



Association Suisse de Traitement
Thermique des Matériaux

DOUZIEME RENCONTRE ROMANDE INTERASSOCIATIONS

SURF – THERM



17th of November 2016



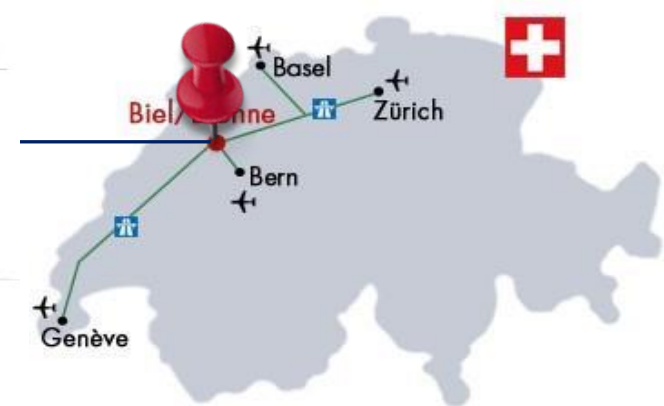
« SACE: Procédé innovant de micro-usinage du verre »

Marco Nadalin
Posalux

Thèmes de la présentation

- Présentation Général Posalux et ses produits
- SACE et ses applications
- Pourquoi le SACE
- Quels matériaux sont usinable par le SACE
- Comment cela fonctionne
- Versatilité du SACE
- Mise en œuvre et concept du SACE
- Exemples d'utilisation
- Concept machine

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

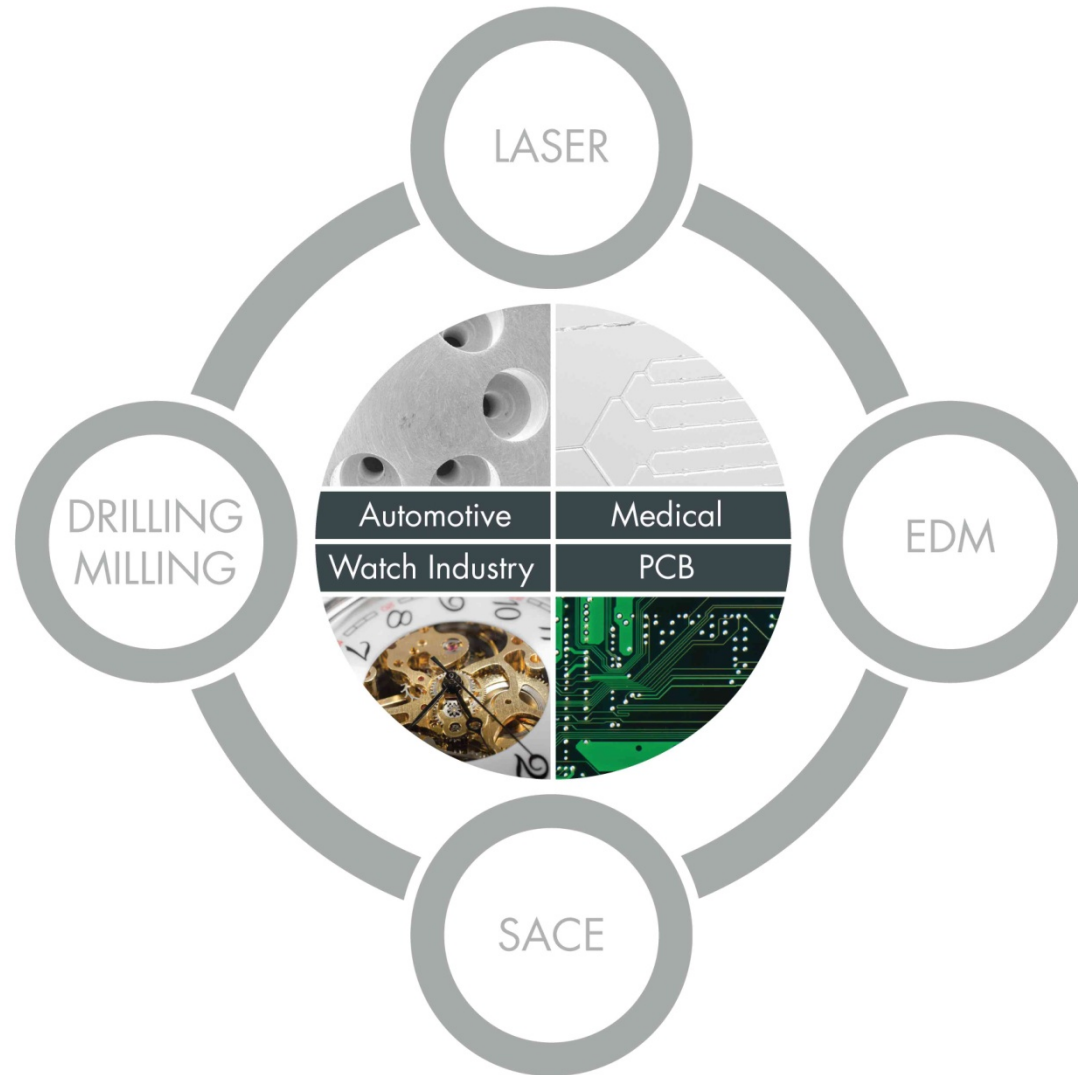
Development and industrialization of standardized high-technology machines for mass production in niche markets

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

Attract, develop and retain highly talented people to 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

Service - active and very efficient worldwide

Excellent knowledge of our worldwide markets

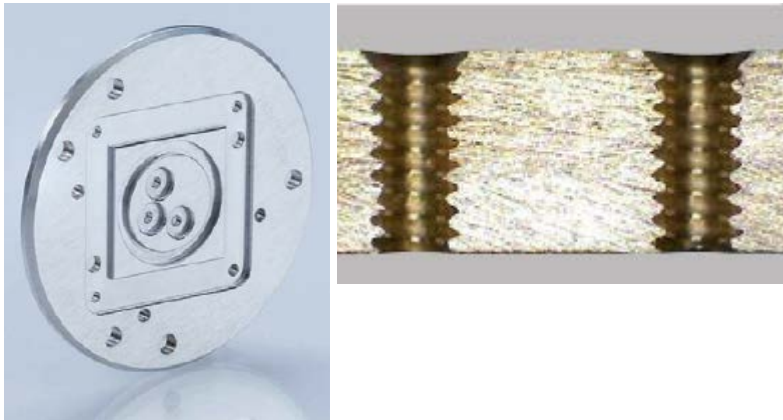
High Dynamic drilling/ routing



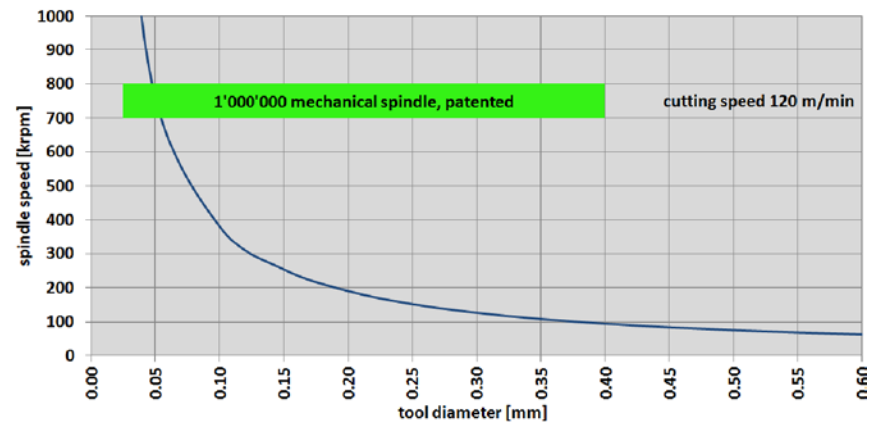
MONO
COMBI TECHNOLOGY
PRODUCTIVITY INCREASE

- High cadence drilling **20 holes /s**
- Drilling/ routing process
- High spindle frequency 350'000 rpm (vibration reduction)
- High routing spindle frequency <60'000 rpm

Patent pending spindle 1 million rpm



Optimal Spindle Speed



Micro Milling

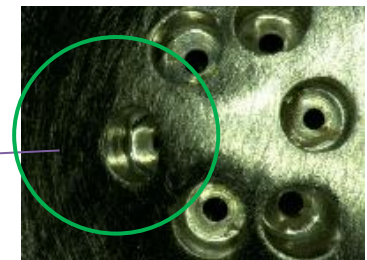
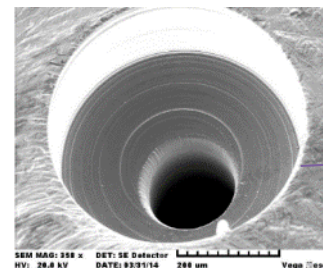
Specifications

