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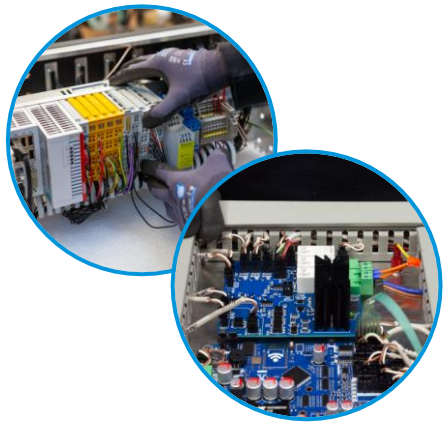
EPIC Technology Workshop on Laser Micromachining Applications

Multi-Seed MOPA lasers, technology and applications

Maik Frede and Chris Randon

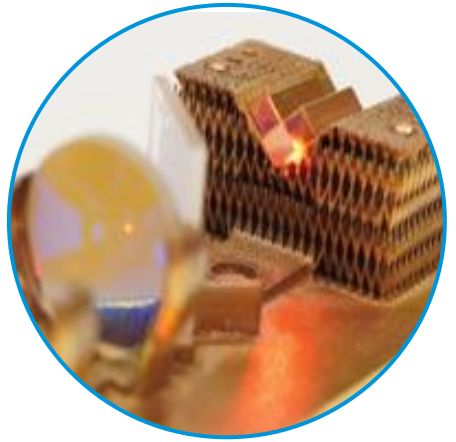
AMS SOLUTIONS – COMPETENCIES

- MOPA Lasers
- Q-Switched Lasers
- Optical Amplifiers
- Optics



- TEC Drivers
- Laser Drivers
- Laser Electronics

- Cooling Loops
- Chillers
- TEC Cooling
- Heat Exchangers



- Assemblies
- Optical / Mechanical / Thermal / All Combined

LASER SOLUTIONS

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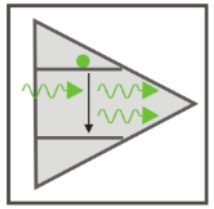
Oscillators

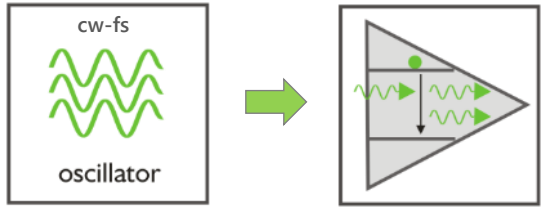
Nanoseconds

Laser Amplifiers



Power and energy scaling

MOPA Lasers

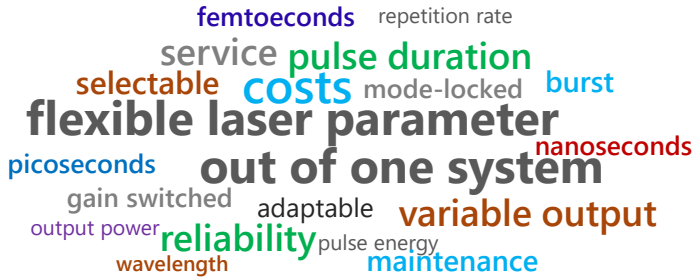


Continuous wave to femtoseconds

MOPA LASER SOLUTIONS

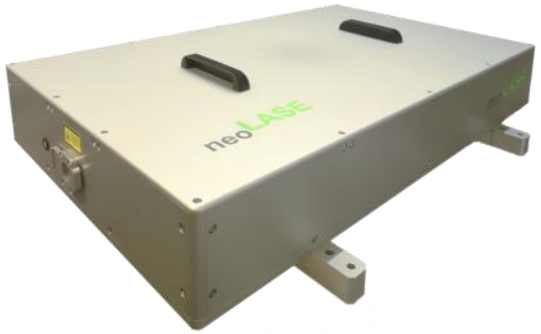
Technology awarded for the **Laser Innovation Award 2020**

Selectable pulse duration, repetition rate and output power



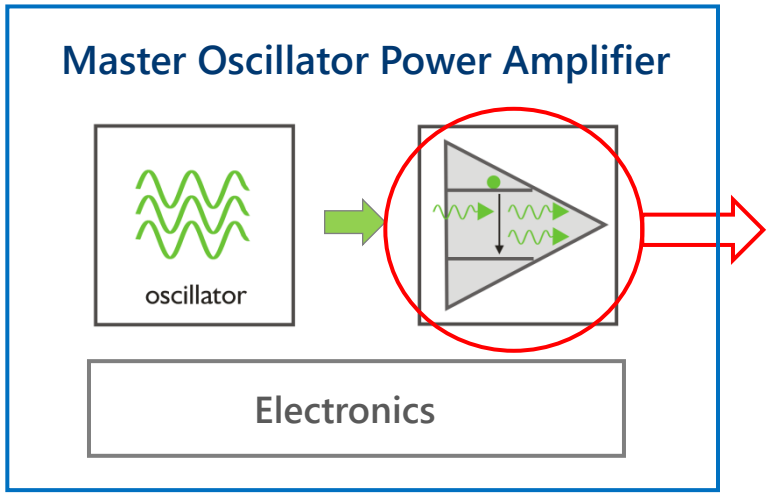
Easy integration, Upgrading, service and maintenance

