications

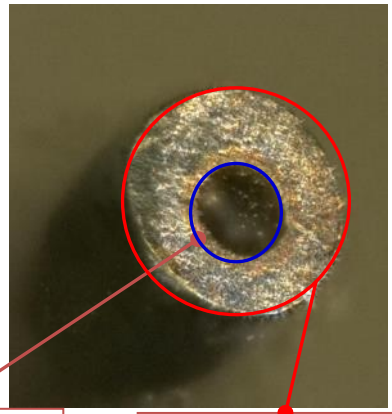
- Hole diameter of 50 microns
- Accuracy +/- 3 microns
- Diameter/depth ratio 1/12
- 4 spindles per machine
- Conical hole

Ø 50 µm



Applications

- Dedicated to conductive material
- Automotive industry : - Diesel high pressure
  - Gasoline Direct Injection (GDI)
- Medical : - Needle



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Micro drilling with EDM

Technology

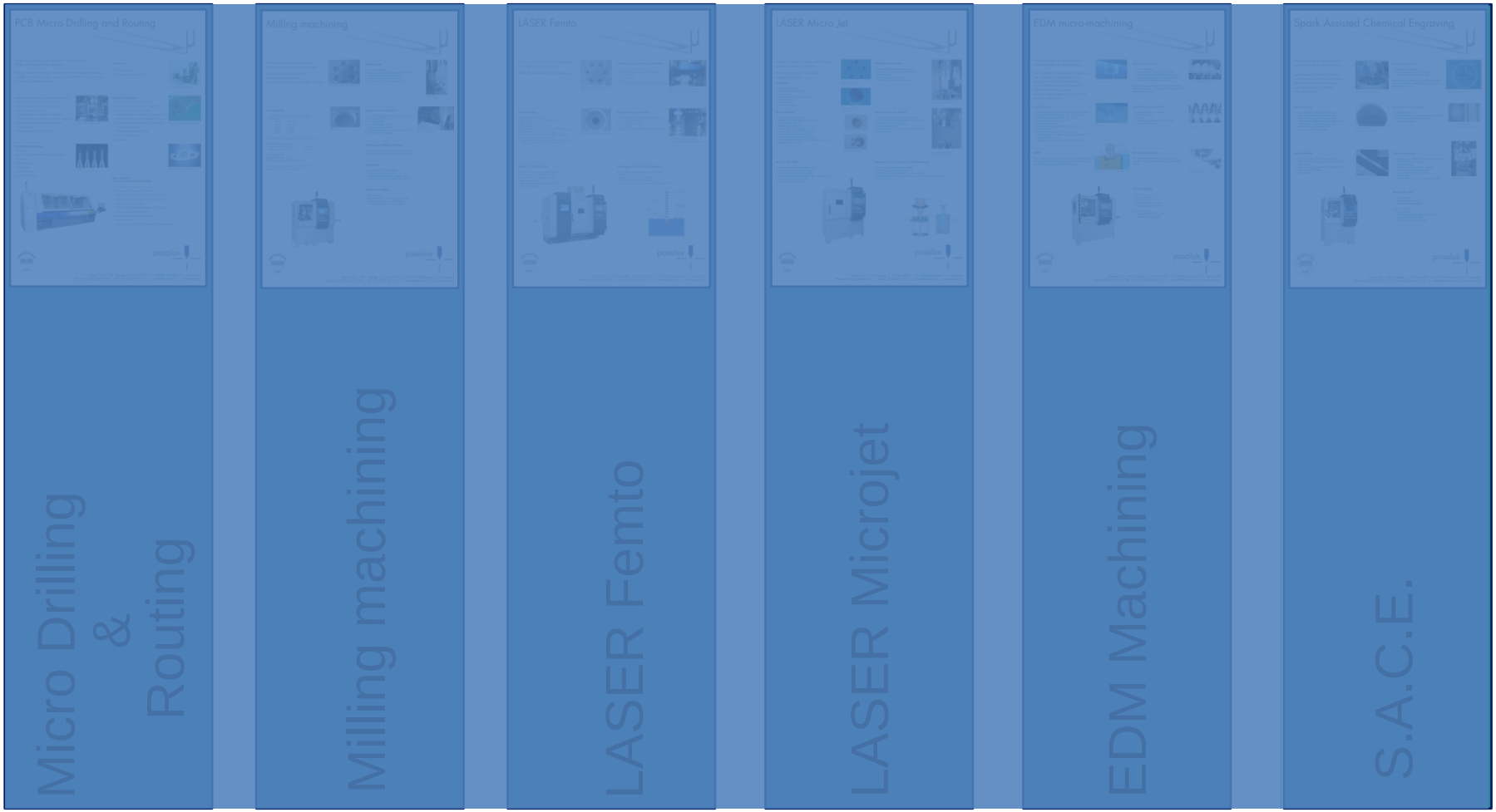
- Short pulse SARIX generator (80 nano secondes)
- Regulation by average voltage
- 6 axes machine

Machine configuration

- HP4: 1, 2 or 4 spindles

- Available options ➔ Automatic load/unload of parts
  ➔ Flow control

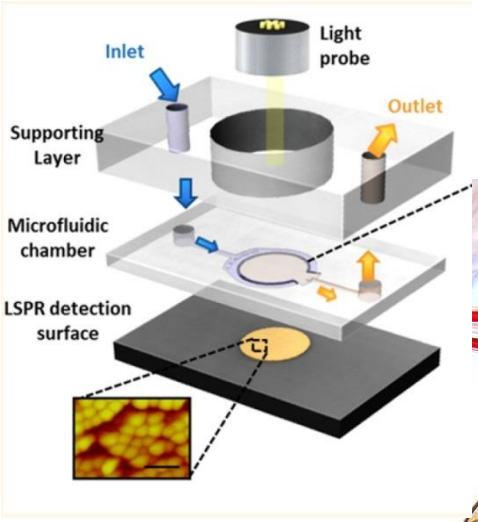
POSALUX - 6 Technologies

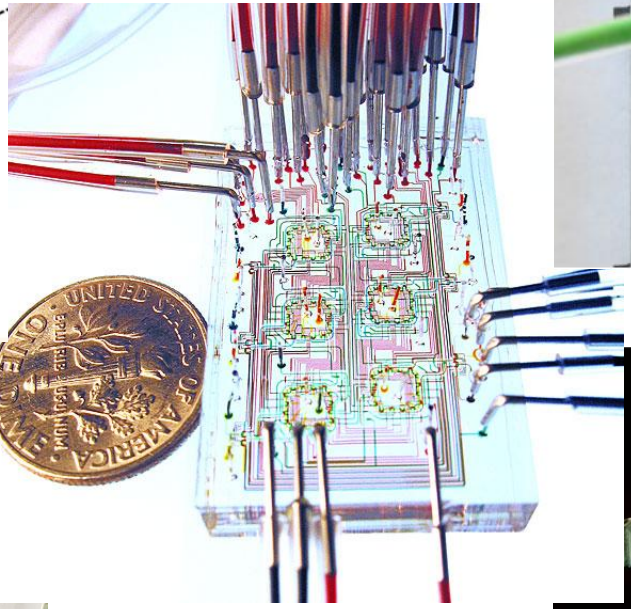


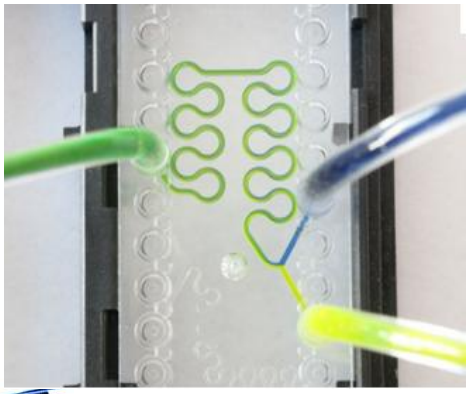
Glass Micro Machining by SACE

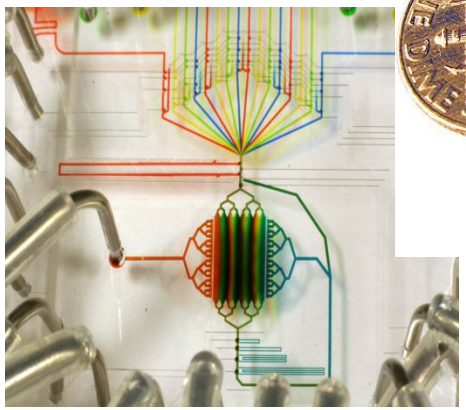
(**S**park **A**ssisted **C**hemical **E**ngraving)

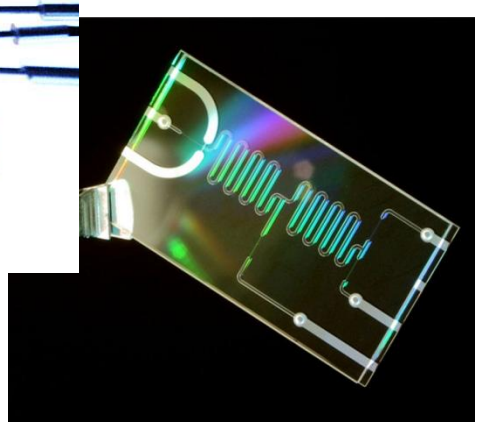
Why Micromachine Glass?