- Micro Milling for hardened material e.g. < 68 HRC dia. 0.3 to 0.9 mm
- High productivity: 6 step-holes and 2 marks < 11 sec
- Vibration reduction during milling process
- Cutting force optimised
- Tool life optimised: > 5 000 holes
- Dedicated to customer application

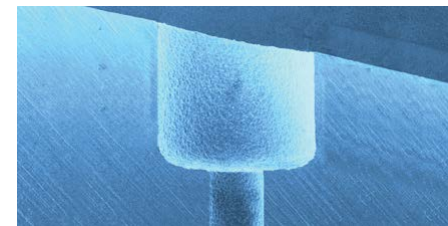
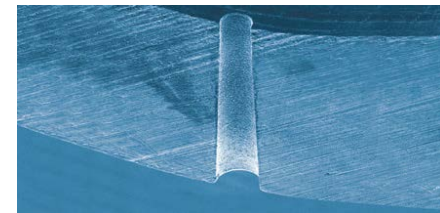
Applications

Dedicated to hardened ferrous material

- Stainless steel
- Titanium
- Automotive and Medical



EDM (Electrical Discharge Machining)

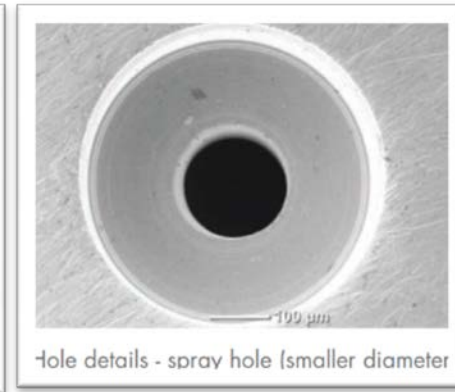
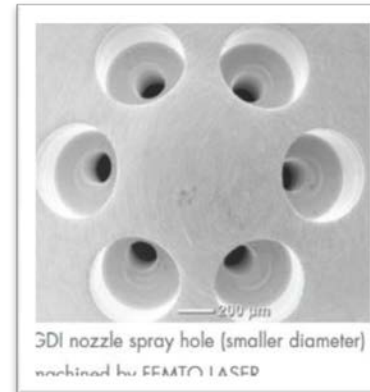


- cylindrical and conical drilling
- Ratio 1:12

Micro drilling and cutting with FEMTO Laser

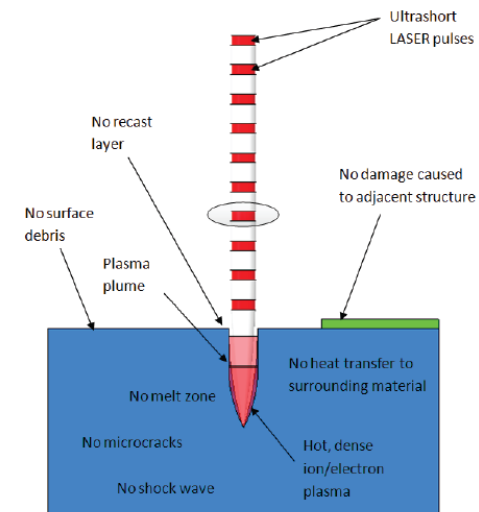
Micro Machining

- Hole diameter down to 30 μm
- Wall thickness / hole diameter ratio up to 15
- High positioning accuracy
- High productivity: less than 1,4s / hole
- Excellent flow stability in +/- 1%
- Surface roughness between 15 & 50 nm (like polished)
- Tapered holes + 23° or - 15° full angle
- Flexibility in circular hole shapes machining (ellipses, squares.....)



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

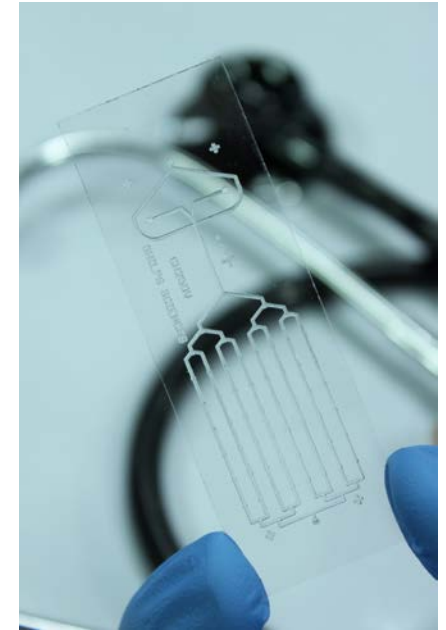


Spark Assisted Chemical Engraving

Micromachining of glass (and all materials that contain SiO_2)



Glass, a fantastic material

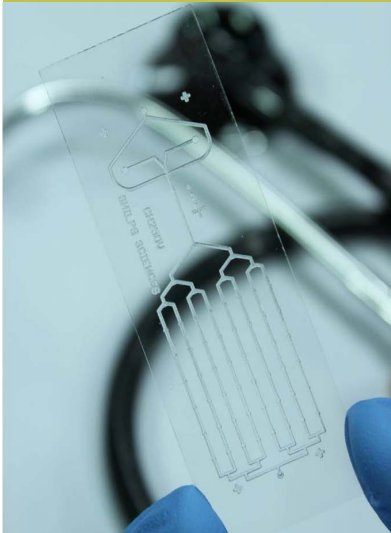


- ✓ Sterilisable
- ✓ Wide optical transparency
- ✓ Impermeable to gases
- ✓ Low thermal expansion
- ✓ Excellent chemical inertness
- ✓ Biocompatible

Nevertheless glass is difficult to machine... until SACE technology introduction

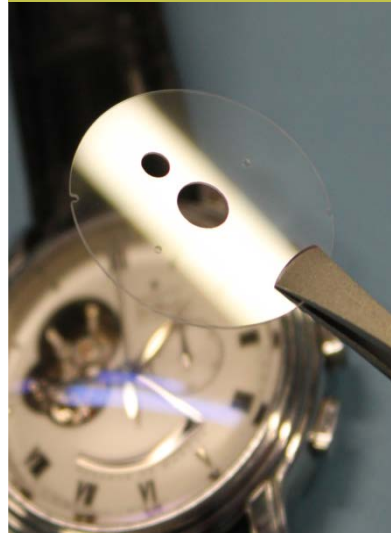
Various applications

Medical



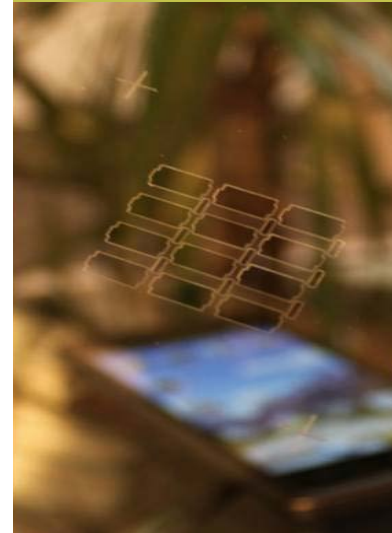
- Medical (Lab-On-Chip)
- Chemical (mixer chips, micro-reactor)
- Multi-layers chips

Watch Industry



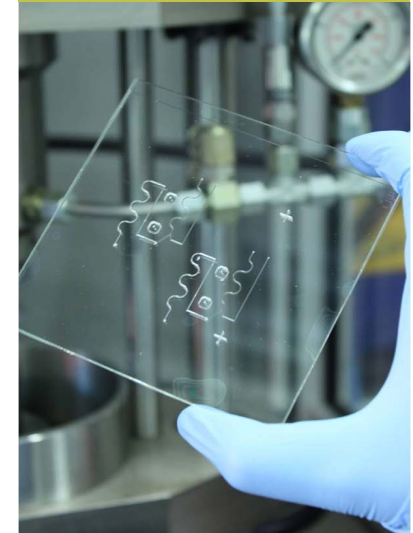
- Watch dial glass
- Mechanical parts
- Process for product anti-counterfeiting marks

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”

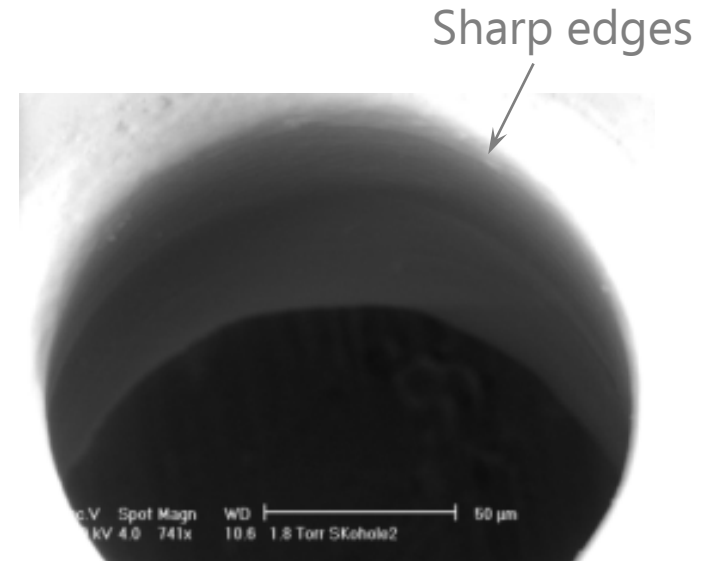
Why the SACE ?

