SNAPP: The Swiss National Application Laboratory for Photonic tools and Photonic manufacturing

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IAP Uni Bern, UAS-TI Burgdorf
Managing director SLN

SLN Swiss National Photonics Labs

- **Swiss National Applicaton Laboratory for Photonic tools and Photonic manufacturing (SNAPP)**
- **Swiss National Fiber Lab (SNFL)**
- **Innovationszelle Optische Technologien: IZOT**
- **OPT EPFL**
- **SUPSI SOLAR**

-> Bottom up

-> Serve industry with research results and access to photonics infrastructure

-> http://www.swissphotonics.net/swiss_national_photonics_labs.html

Swiss National Applicaton Laboratory for Photonic tools and Photonic manufacturing (SNAPP)

- **Interest of Swiss material processing industry in a Swiss National Application laboratory for Photonic tools and Photonic manufacturing (SNAPP)**
  - **Proximity for ease of access of application laboratory,**
  - **personel continuity at Swiss center of competence,**
  - **protection of know how in international competitive landscape**
  - **priority of access which is not guaranteed at international laboratories.**

SNAPP consists today of the following four laboratories with the following contacts:

–**EMPA Thun** (EMPA), Dr. P. Hoffmann

–**UAS Burgdorf**, Dr. B. Neuenschwander

–**UAS Windisch**, **B. Lüscher (SLN coordinator of SNAPP)**

–**ETH Zürich** (Inspire), Dipl. Ing. ETH Josef Stirnimann

If you are not sure who is the best partner for you please contact SNAPP coordination by
Email: luescher@swisslaser.net

Available infrastructure (tendency growing)

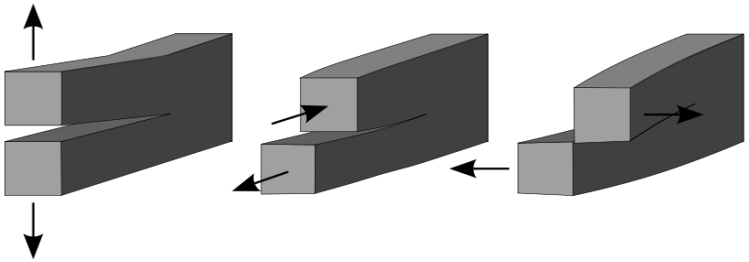
Equipment	Inspire	UAS W	UAS B/Uni B	EMPA
CO2 kW	2.2kW;5kW		x	
Fiber kW			x	
Excimer				x
ns	1mJ/100W	0.7mJ/15W	40mJ/150W	
ns 533			20mJ	
ns 355	23uJ/1W	7W		
Lab	x	x	x	x
Scanner	x	x	x	
Beamcharacterisation	25kW	x	x	
fs-Laser			x	
ps-Laser		x	x	
Microscope	3D	3D	x	
REM/TEM/SEM/EDX	x	x	x	x
AFM			x	
Fiber			x	

New diagnostic and laser systems are continuously acquired

At present: focus on ps and fs systems for microprocessing

EMPA
Materials Science & Technology

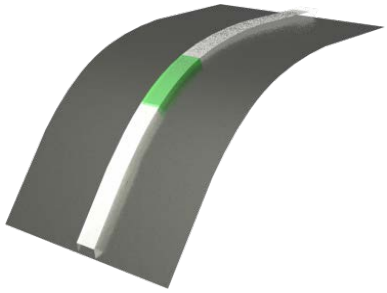
Advanced Materials Processing competences



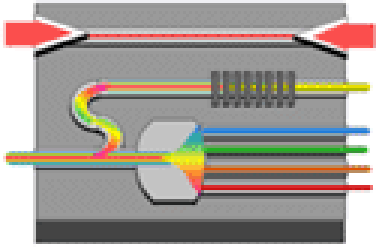
Deformation of materials & Fracture mechanics