Low down time
Reduced investment costs
sustainable

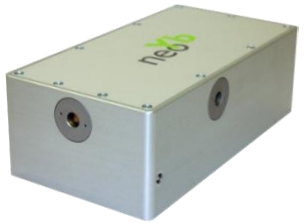


High reliability

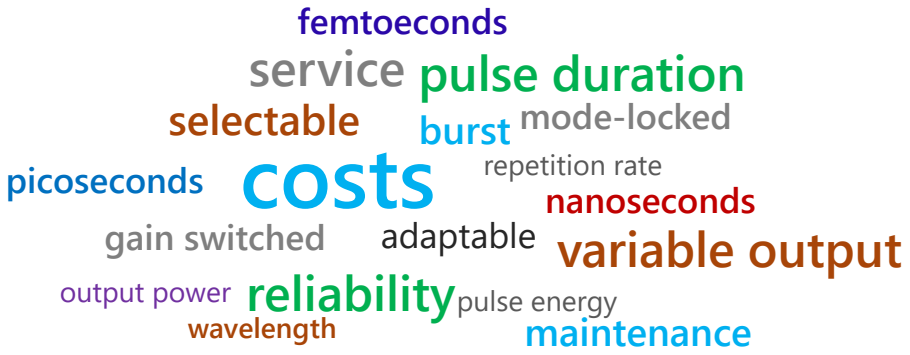
MOPA LASER SOLUTIONS



neoVAN
Wavelength: 1064 nm high gain / cw - ps
neoYb
Wavelength: 1030 nm med. gain / high energy / cw - fs
neoTAP
Wavelength: 1940 nm low gain / cw-fs
neoHOF
Wavelength: 2050 nm low gain / cw-fs

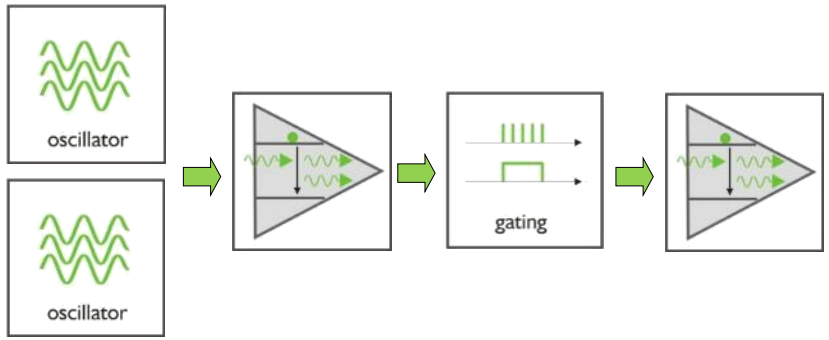


ENABLING YOUR IDEAS



How can we build a laser
with different pulse durations …?

OFFER: multi-seeder approach



Laser Parameter:

Pulse Repetition Rate:	0 - x0 MHz
Pulse Width:	ns - fs
Output Pulse Energy:	> 500 µJ
Average Output Power:	> 150 W

LASER SOLUTIONS

Q-Switch

Diode laser
Microchip

TEEM, Horus,
Elforlight ...