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

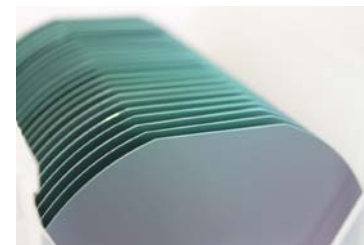


Enamel

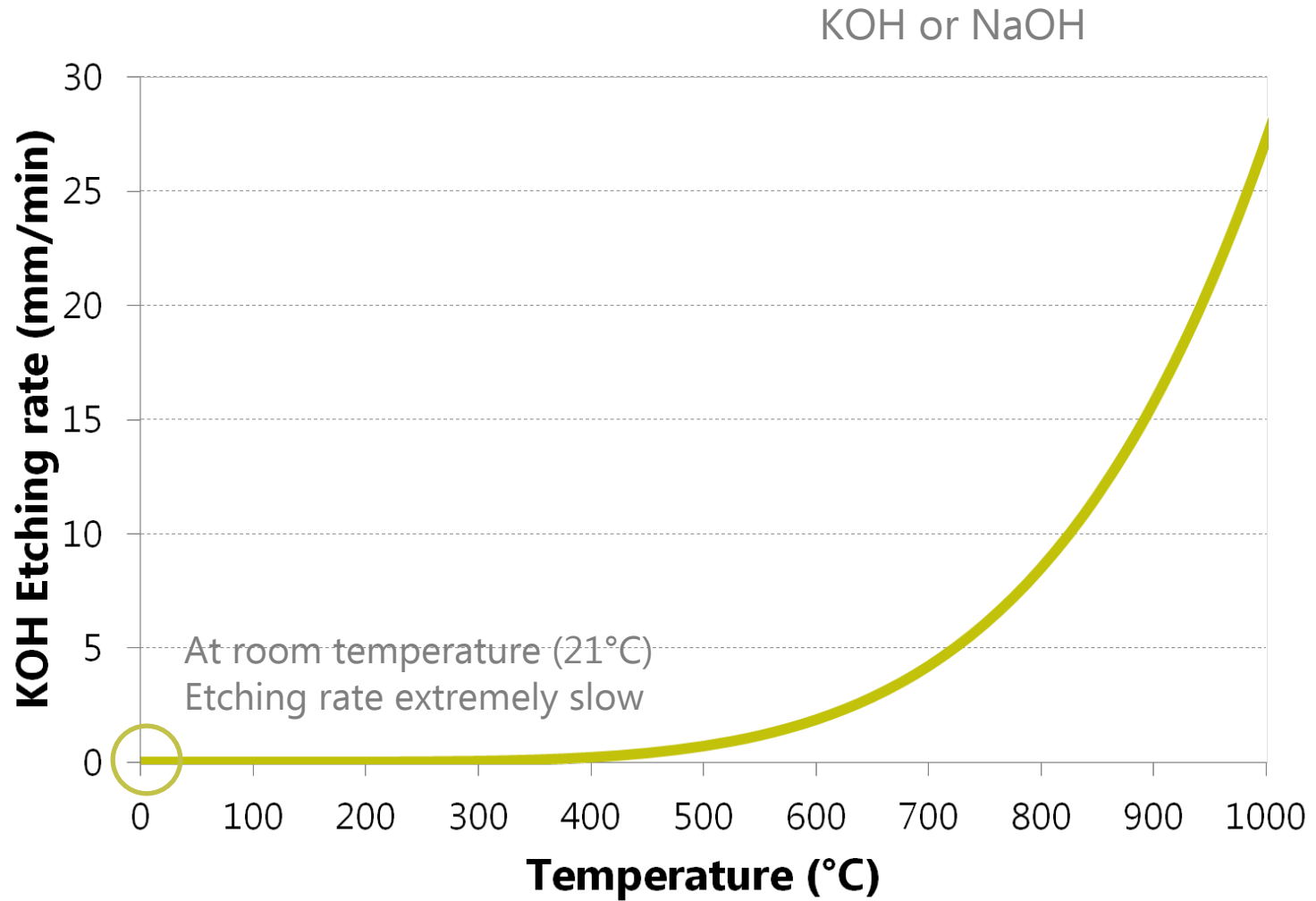


Tempered glass

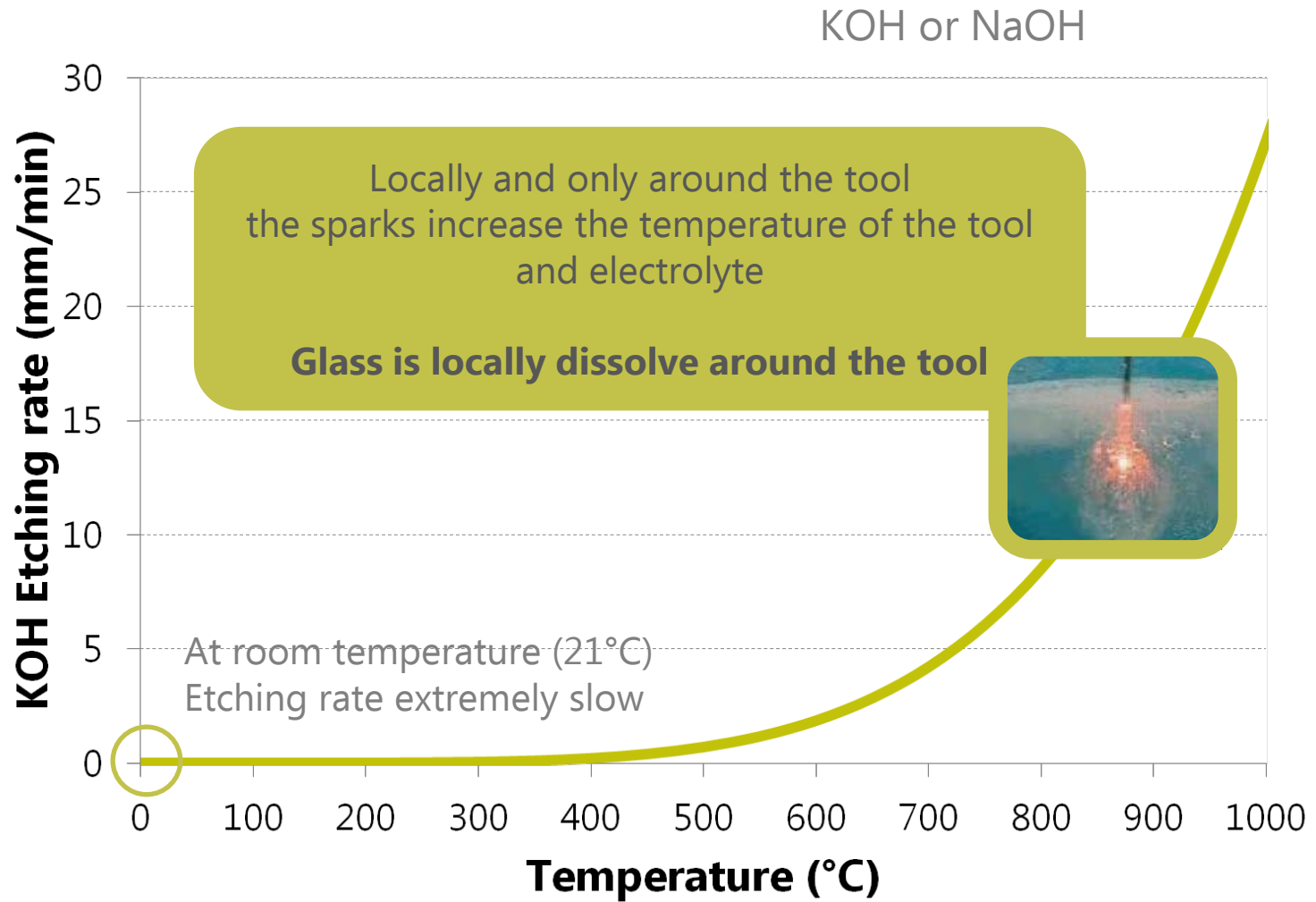
Corning Gorilla,
AGC Dragontrail,
Schott Xensation,
...