Laser processing

Tribology



Surface functionalisation



Optical materials

CREALAS
Smart Micromachining

EMPA
Materials Science & Technology

SLN

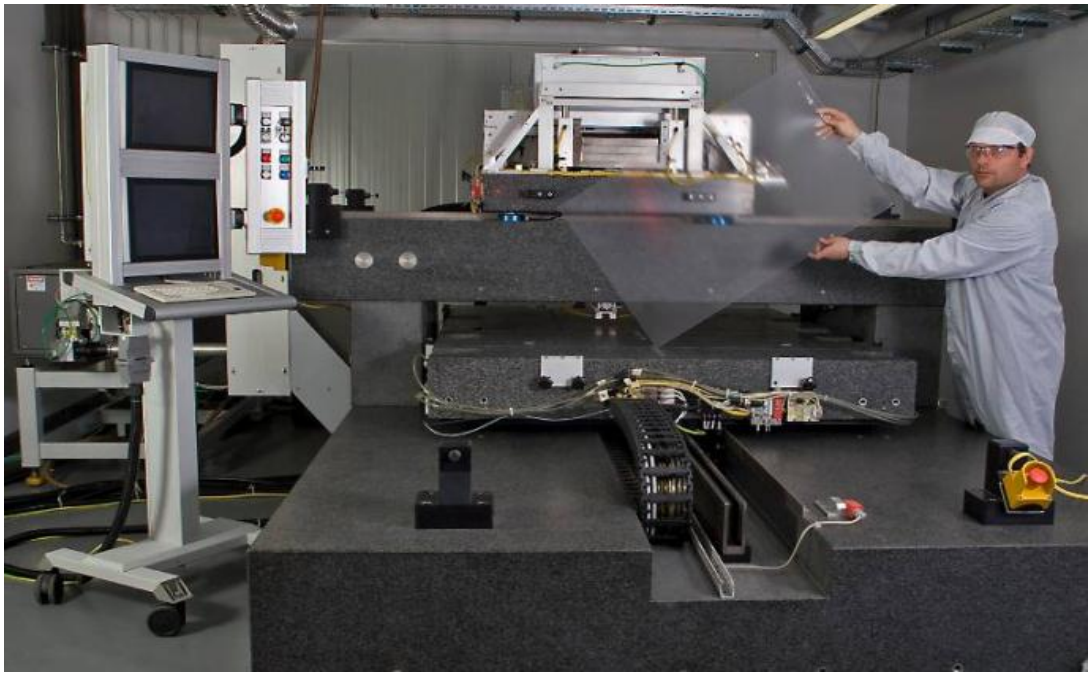
Laser Lab Thun – Collaboration between Empa and Crealas

Equipment:

2 Excimer laser micro machining work stations.

->Up to 2m x 1.5m substrate size.