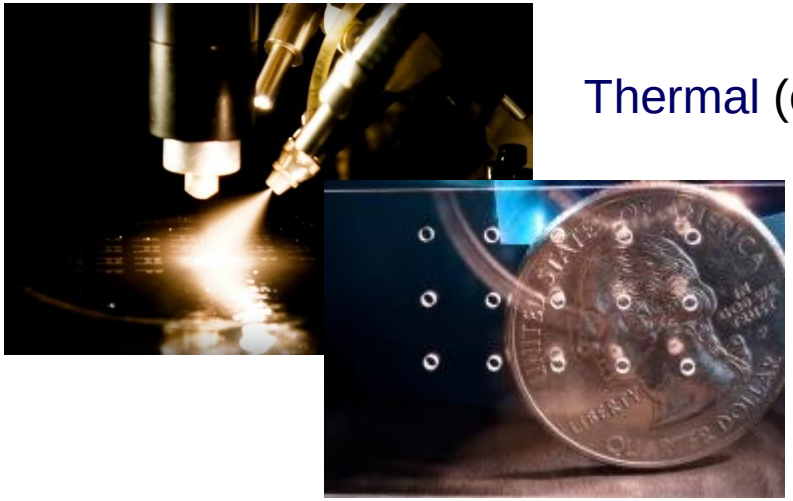






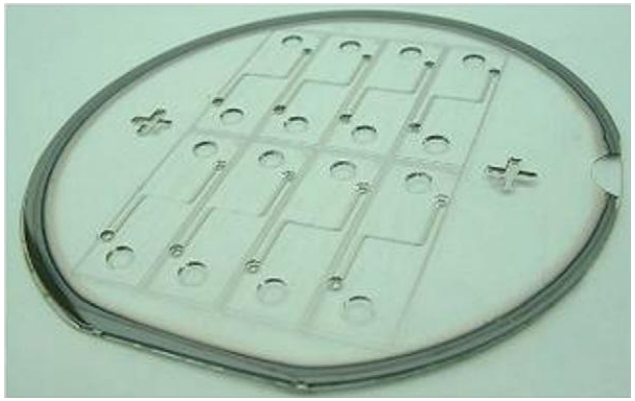


Glass Micromachining Techniques



Thermal (e.g. laser)

Chemical (e.g. HF etching)



Mechanical (e.g. diamond tool drilling)

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Glass Micromachining in a Nutshell

Mechanical (mechanical drilling, USM, AJM, ASJM)

Features	*Limitations*
• Flexible (mech drill/ USM)	• Tool wear (mech drill / USM)
• No tool wear (AJM / ASJM)	• Rough surfaces
• Batch process (AJM)	• Chipping, exit cracks
• Lean process	• Low aspect ratio (AJM / ASJM)
	• Mask required (AJM)
	• Frosted area (ASJM)
	• Moderate speed drilling

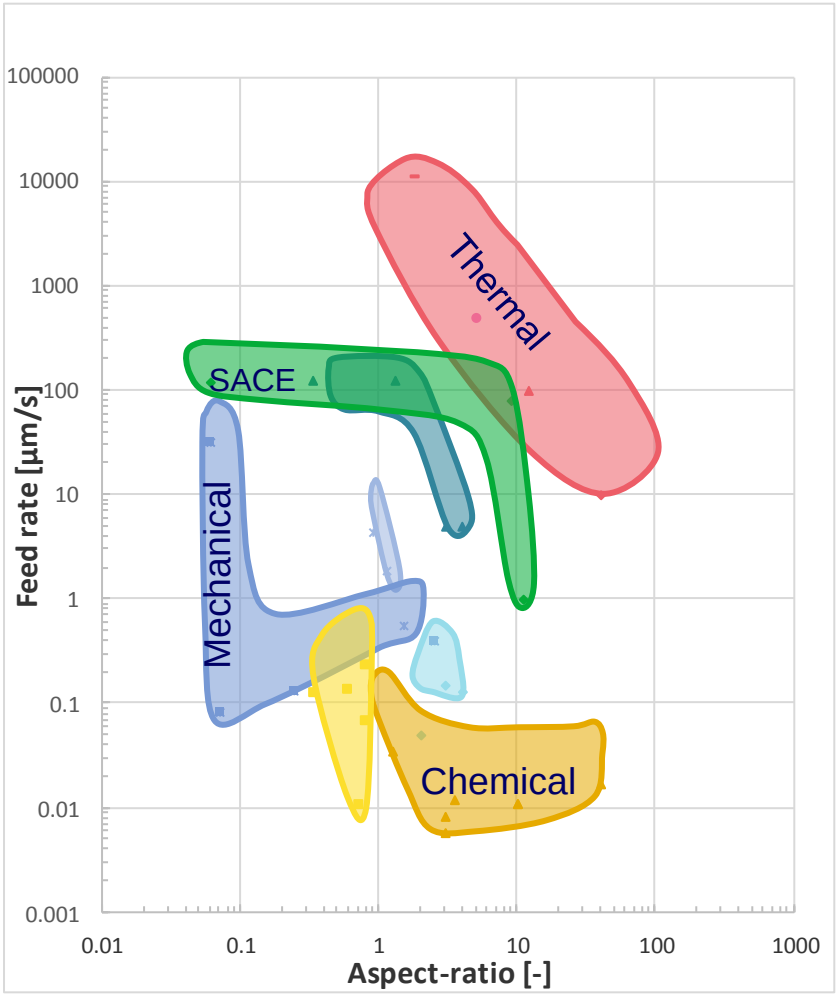
Thermal (Laser drilling, FEDM)

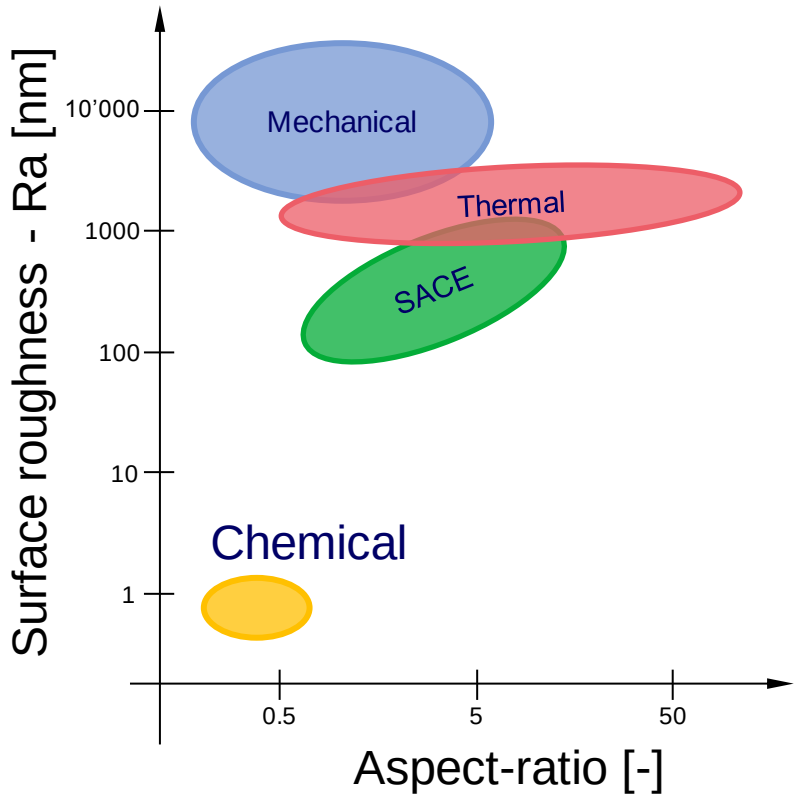
Features	*Limitations*
• Flexible (no mask)	• Bulges (debris)
• High aspect ratio	• Heat Affected Zone (HAZ)
• High speed drilling	• Microcracks
• No tool wear	• Chipping
	• Specific types of glass
	• Expensive equipment