Silicon

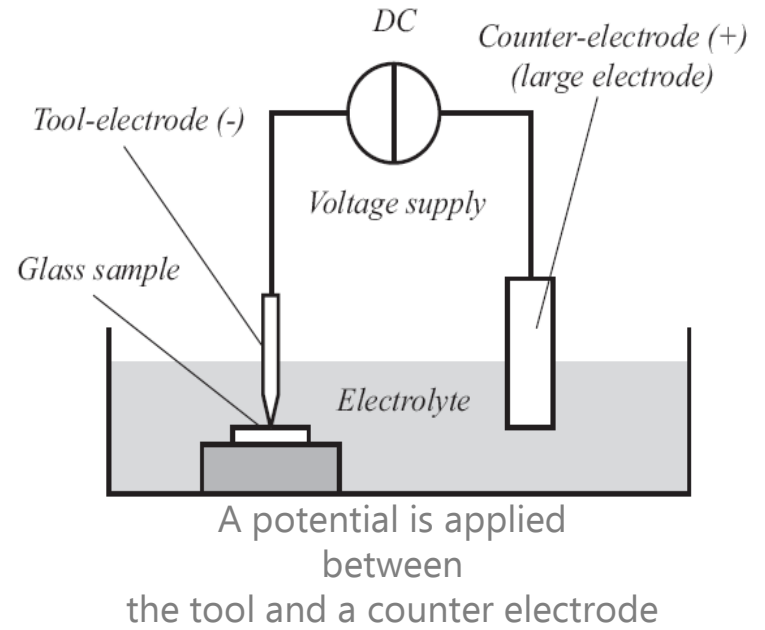
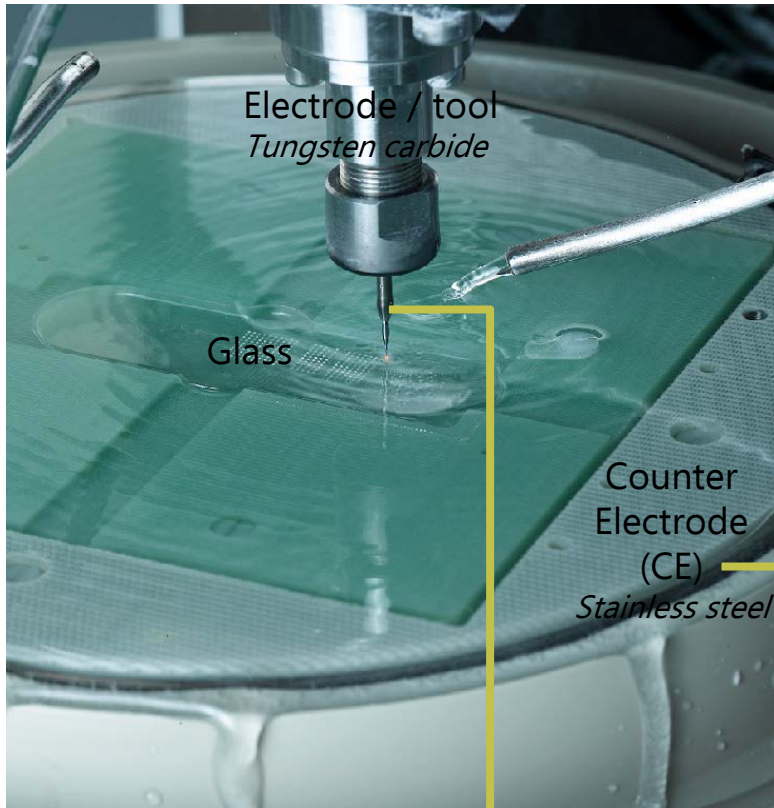


SACE Electrolyte



How does the SACE work?

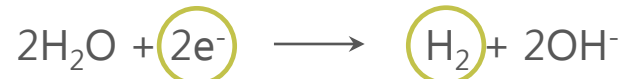
SACE setup



Voltage supply (DC)

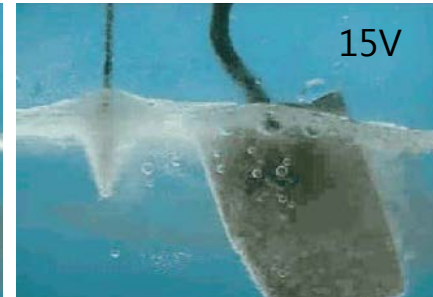
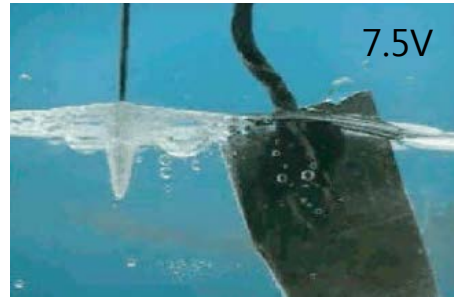


Gas film and spark formation



Potential applied to the tool

Gas film production around the tool



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

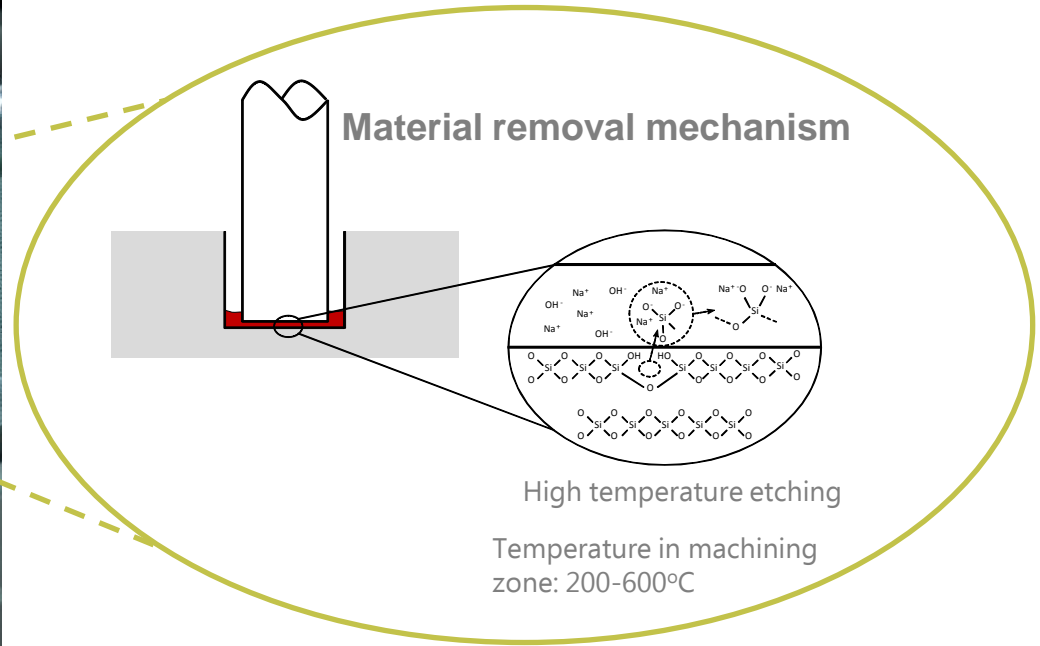
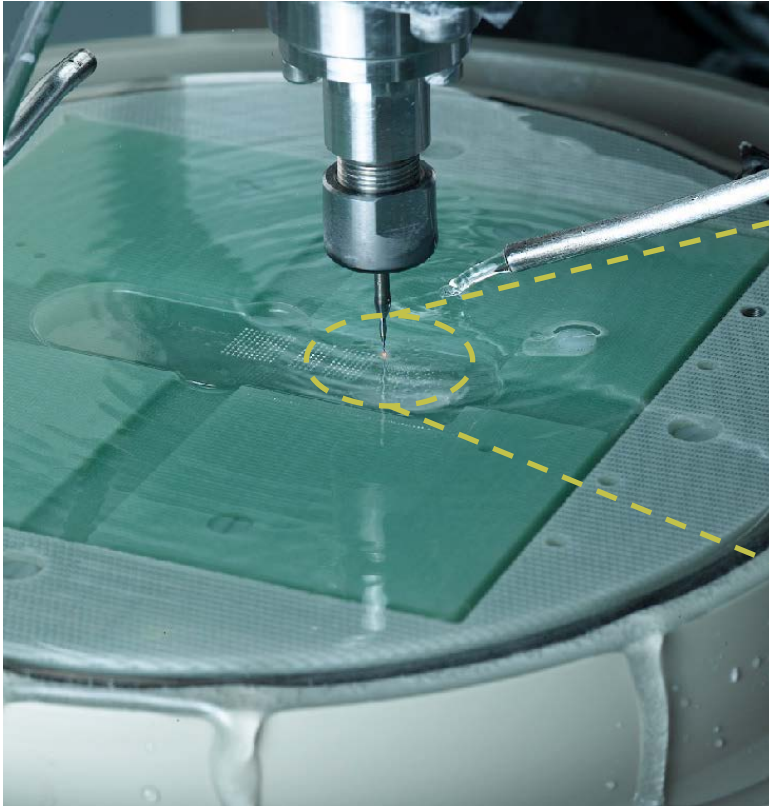