INO, PicoQuant, IPG…

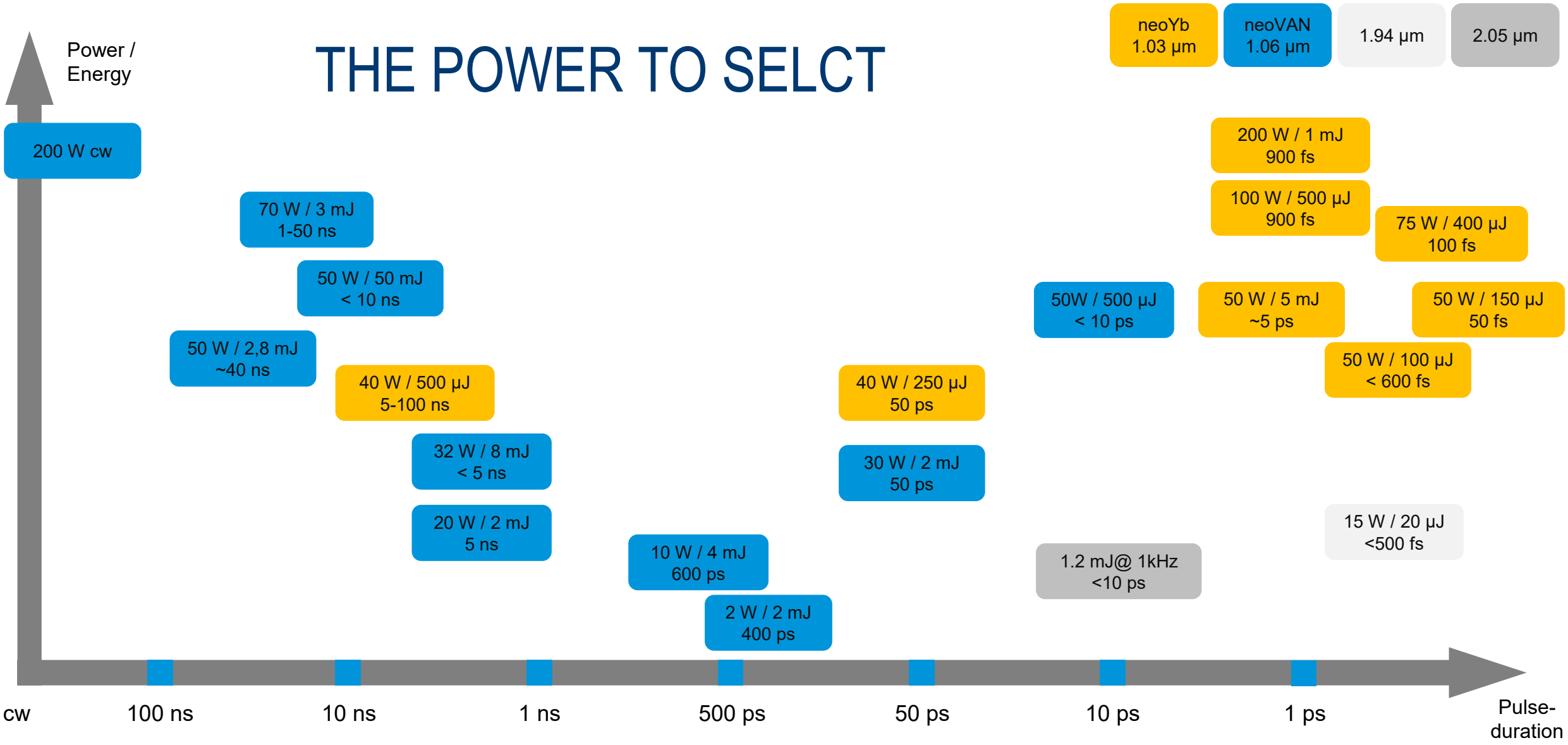
Fiber laser

Toptica, NKT, Ekspla …

Pulsed / external modulated → **Pulsed Laser diode** → **Mode-locked**

10ns 1ns 100ps 10ps 1ps

THE POWER TO SELCT



Micromachining

- Features of ~micron

- If laser power too high you cannot get the desired result
  - Higher the power → Faster →Cheaper
  - Too much power you no longer have a part

- Over time industry has migrated to Ultra Short Pulse (USP)
  - Less heat → Better quality

- What was once a difficult task is now easier to achieve
  - USP levelled the field

- Differentiator not longer just about quality
  - Price
    - ➢Speed of processing