Chemical (Wet etching (HF) + DRIE)

Features	*Limitations*
• Smooth surfaces (very low R_a)	• Low aspect ratio *(wet etching)*
• High detail (small structures)	• Extremely hazardous etchant
• Batch process (mass-fabrication)	• Many process steps
• No HAZ	• Slow etch rate
• No microcracks	• Requires a clean room

Glass Micro-drilling





Excluding expensive chemical etching technologies, SACE gives best surface quality at high drill rate

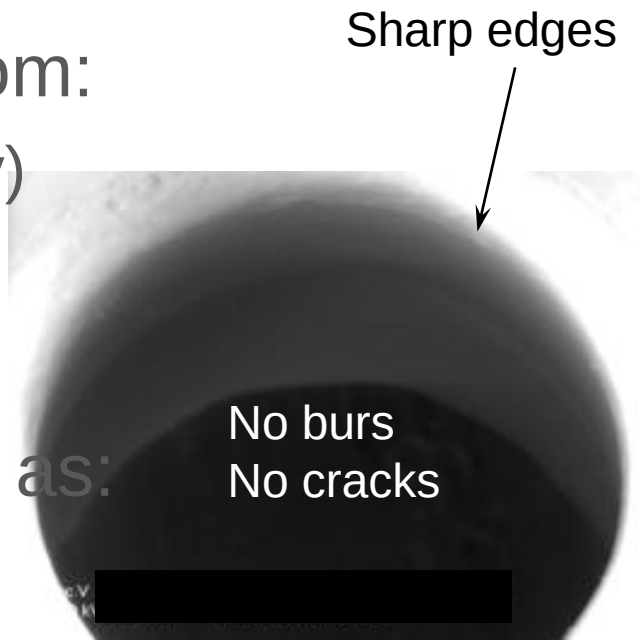
SACE – The Hybrid Process

SACE combines advantages from:

- Chemical (good surface quality)
- Thermal processes (Speed)

While avoiding drawbacks such as:

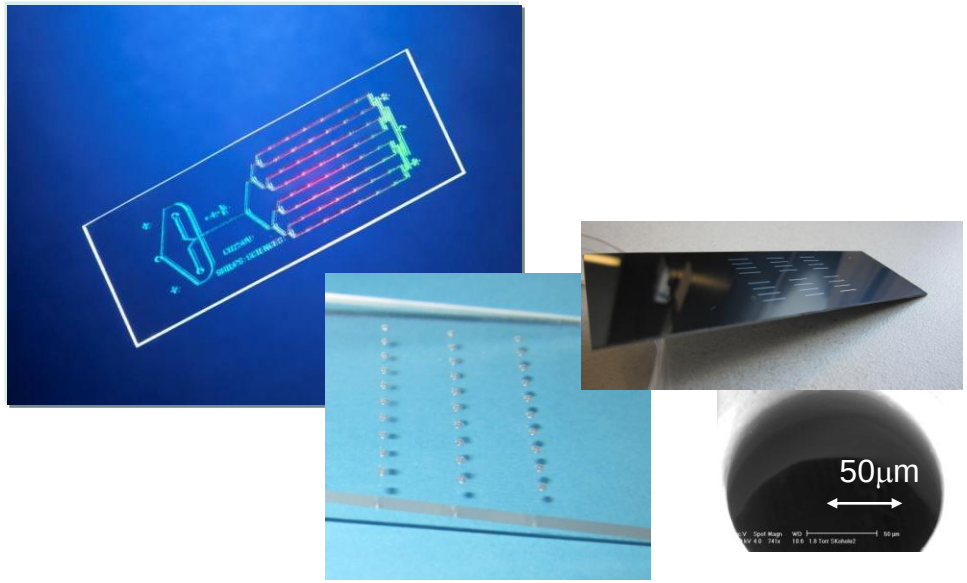
- Microcracks
- Burs
- Masks
- Highly toxic chemicals



SACE a versatile technology

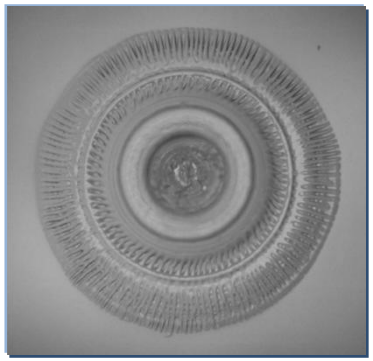
SACE technology allows

- Drilling (Ø 150 µm, 1:10)
- Cutting (3 mm)
- Milling
- 2.5D machining
- Texturing



SACE technology is

- Clean room compatible (e.g. bonding)
- Fast (faster than traditional glass machining technologies)
- Mask less process
- Lean process (very low tool wear)
- Applicable to all SiO based materials



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Micro-drilling and engraving with SACE

Technology

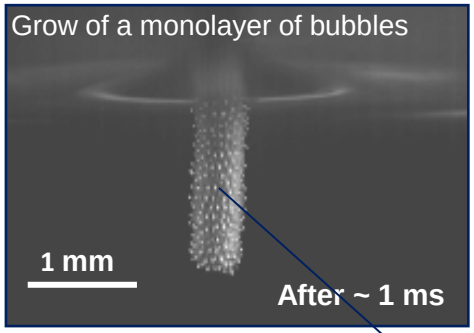
- SACE : Spark Assisted Chemical Engraving on glass **Patented**
- DC generator
- Regulation by micro force
- Electrolyte management
- 4 - 5 axes machine
- Siemens 840D

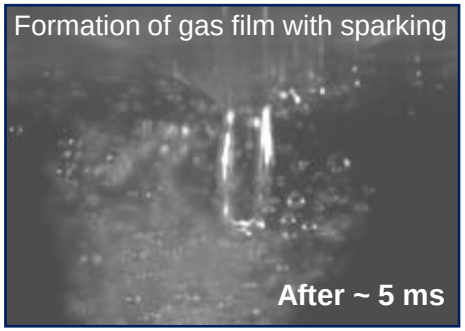
Machine configuration

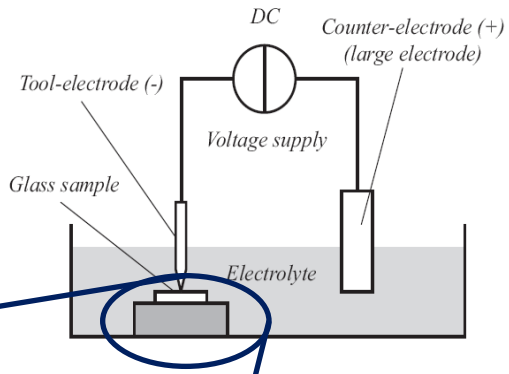
- Mono-Head machine
- Mutli-Head machine
- Customized workpiece holders

SACE is thermally assisted chemical etching

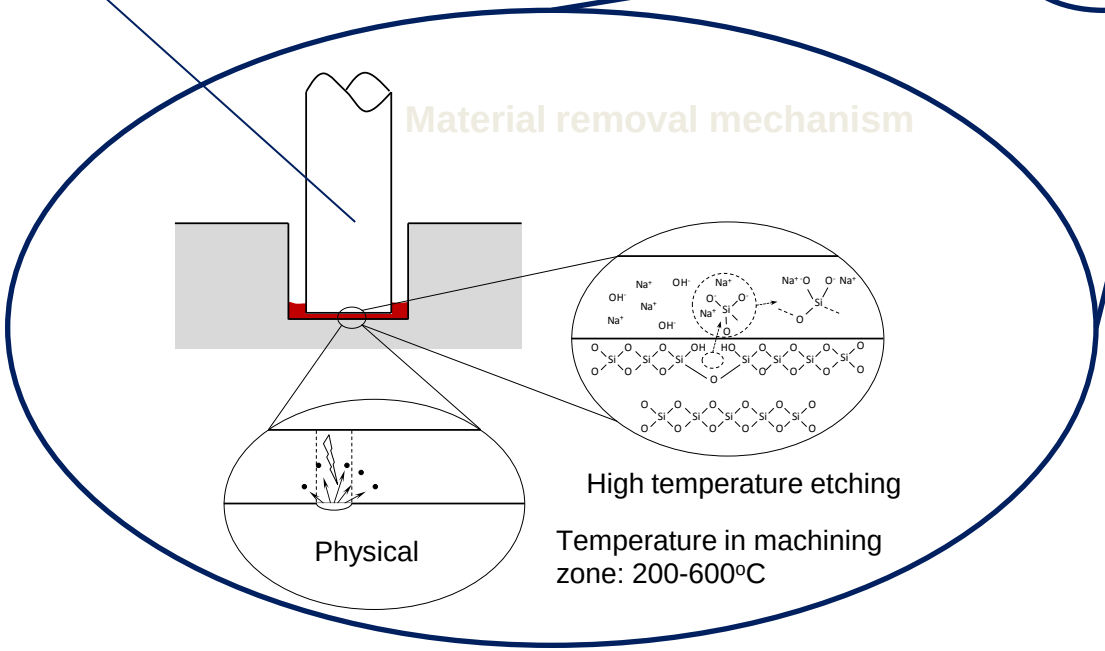
Heat source: sparks through electrochemically formed gas film