Sparks appear through gas film (U > 30V)

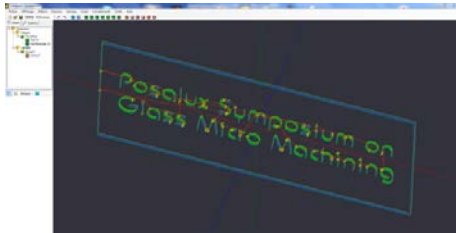
SACE a hybrid process

SACE combines advantages from 3 processes:

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



SACE a versatile and simple to use technology



1. Drawing

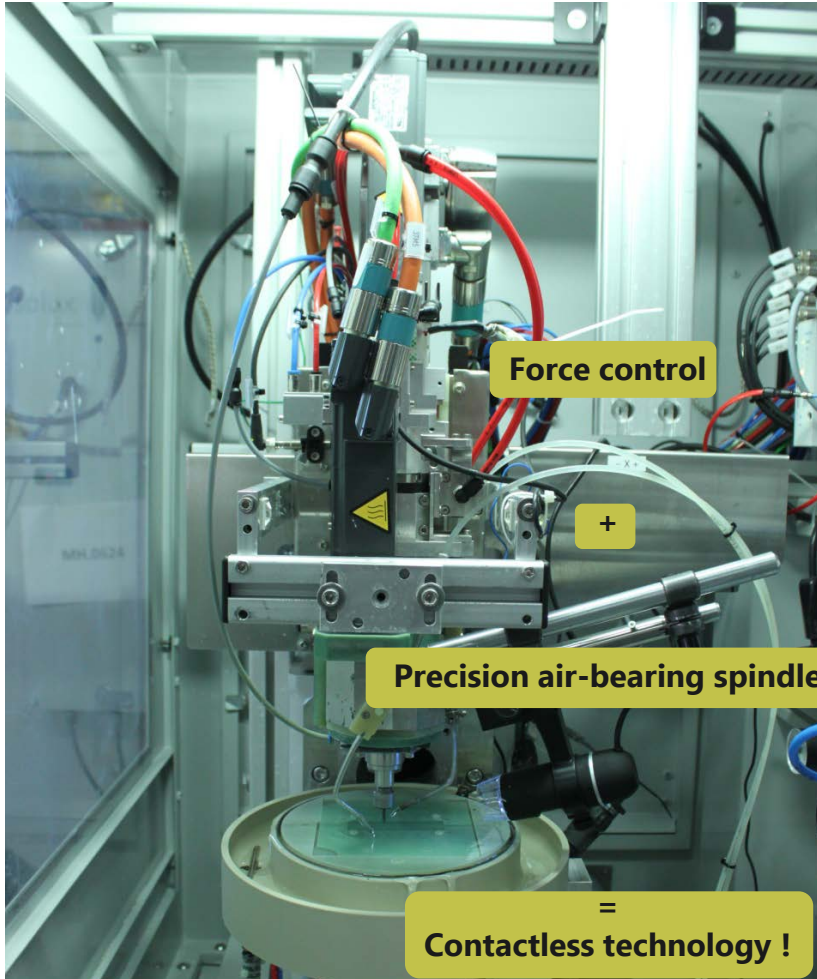
```
G0 X-39.4663 Y-7.4426  
G0 Z0.001  
G1 F2.5 Z-0.2  
G3 F10.0 X-39.3377 Y-7.3901 I0.0536 J0.0525  
G1 Y-1.267  
G3 X-39.4877 I-0.075 J0.0  
G1 Y-7.3901  
G3 X-39.4663 Y-7.4426 I0.075 J0.0  
G0 Z0.3  
G0 X-37.4504 Y-6.4481  
G0 Z0.001  
G1 F2.5 Z-0.2  
G3 F10.0 X-37.0894 Y-6.9679 I1.9148 J0.9446  
G3 X-37.0883 Y-6.9691 I0.0546 J0.0514  
G3 X-36.419 Y-7.4203 I1.4489 J1.4271  
G3 X-36.4186 Y-7.4205 I0.0288 J0.0693  
G3 X-35.5707 Y-7.5823 I0.8271 J2.0318  
G3 X-34.7851 Y-7.3816 I0.0419 J1.4741  
G3 X-34.8607 Y-7.2521 I-0.0378 J0.0648  
G2 X-35.5678 Y-7.4323 I-0.6681 J1.144  
G3 X-35.5707 I-0.0022 J-0.075  
G2 X-36.3618 Y-7.2817 I-0.0207 J2.0436  
G2 X-36.9808 Y-6.8644 I0.7225 J1.7397  
G2 X-37.3846 Y-6.2258 I1.4452 J1.3608  
G2 X-37.5262 Y-5.4036 I2.1627 J0.7958  
G3 Y-5.4018 I-0.075 J0.0009  
G2 X-37.3847 Y-4.5946 I2.2123 J0.0281  
G2 X-36.9812 Y-3.966 I1.7476 J-0.6779  
G2 X-36.3618 Y-3.5483 I1.3419 J-1.322
```

2. Encoding
(code ISO)



3. Manufacturing

SACE a unique and patented technology



Glass is a strong and brittle material to machine



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

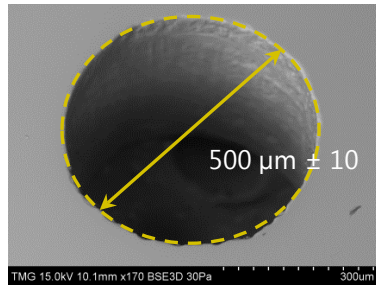


Polishing step

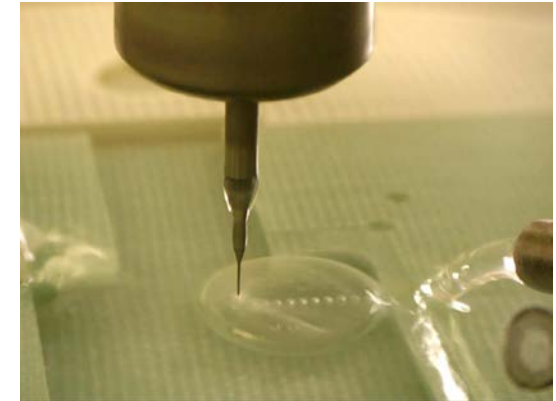
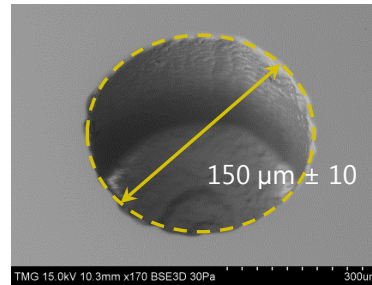
Only electrochemical process machines it !