Applications – Helical Probe

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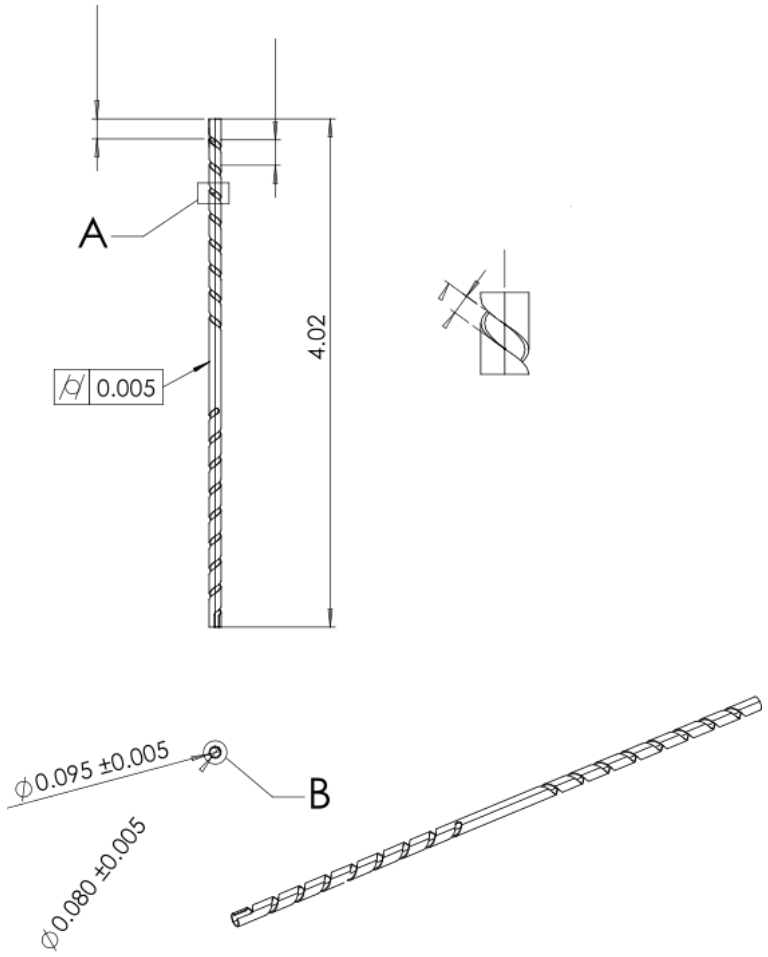
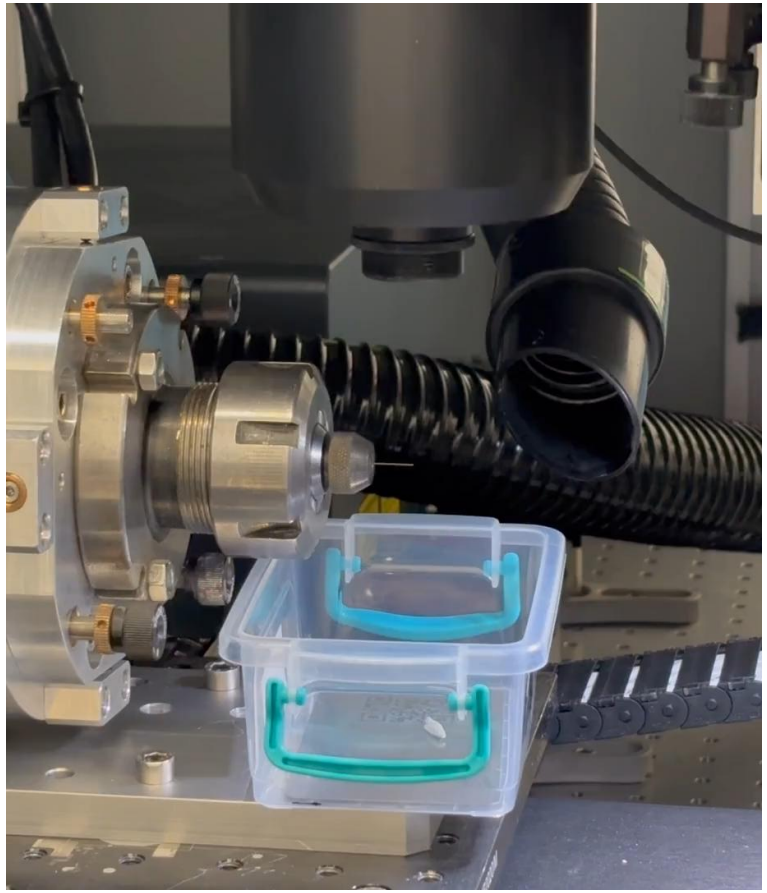
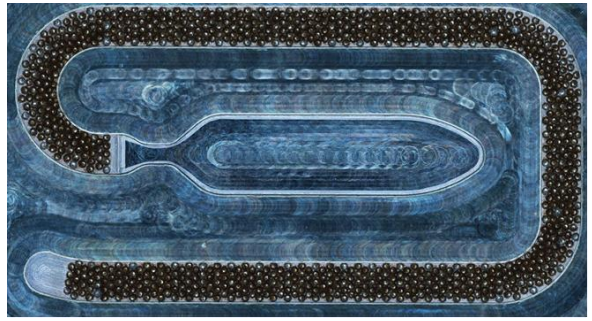
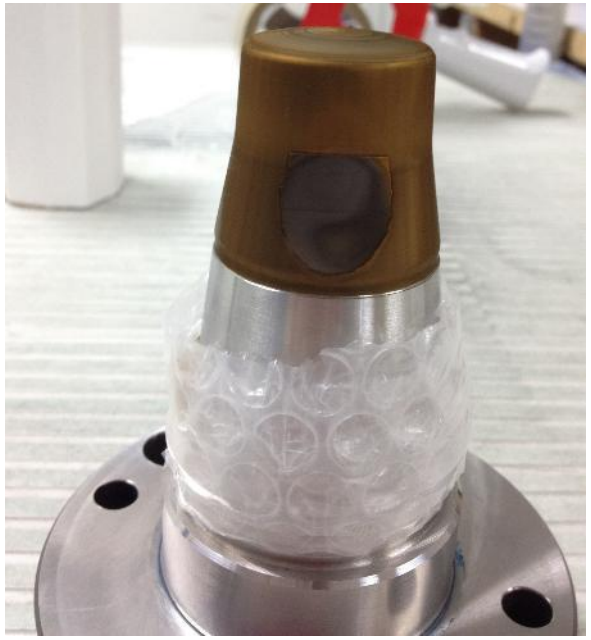
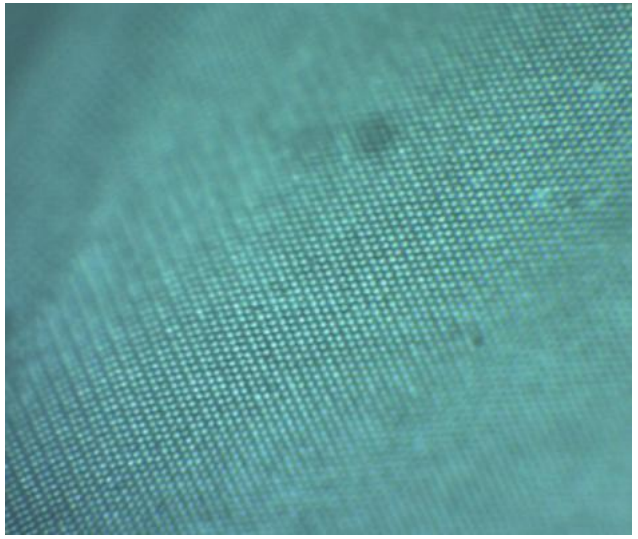