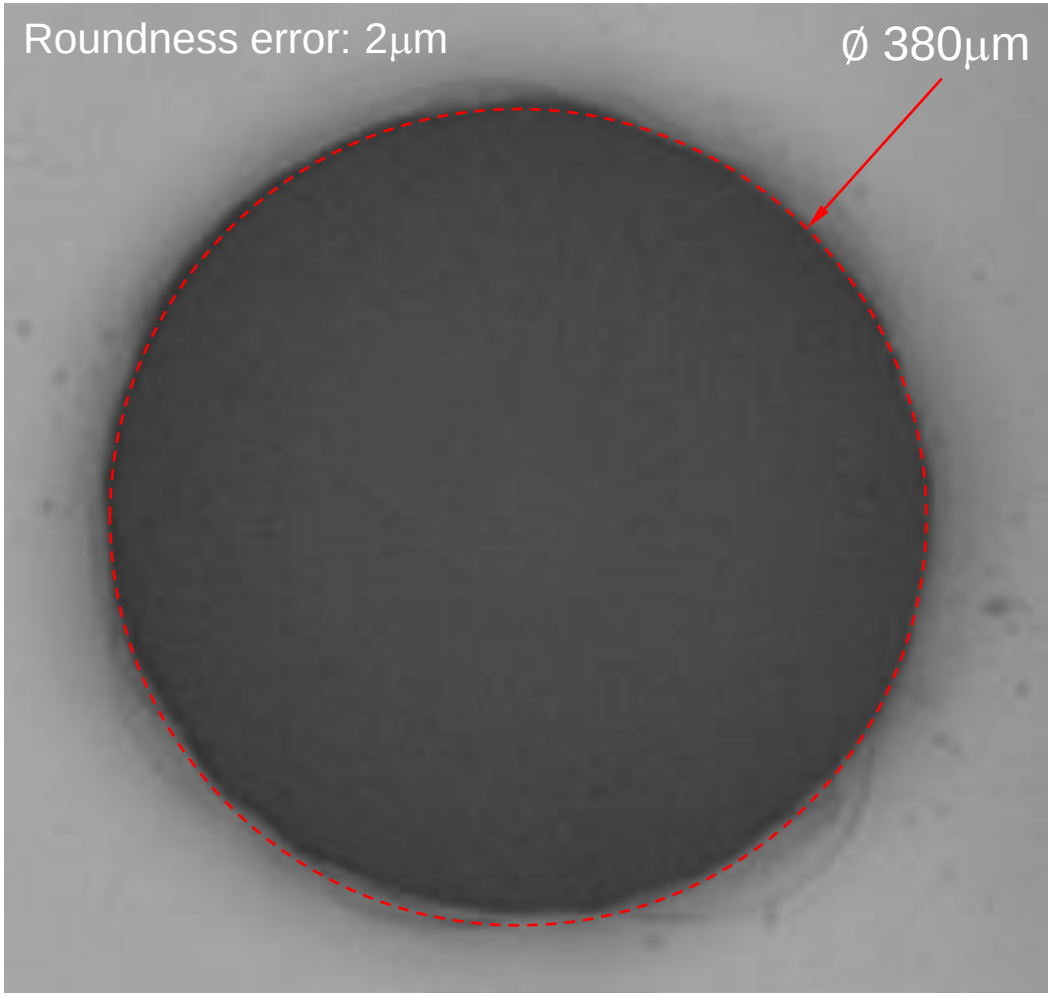


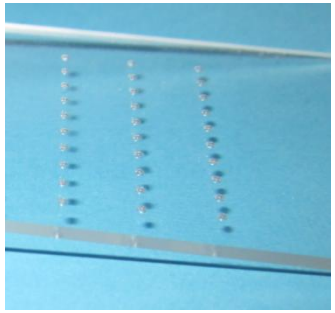


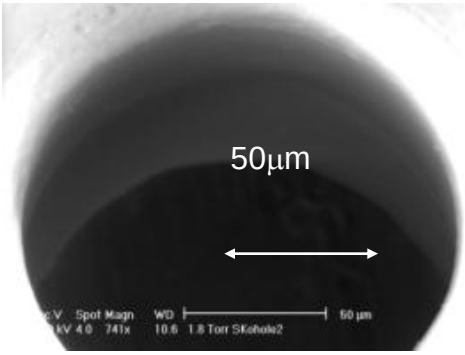
Material removal mechanism



Micro-drilling of glass

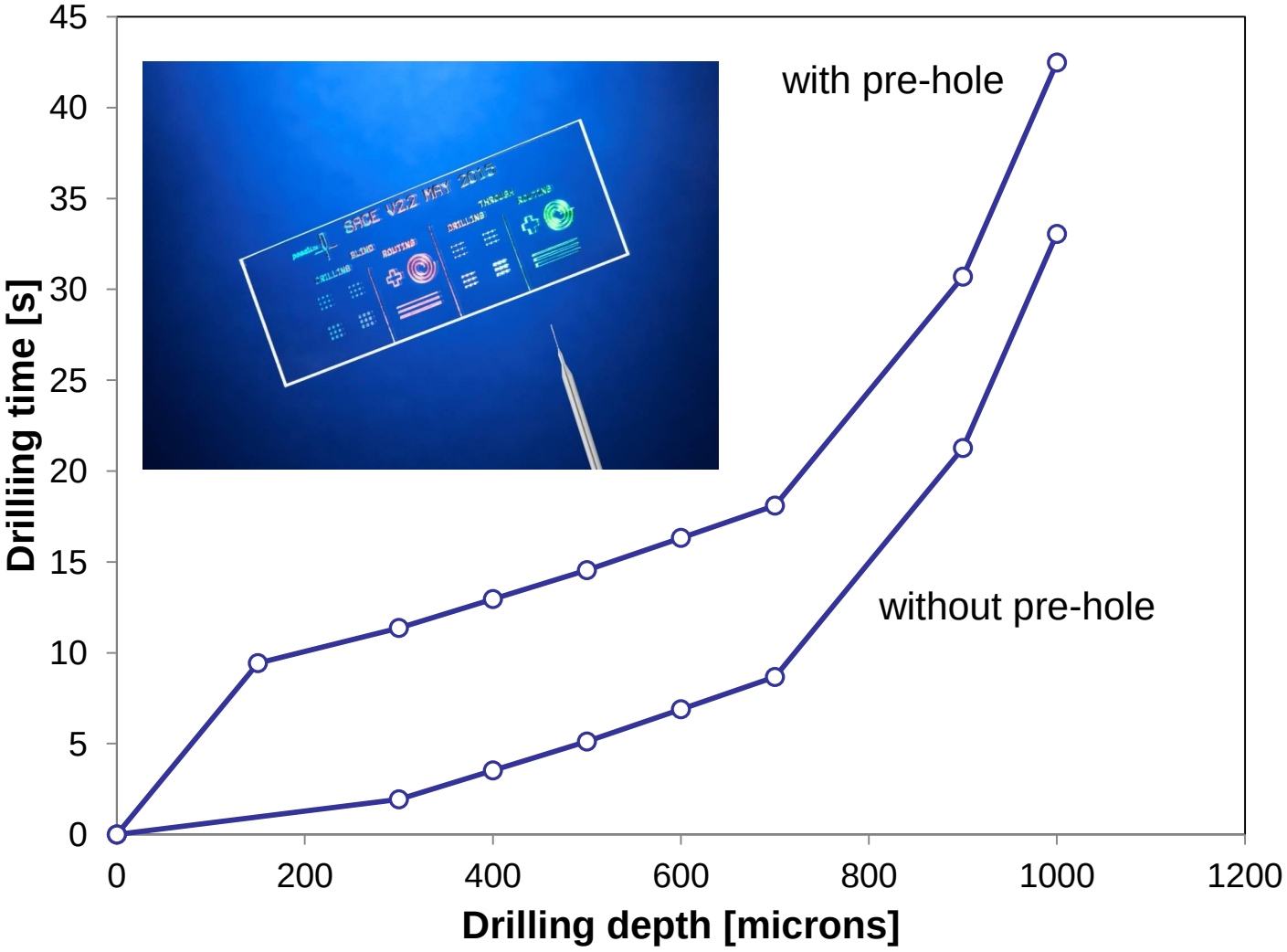