Drilling

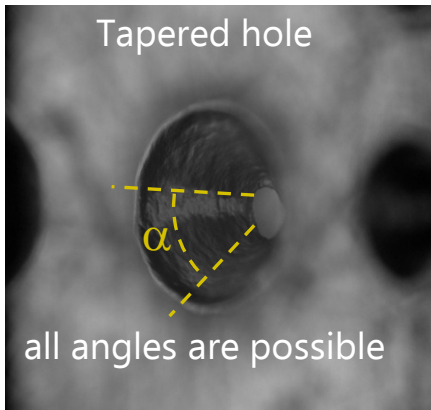
hole



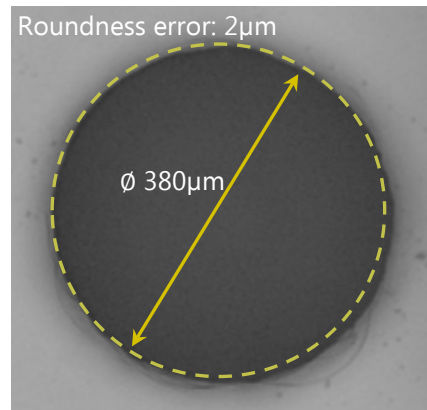
Blind hole



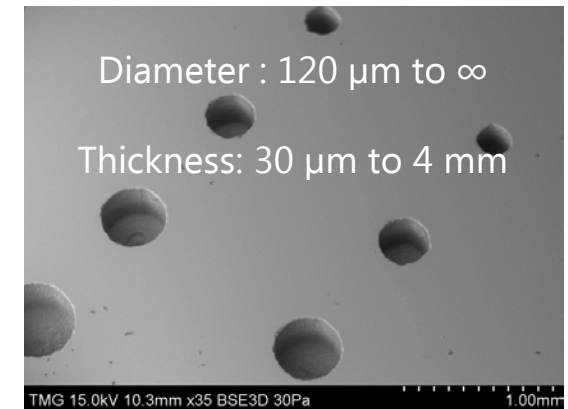
Tapered hole



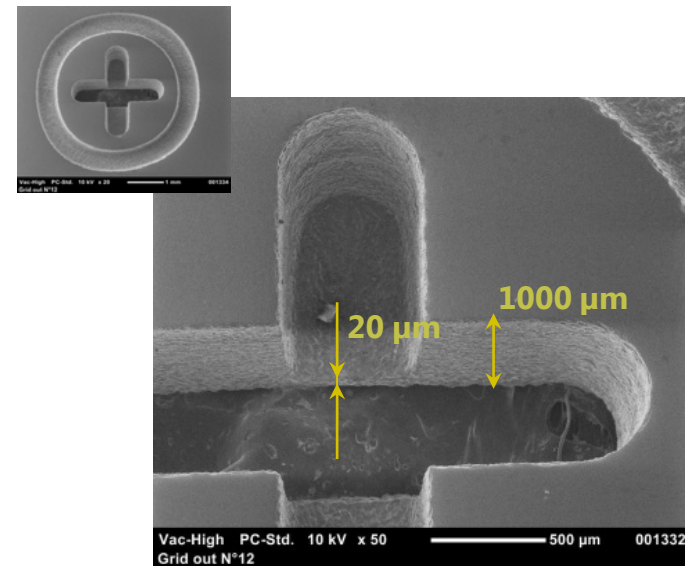
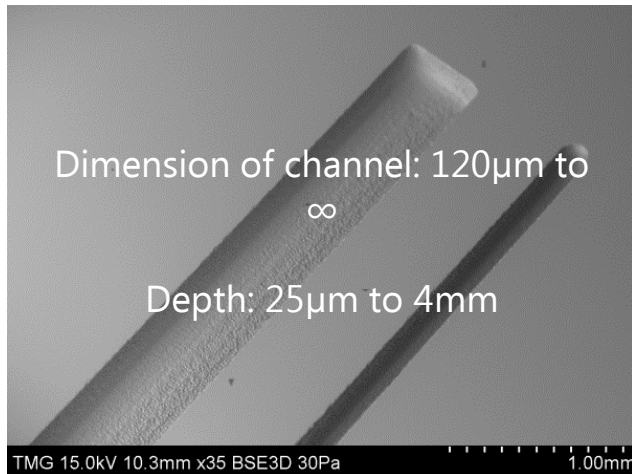
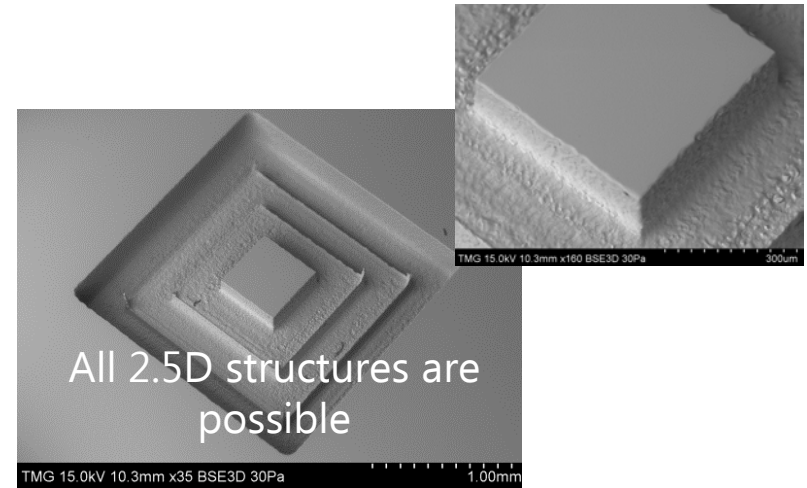
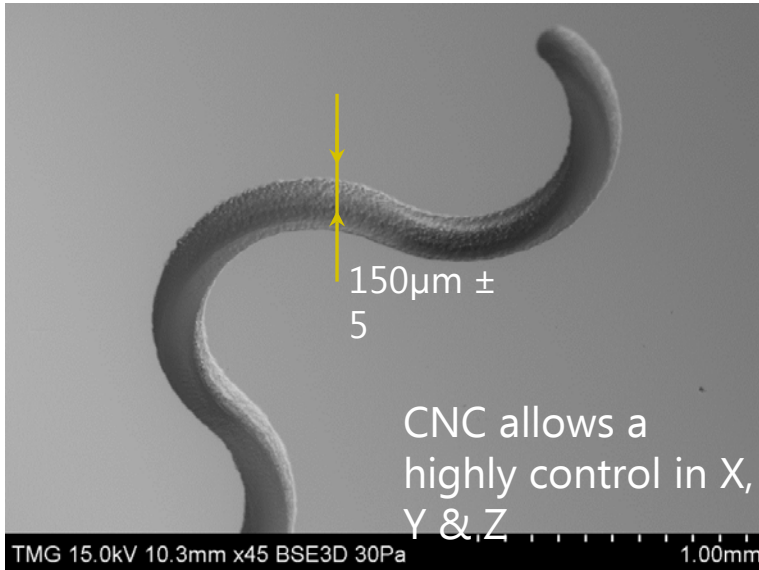
Roundness error: 2 μm



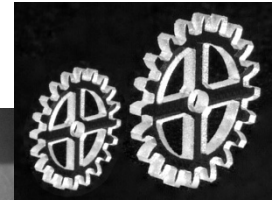
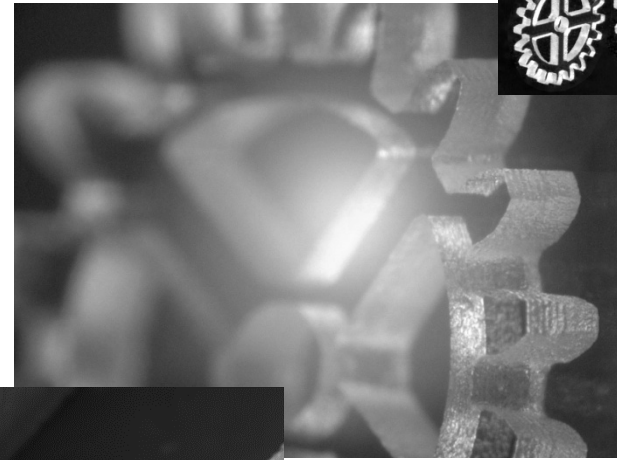
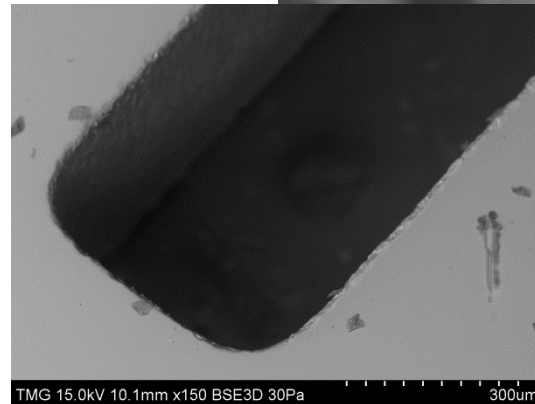
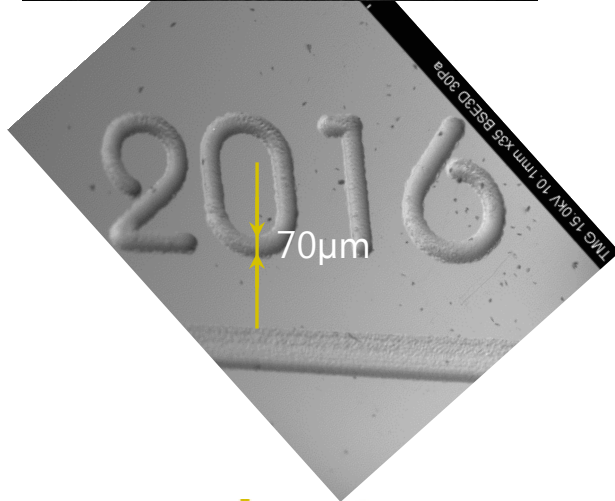
Diameter : 120 μm to ∞
Thickness: 30 μm to 4 mm