Contact: kilian.wasmer@empa.ch, karl.boehlen@crealas.com



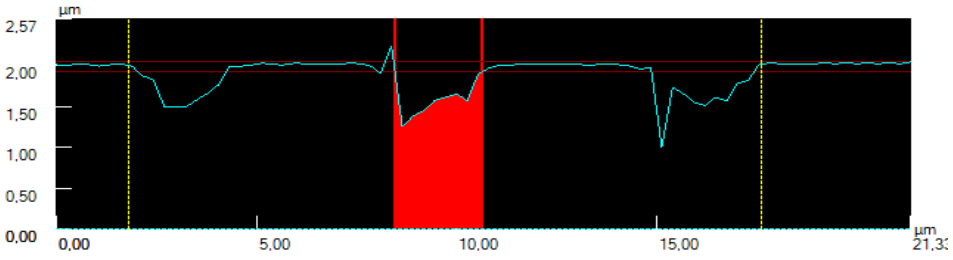
CREALAS
Smart Micromachining

EMPA
Materials Science & Technology

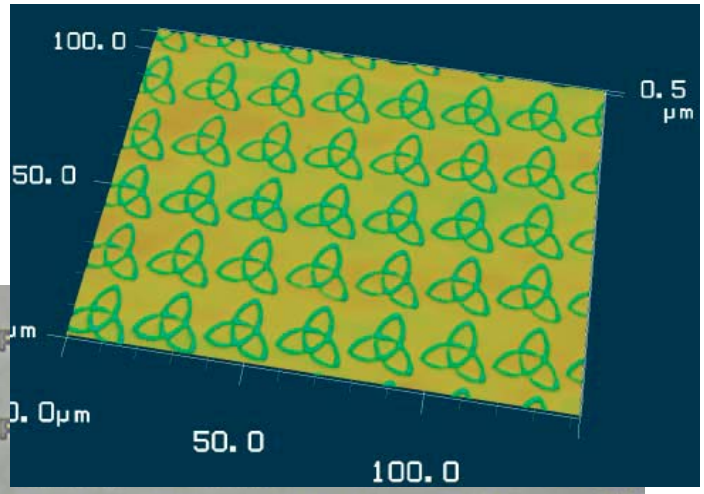
SUN

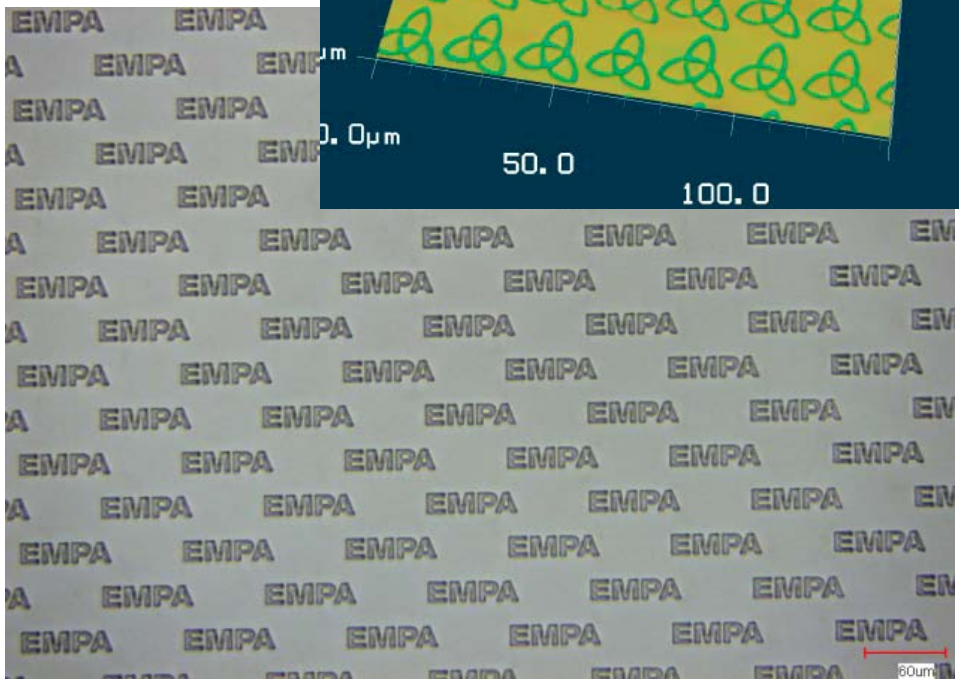
Super High Resolution Marking

Line width 2 µm & Text height 15 µm



Profil1	Horiz.Abst.	H-Unters.	Durchs.-H	Winkel	Quers.Lä.	Quers.Fl.	R	Anr
Alle	21,33µm	0,03µm	1,88µm	0,08°	24,29µm	40,64µm2		
Seg.1	15,76µm	0,02µm	1,84µm	0,06°	18,71µm	29,73µm2		
Seg.2	2,16µm	0,12µm	1,62µm	3,16°	2,99µm	3,94µm2		