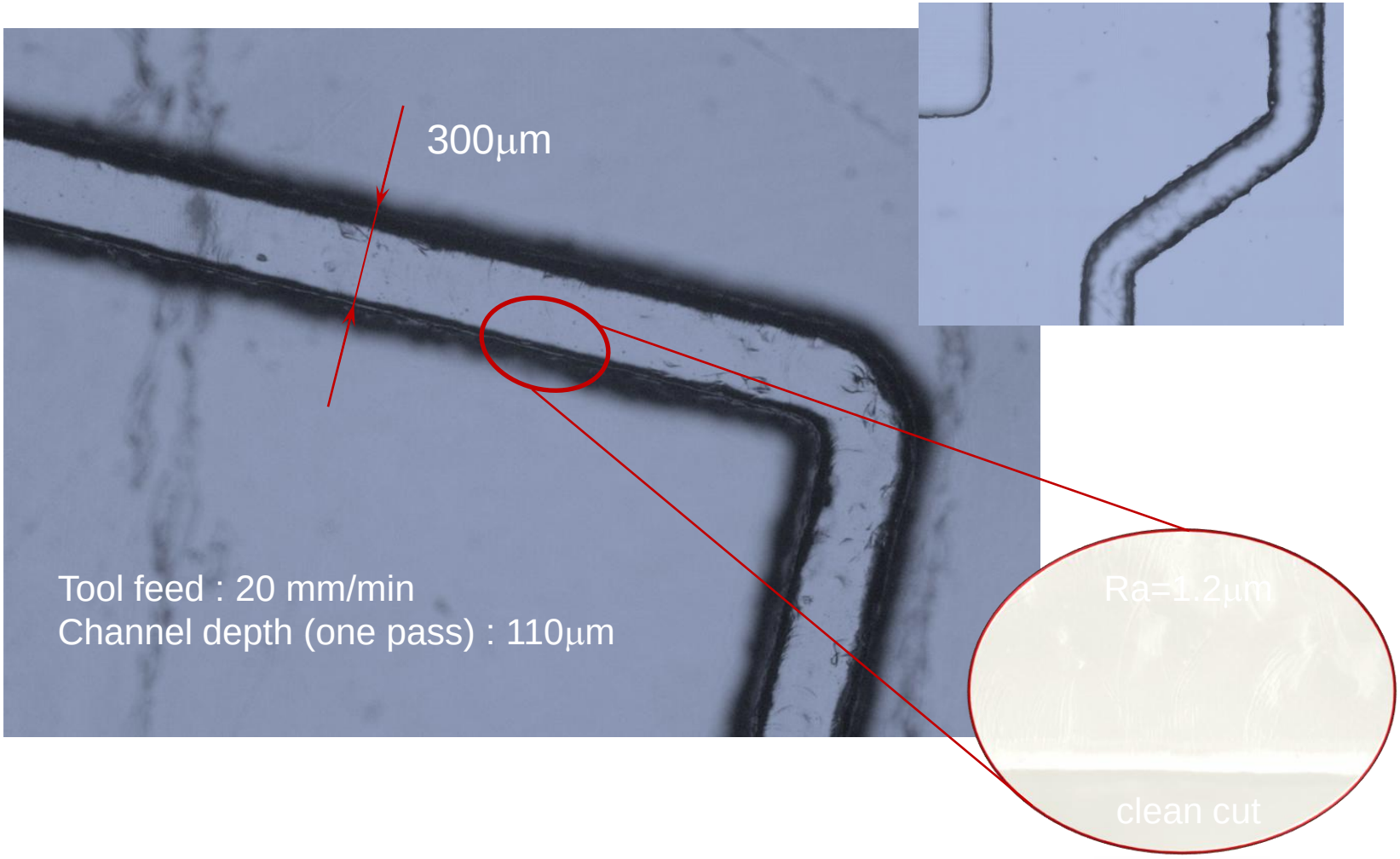


1mm deep
1:5

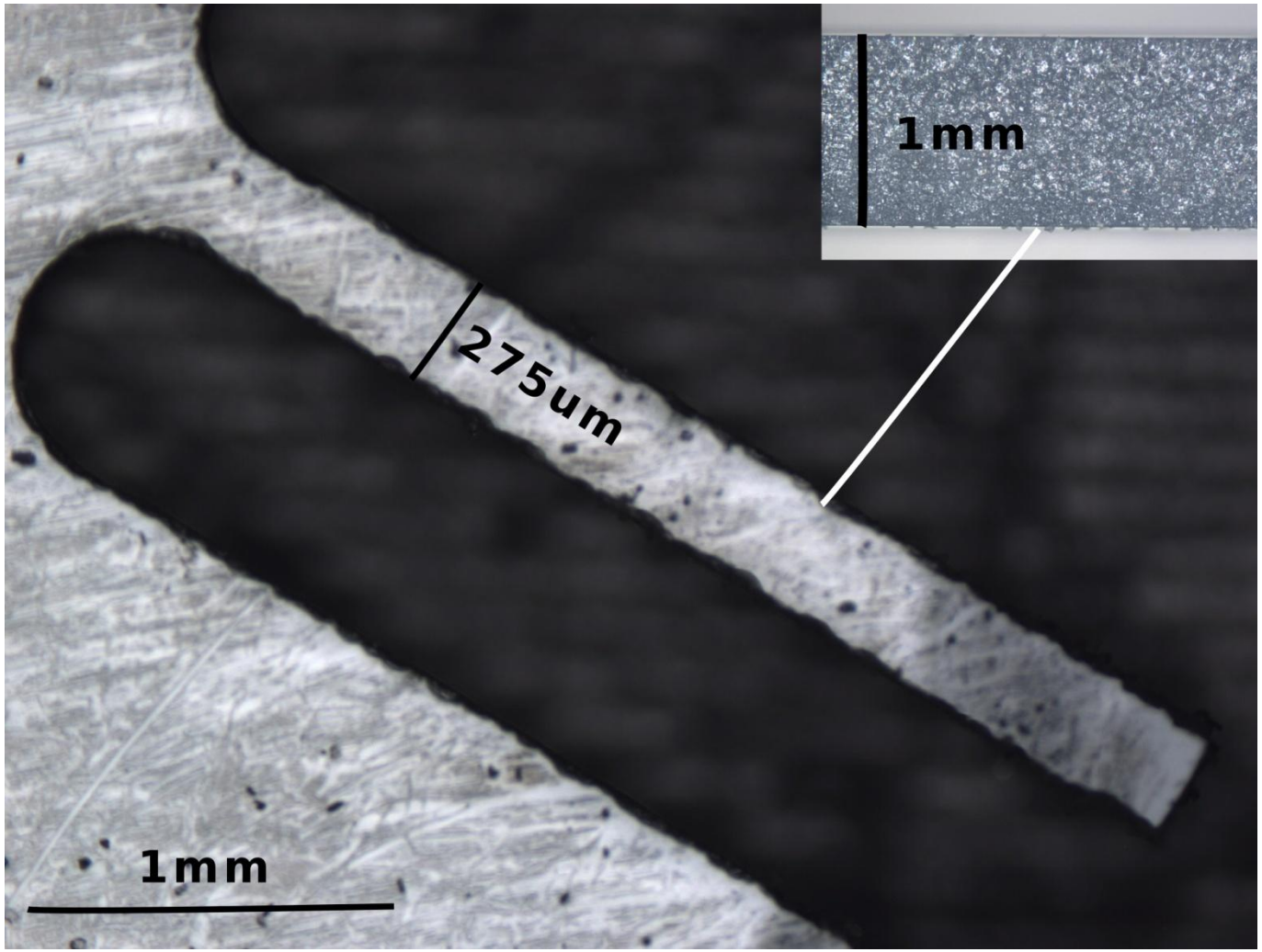
Typical drilling times – 4 Spindles



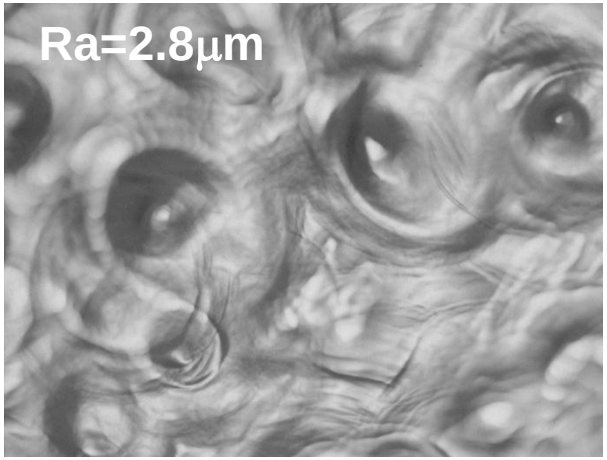
Micro-milling of glass

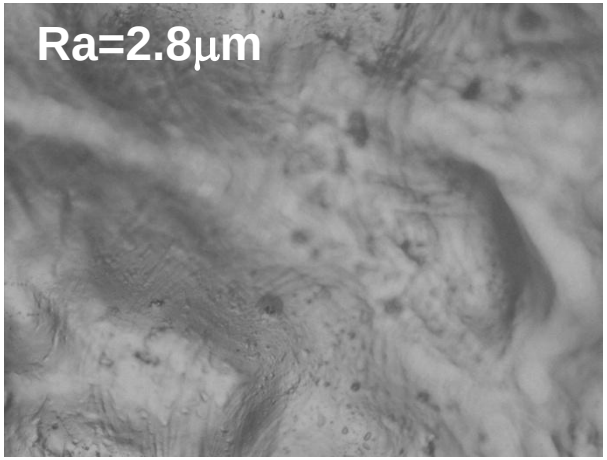