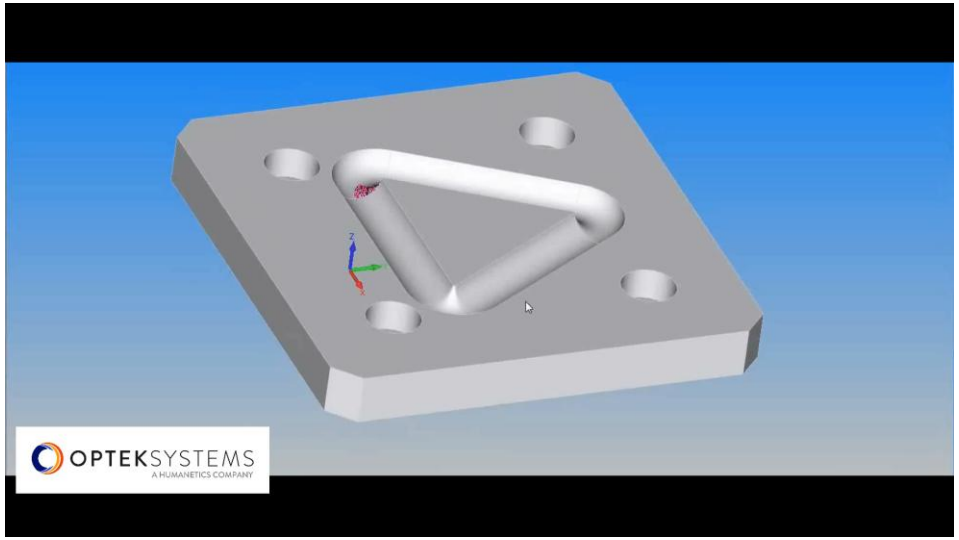
Patterning of Mold tools



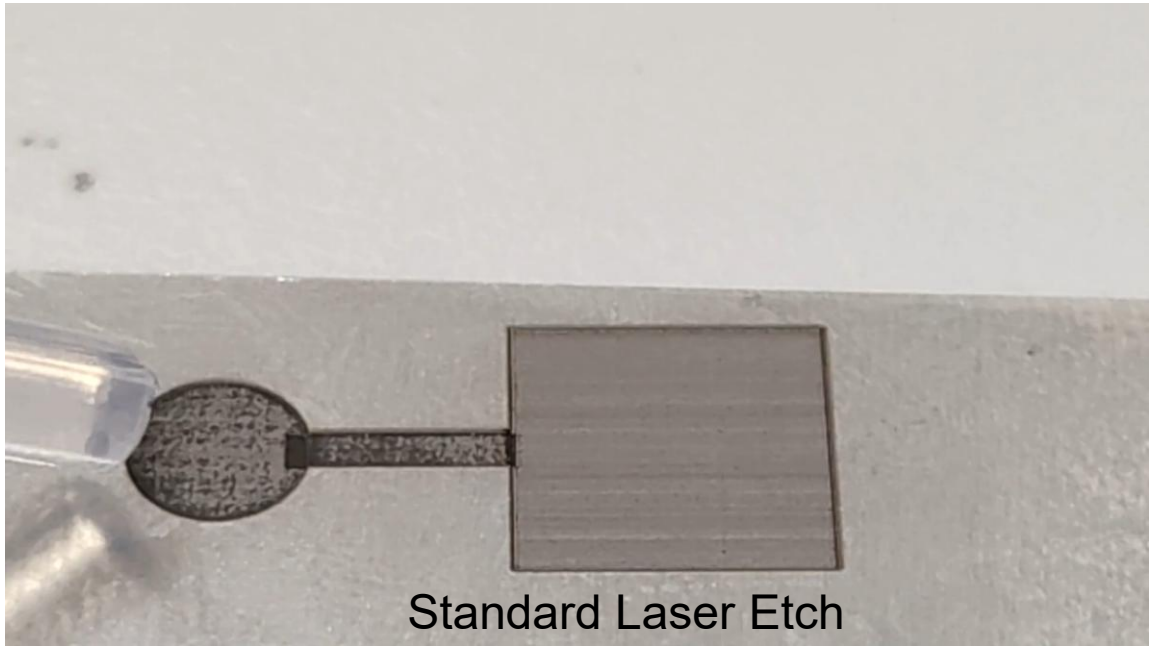




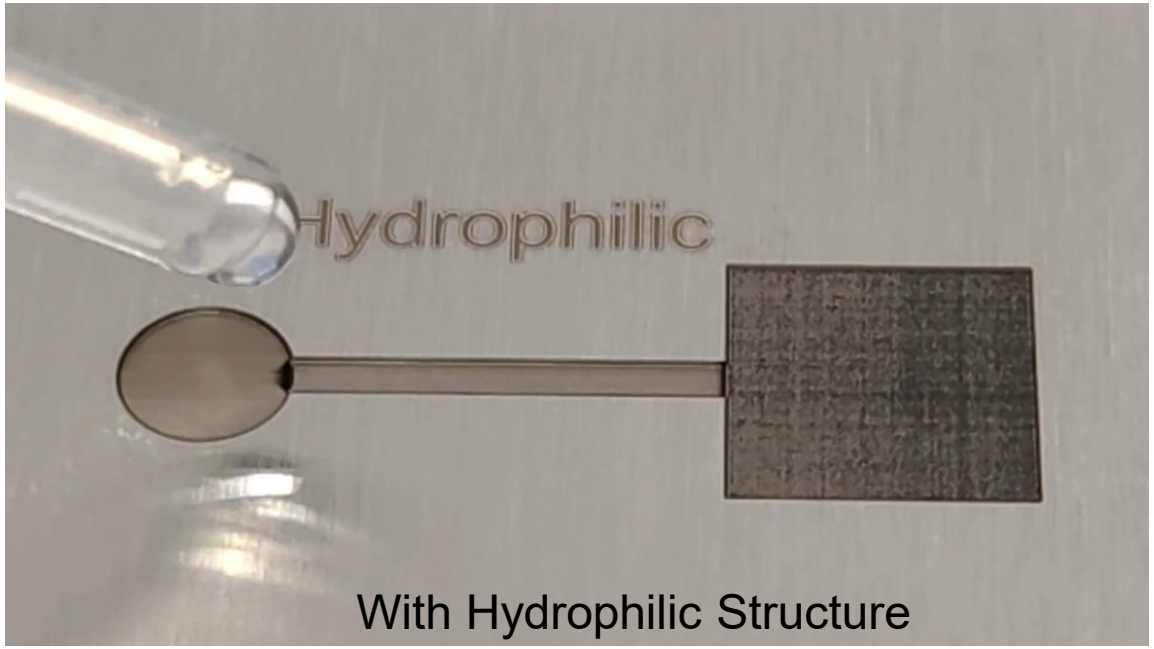
- Pillars to cause turbulence
  - Mixing in micro-fluidics
- Hydrophobic surfaces
- Hydrophilic surfaces
- Bacteria shedding surfaces