Milling

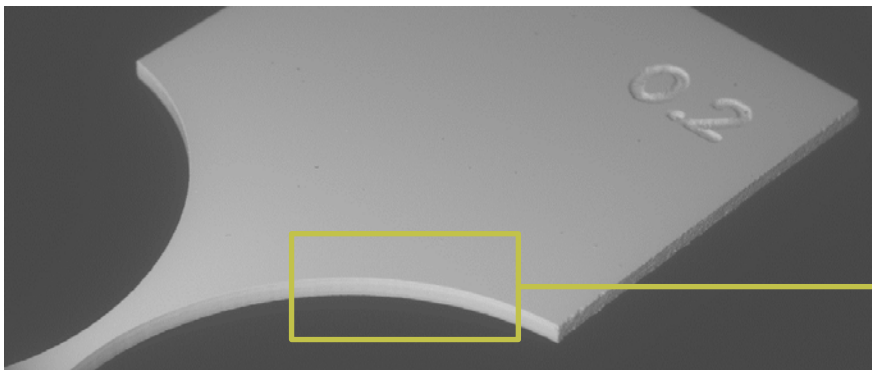
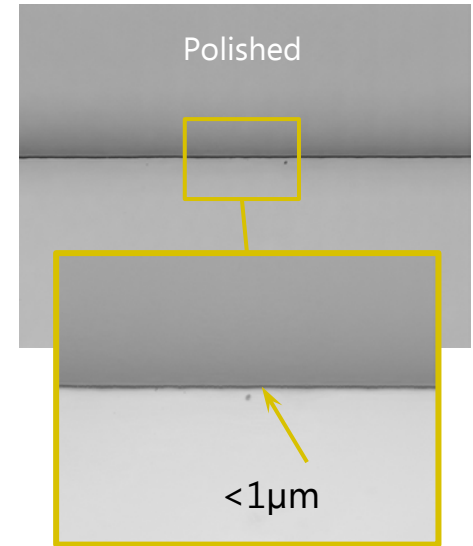
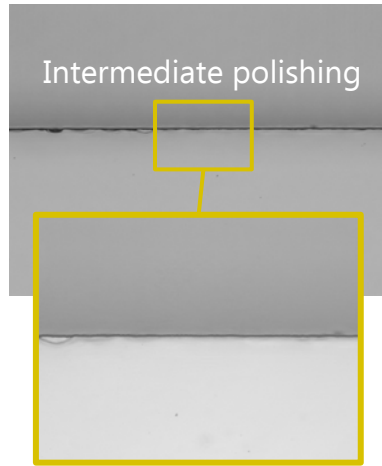
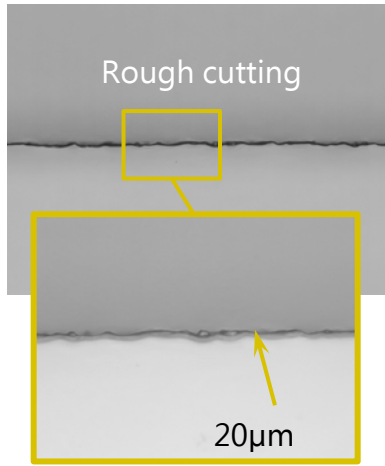