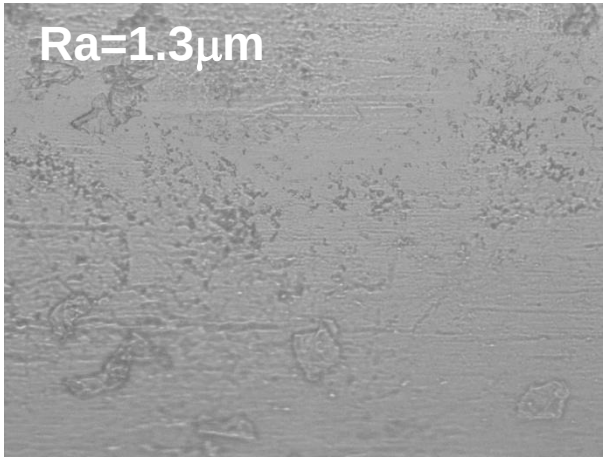
Micro-cutting of glass



Examples of cut surface qualities





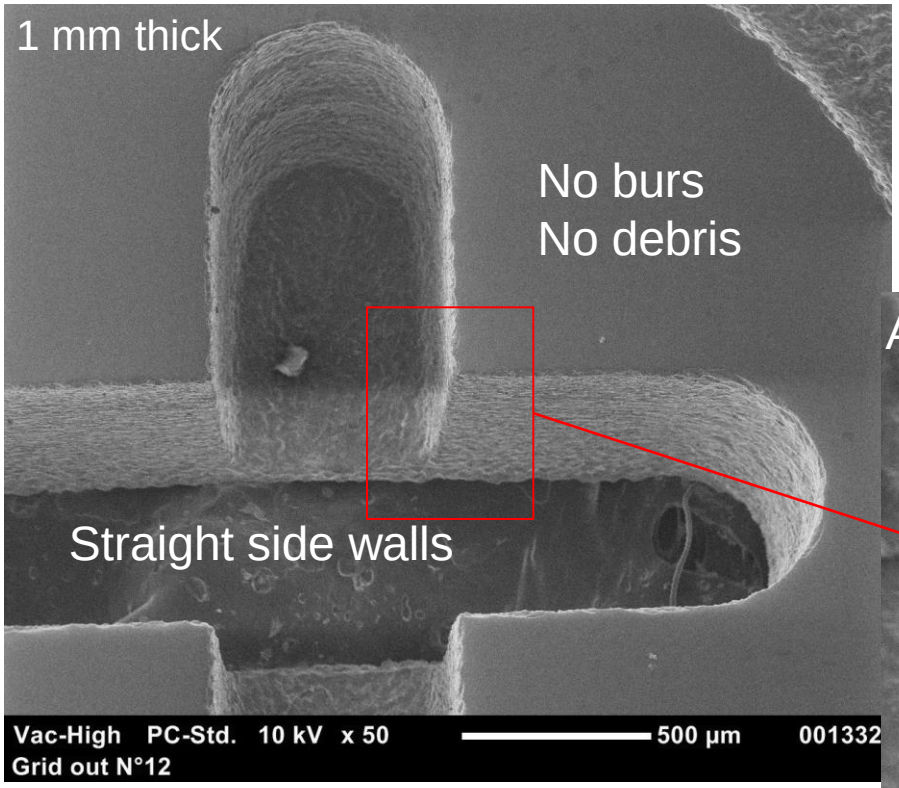


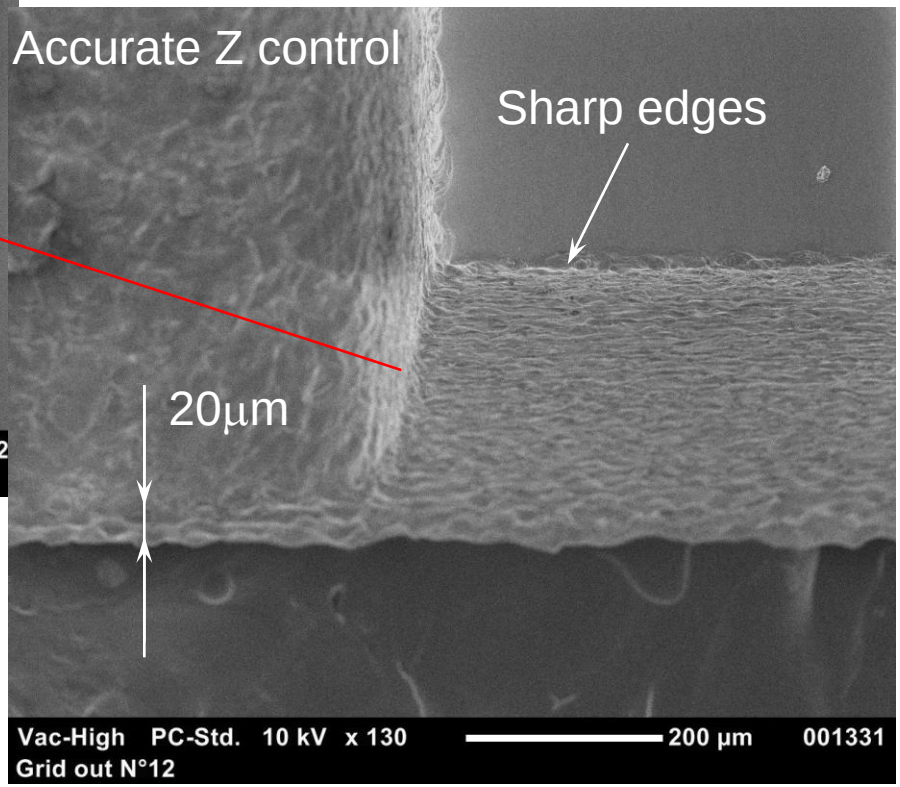
Typical cut parameters:

Tool feed : 15 mm/min
Cut depth : 80 µm/pass

No micro-cracks

2.5D machining of glass





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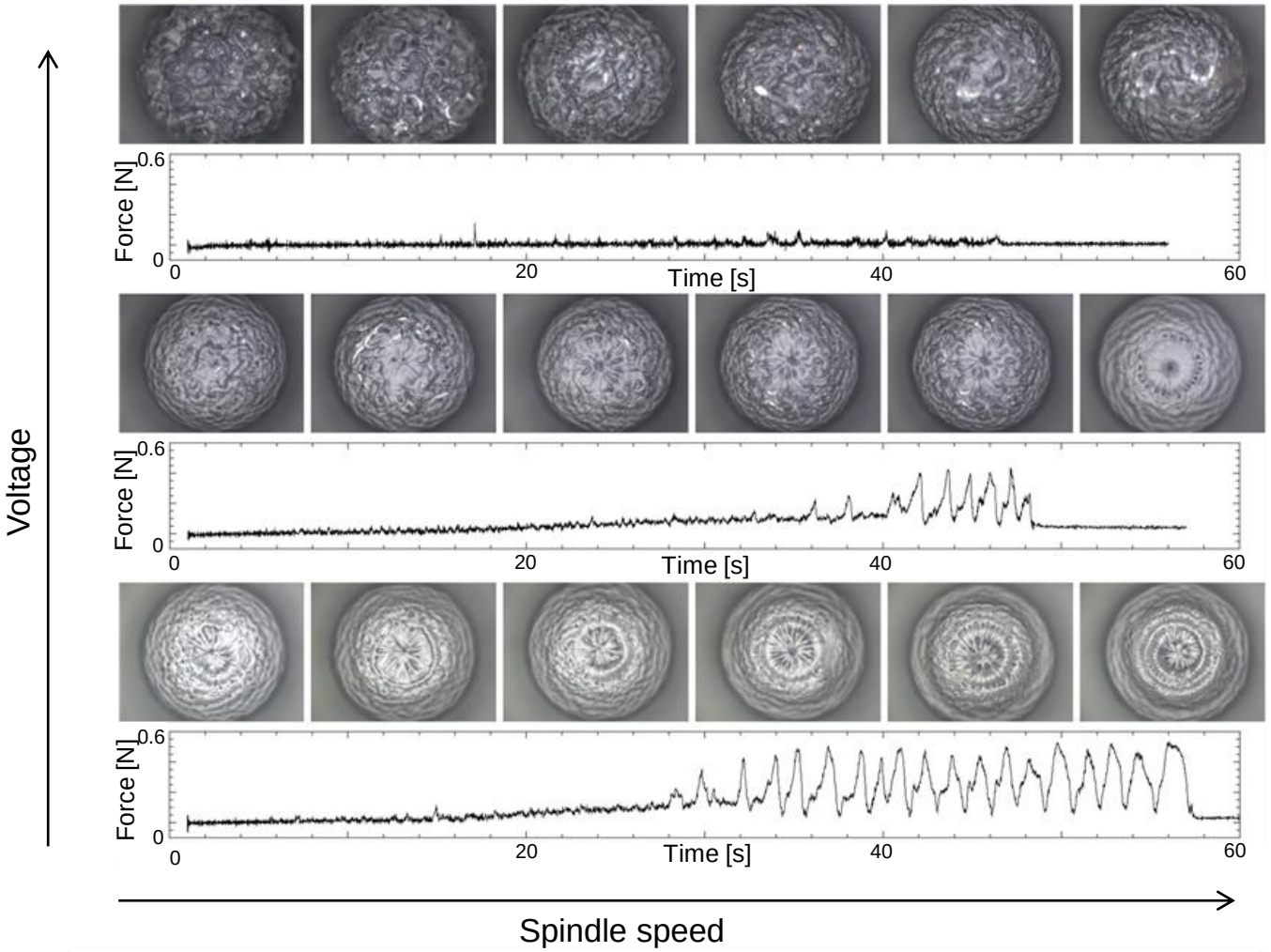
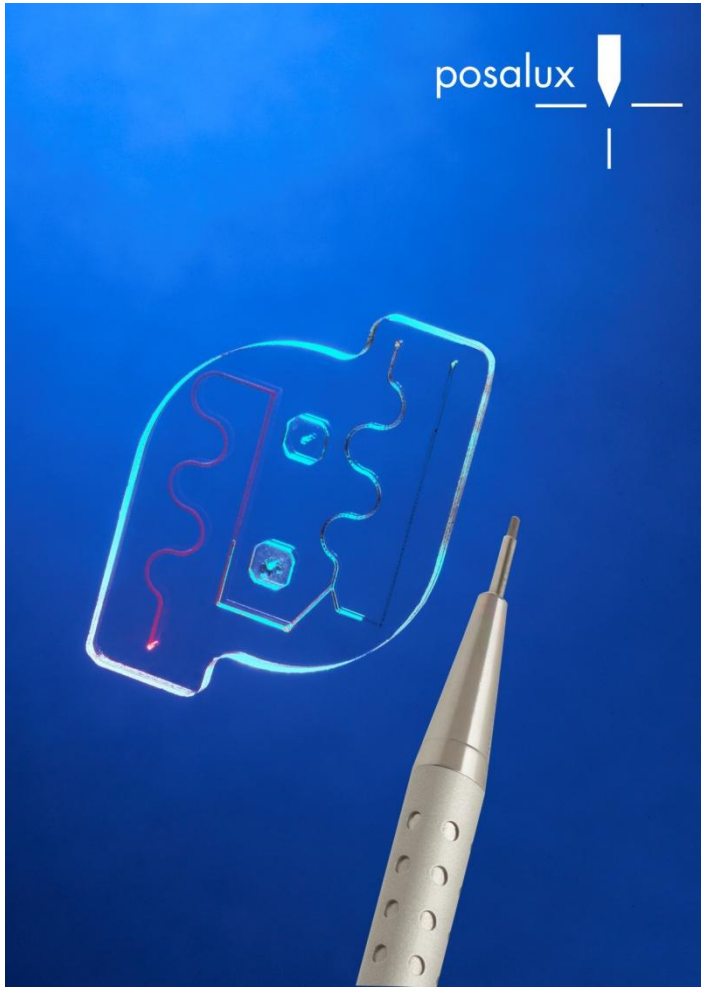
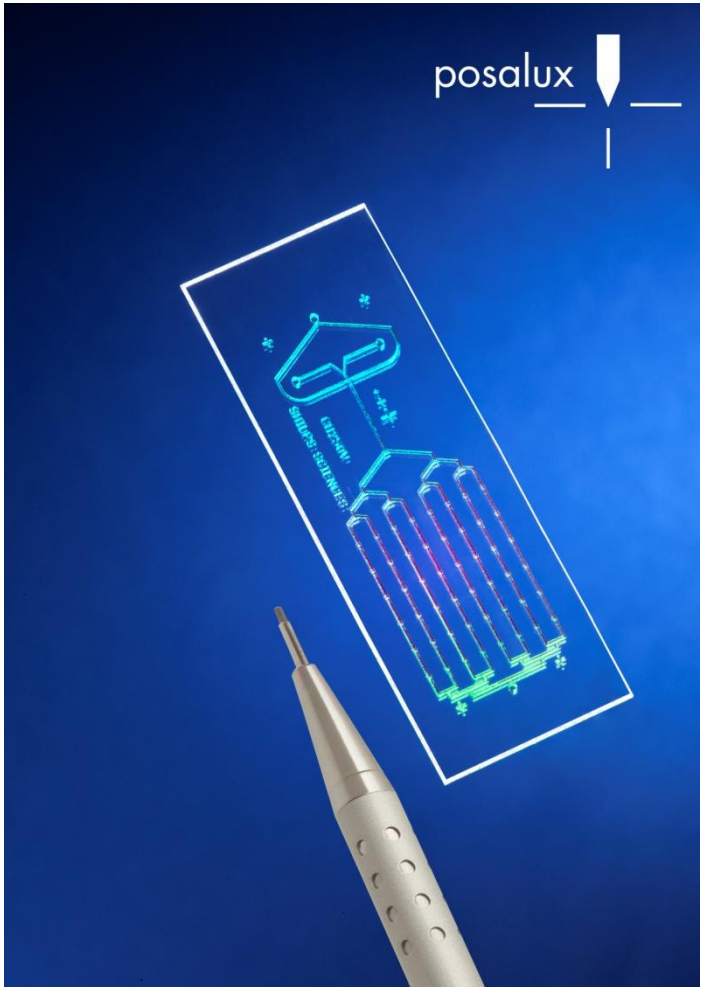
Microhole texturation



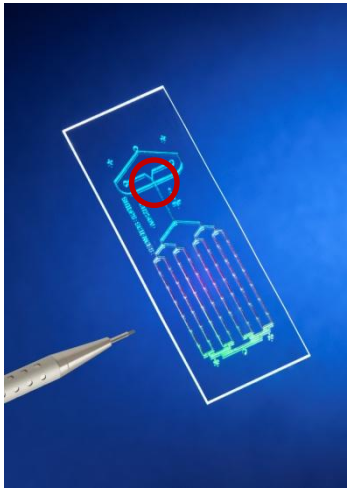
Different machining settings generate different controlled surface patterns