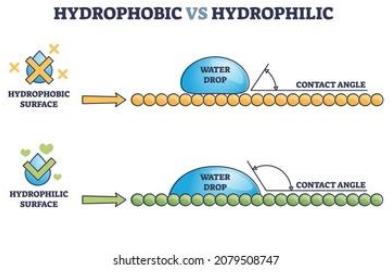
Hydrophilic Patterning



Standard Laser Etch



With Hydrophilic Structure



Hydrophilic means water-loving; having an affinity for water;

Hydrophilic surface properties are also often preferred in biomedical applications as they can prevent protein adsorption as well as improve the lubricity of the urinary catheters

Can we get high quality faster ?

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USP slow at bulk removal

ns is faster (but process is thermal)

- **Bulk removal on one system**
- **Finesse on another system**
  - LIPSS structures
  - Fine cutting
  - Polishing

- **Small features with small tolerance**
  - Expensive alignment
  - Duplicated (as you have 2 system)
  - Slow, Skilled, $$$$$

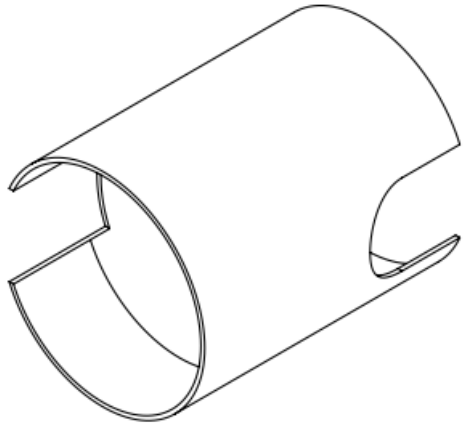
- **ns and USP in same chassis**
  - Loss of real estate
    (especially if they both need chillers)
  - More complex beam-line
    - Co-alignment at the output
  - More complex control
    - Longer set-uptimes
    - $$$$$

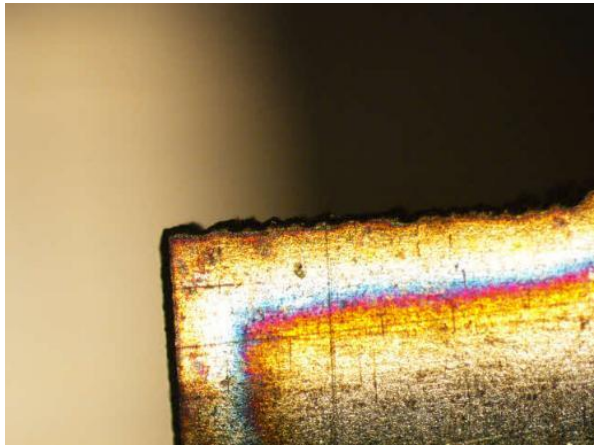
Multi-seeder overcomes these issues

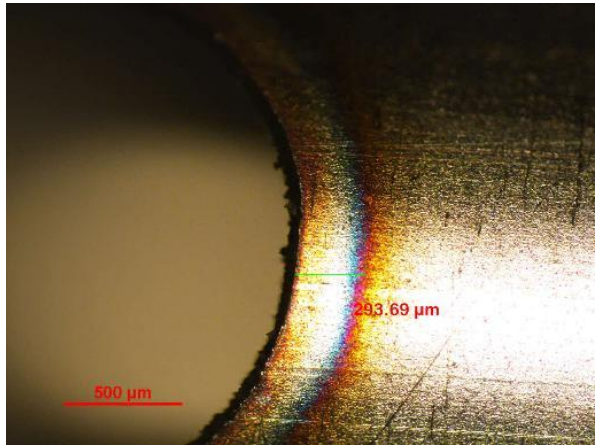
Implementation

- **ns and USP delivered through the same galvo and beamline**
- **Surface mapping**
  - Profile ns etched surface
  - Etch high spots with USP laser
- **Add final features with USP**
    - LIPSS
    - Black Mark
- **Single system**
  - Easier to use, faster to process
    - Cheaper parts