Engraving & cutting

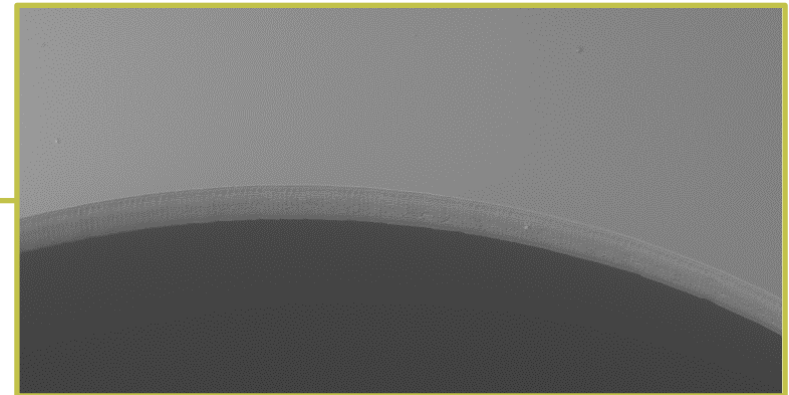


Cutting thickness:
30µm to 4mm

Surface finishing

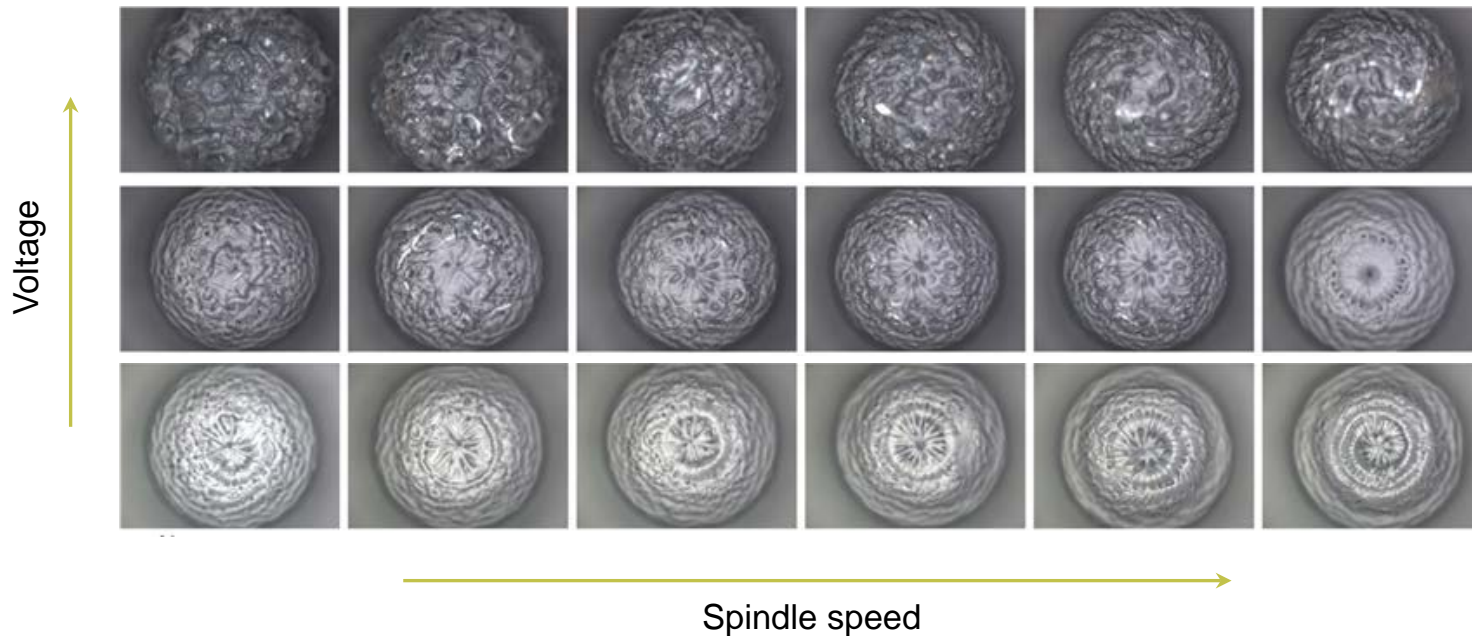


Glass thickness: 500 µm



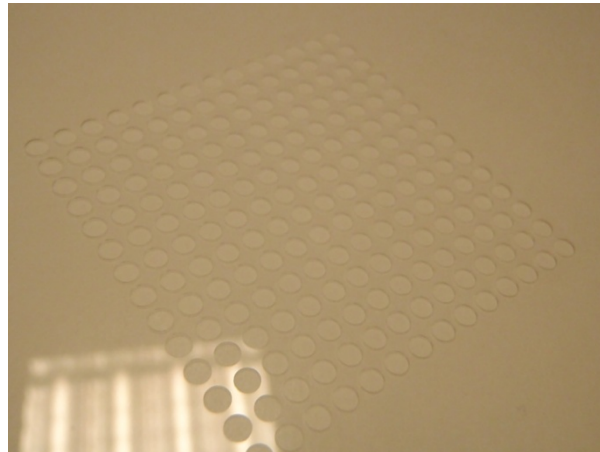
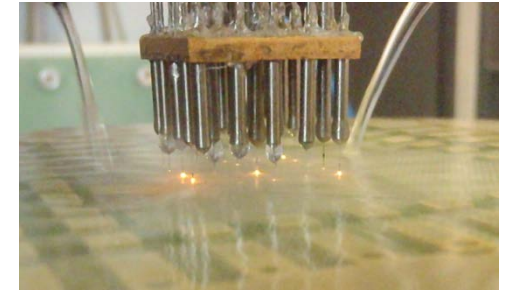
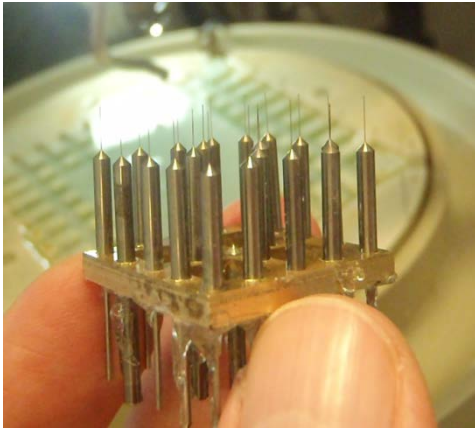
Surface texturing

Micro-hole texturation



Different machining settings generate different controlled surface patterns

High productivity with multiple tool approach



Example:

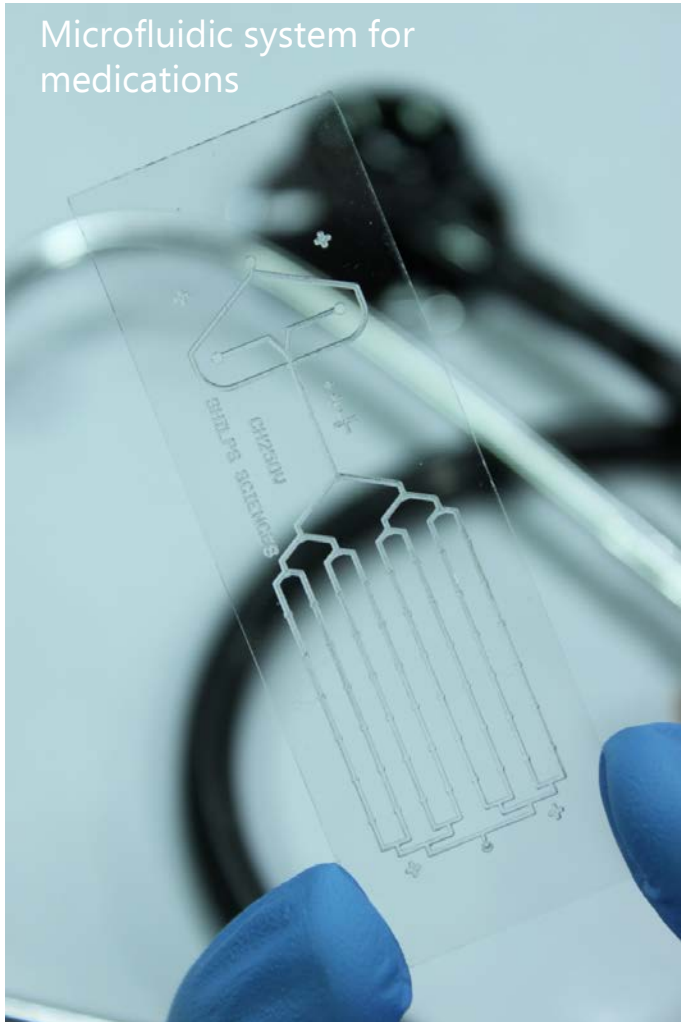
Diameter: _____ 1'500 μm

Thickness: _____ 300 μm

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

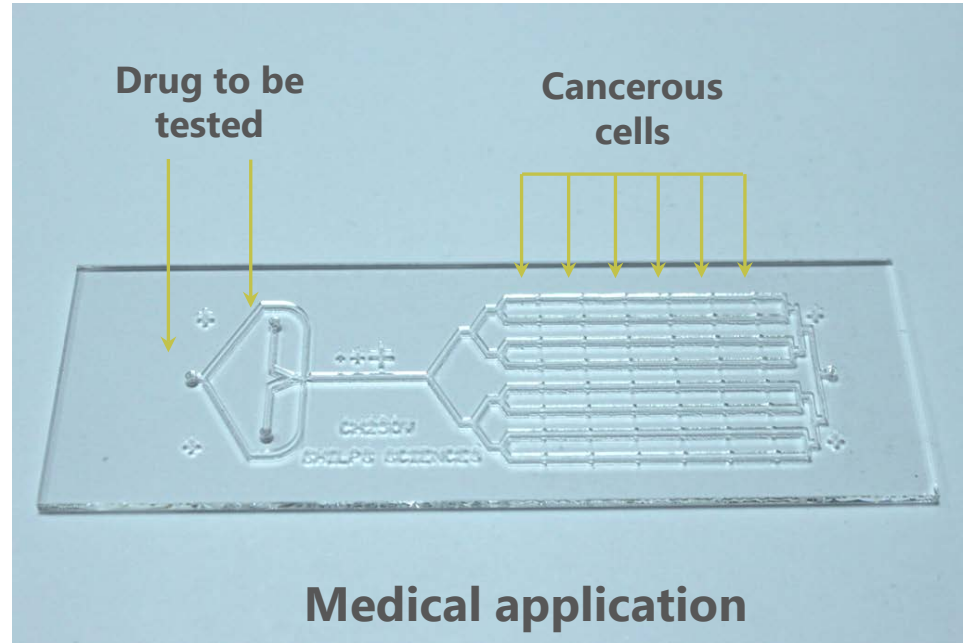
Lab on chip for high speed diagnostic

Microfluidic system for medications



Drug to be tested

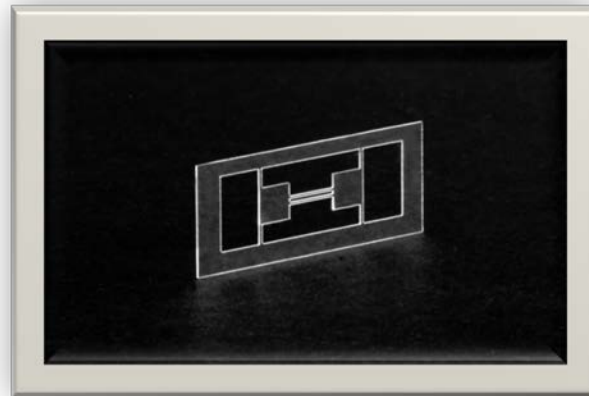
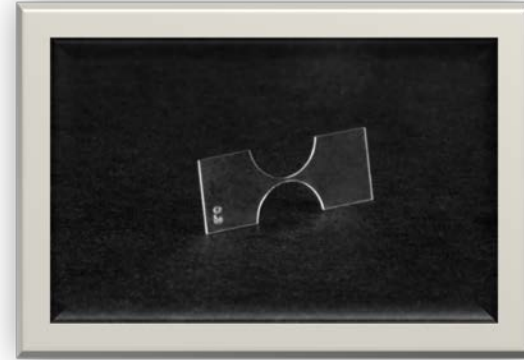
Cancerous cells



Medical application



Samples



Modular machine concept





Merci de votre attention

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