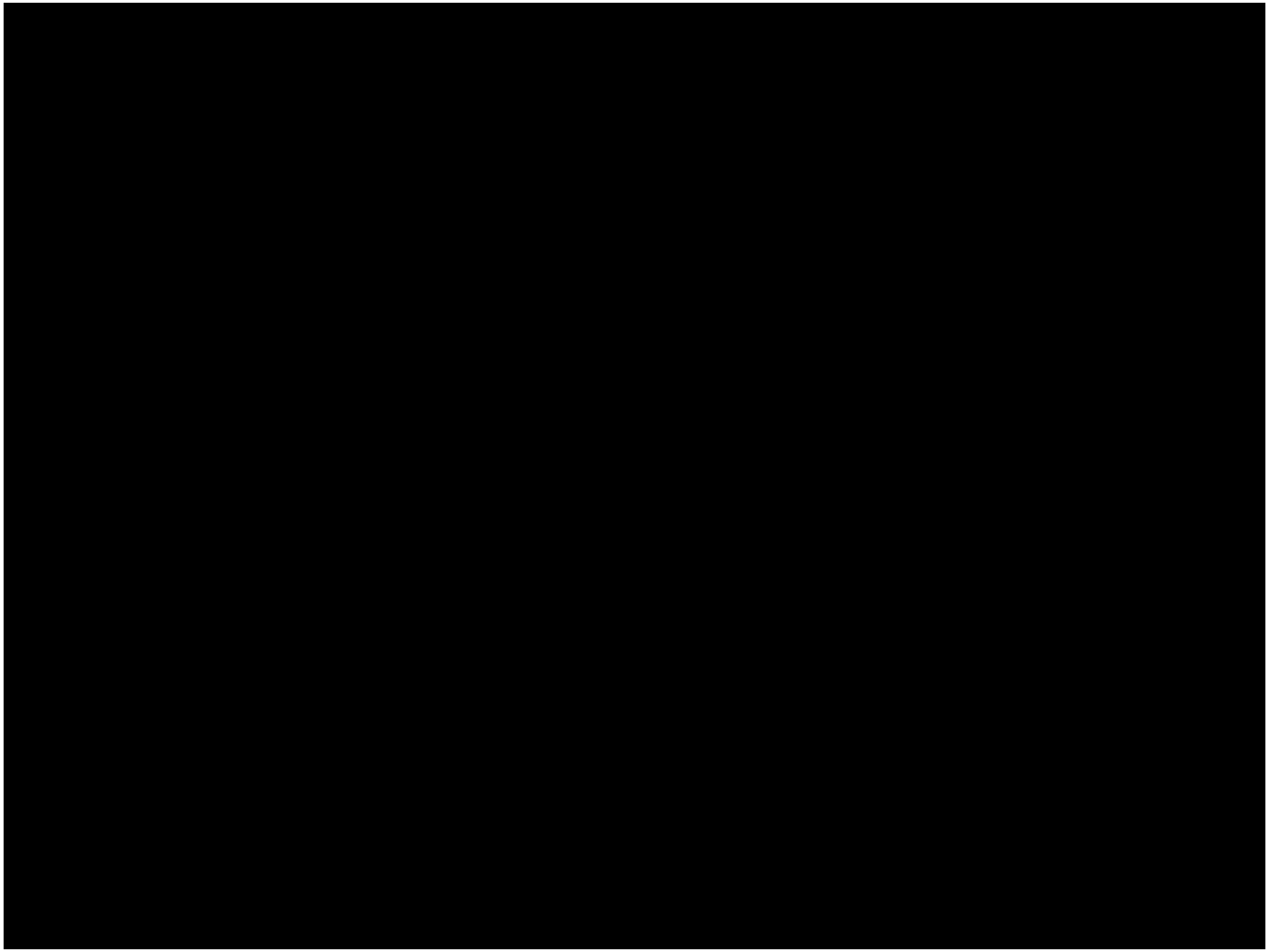
Two application examples



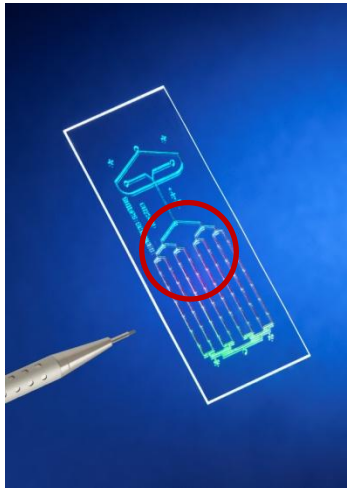


Micro-droplets generation



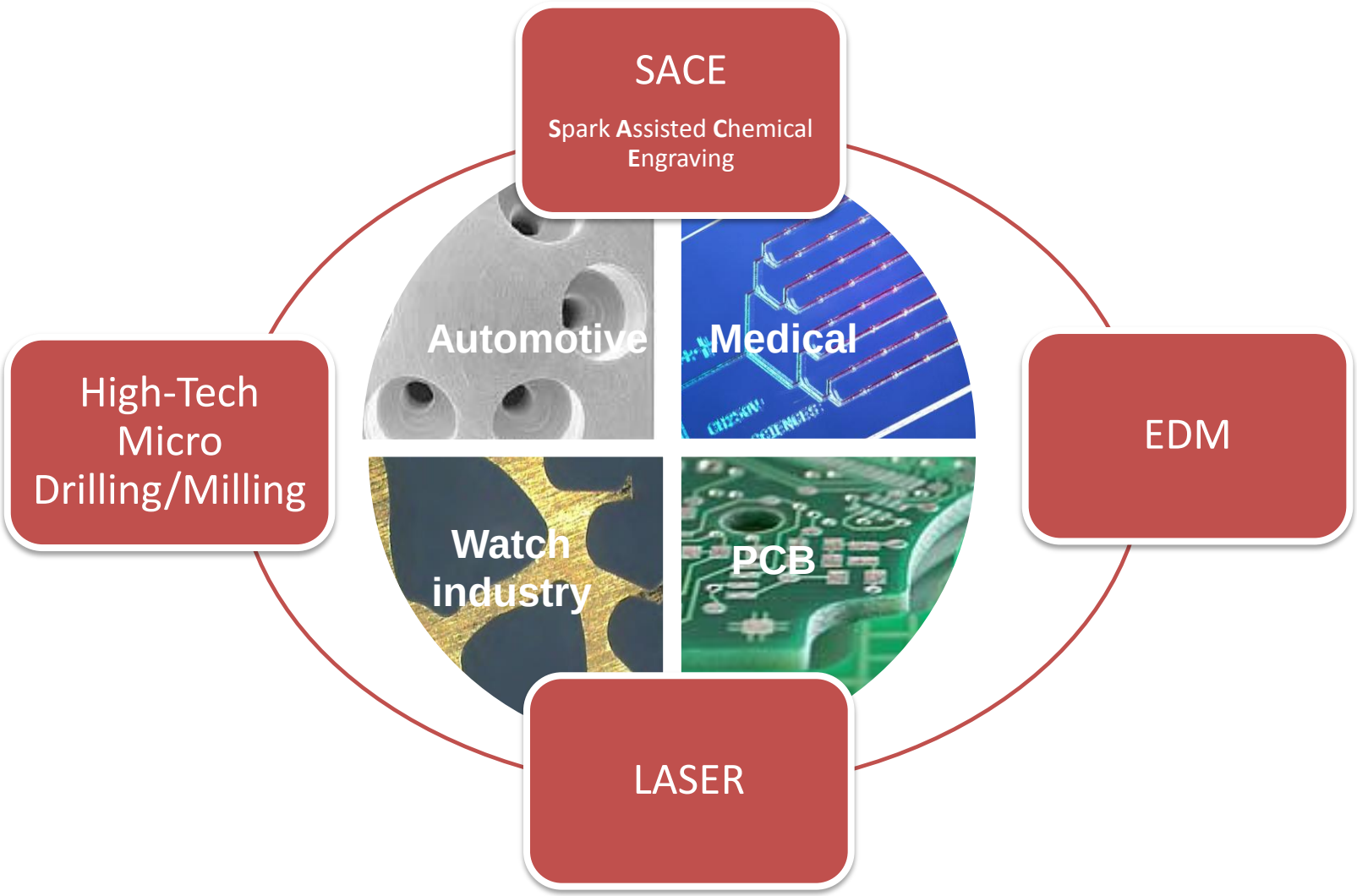


Micro-droplet distribution



What Posalux offers to promote our technologies

Four technology families for four markets



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Appendix