Coupler – Surface Roughening



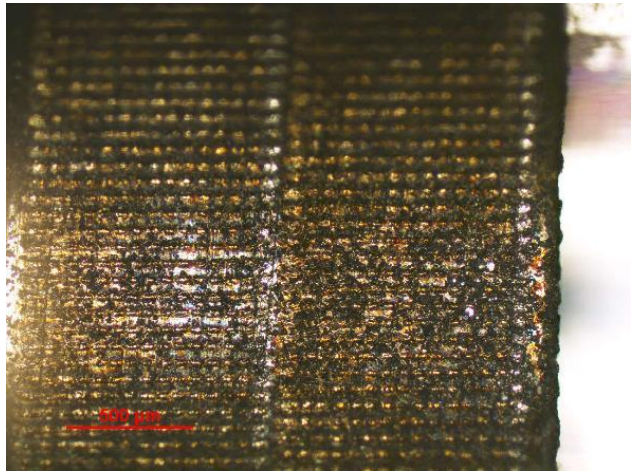


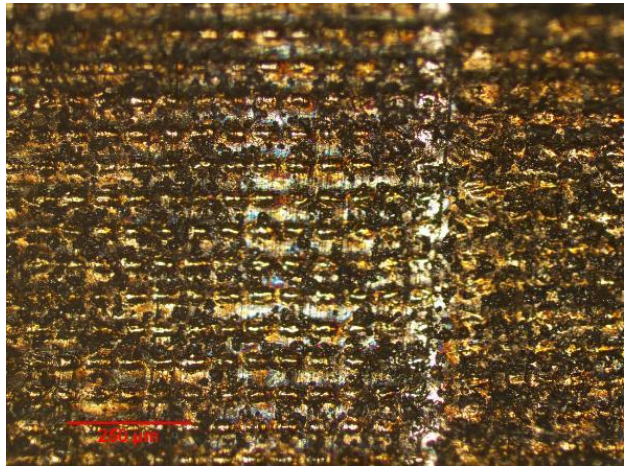


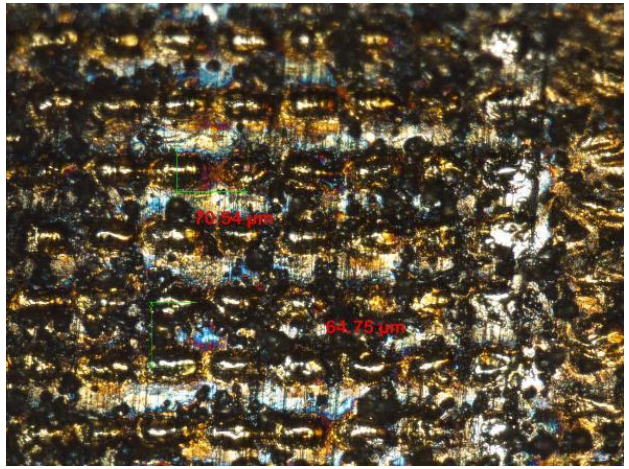
5x

10x

20x







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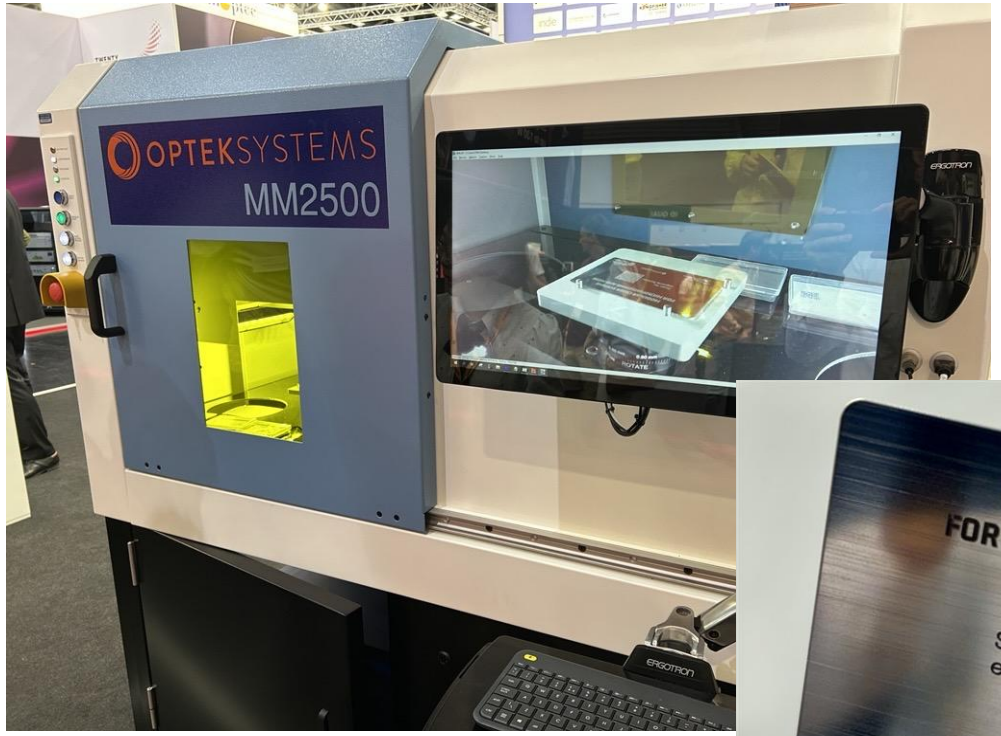

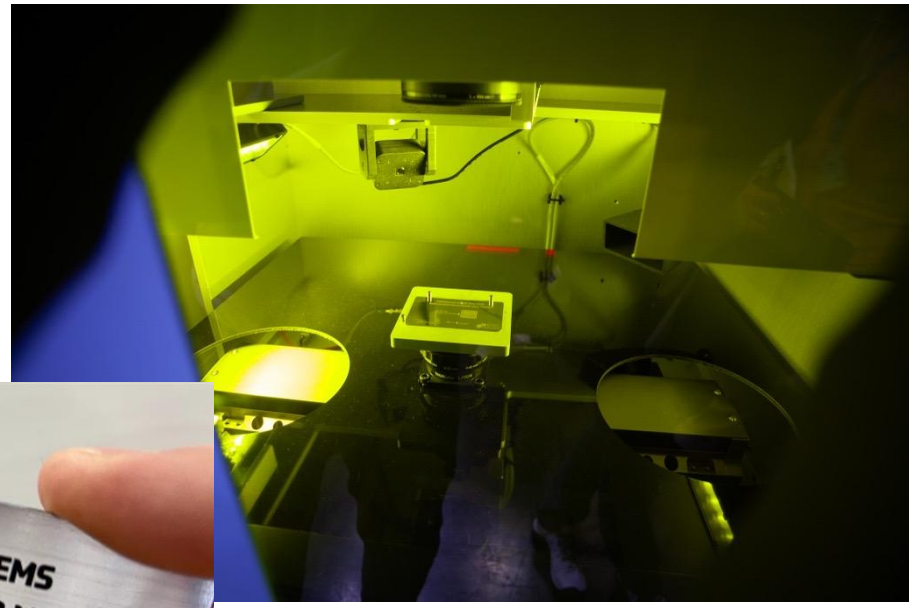

Thanks for your attention

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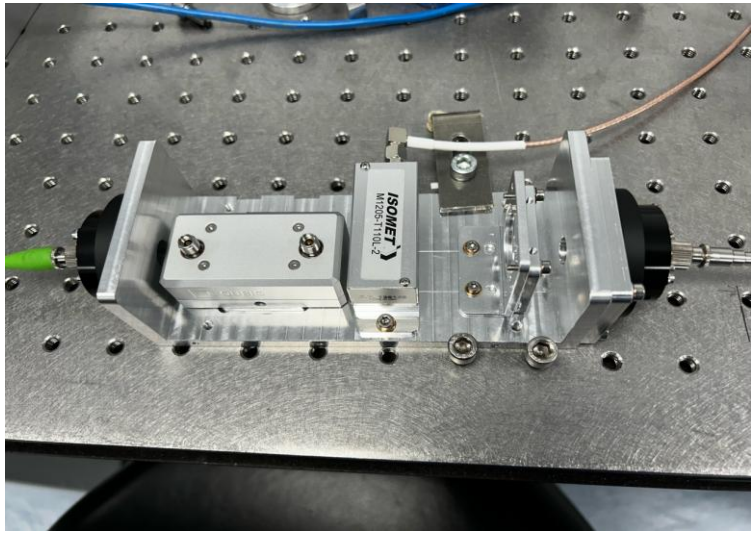
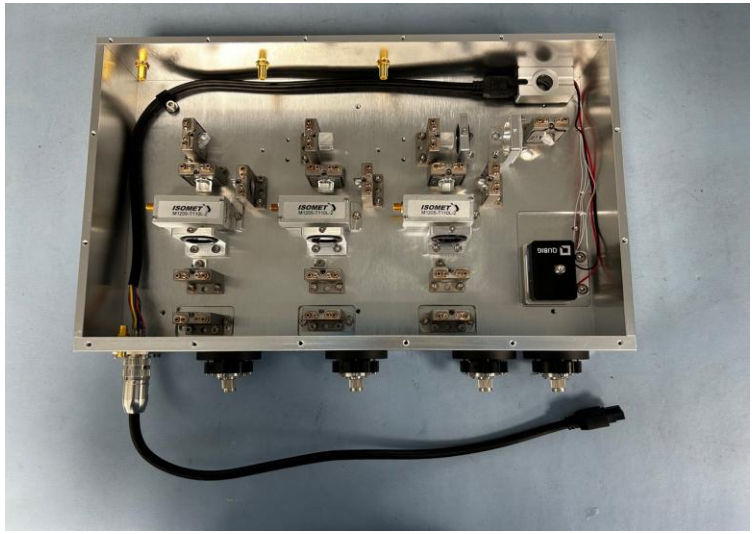
OPTICAL SOLUTION

QUANTUM COMPUTING

- Modulation Boxes for Quantum Computing
- Design/ Engineering/ Prototypes
- Lot Size 1- 3 Systems





ELECTRONIC SOLUTION

LASER SYSTEMS

- Serial Production of Industrial Laser System for Aluminium Sorting
- Laserhead/ Control Box/ Cables
- 60-100 units per year

WE ARE ALWAYS THERE FOR YOU

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