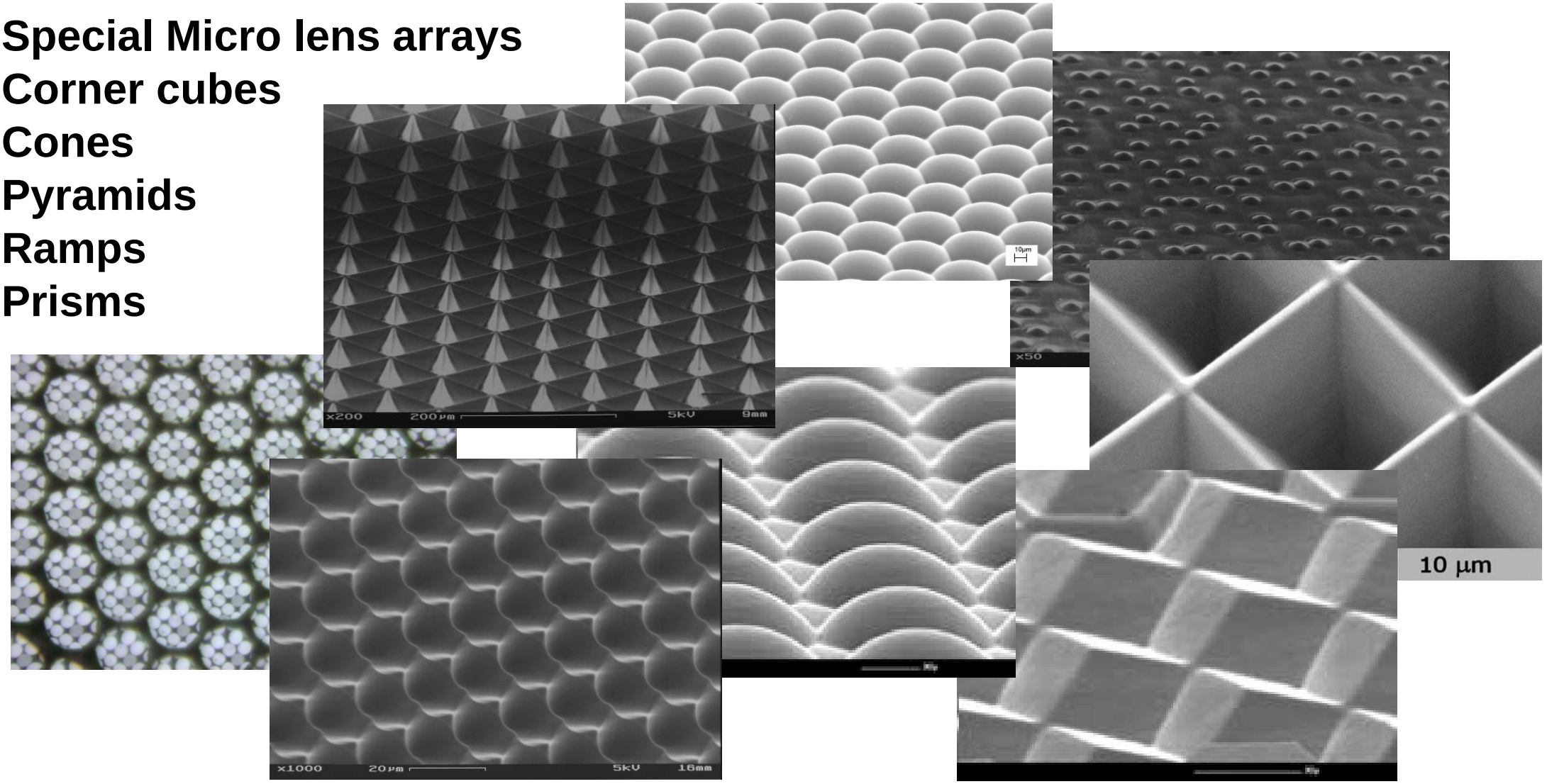
CREALAS
Smart Micromachining

EMPA
Materials Science & Technology

SUN

Highly engineered Micro-Structures

Special Micro lens arrays
Corner cubes
Cones
Pyramids
Ramps
Prisms

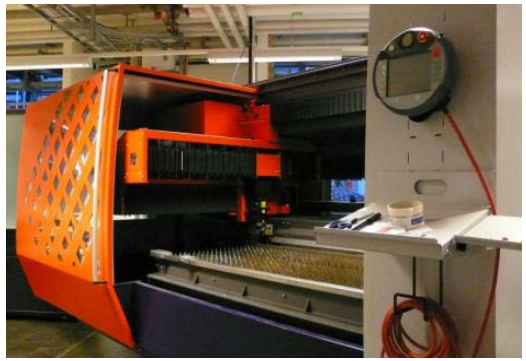


- Process development
- Process analysis and determination of required parameters
- Macro- and microprocessing of materials
  - cutting, welding, deposition welding
- Microprocessing of materials with ns and ps pulses is being intensified
- Machining of tool surfaces (ultrahard materials: diamond, CBN, sapphire)

Time-Bandwidth MOPA DPSS picosecond laser system

Fig. 3: IPG YLP-HP fibre-based nanosecond laser system

Trumpf TruLaser Cell 7000 series laser processing centre



Bystronic 3-axis cutting laser machine

Trumpf Vector Mark compact nano-second workstation

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

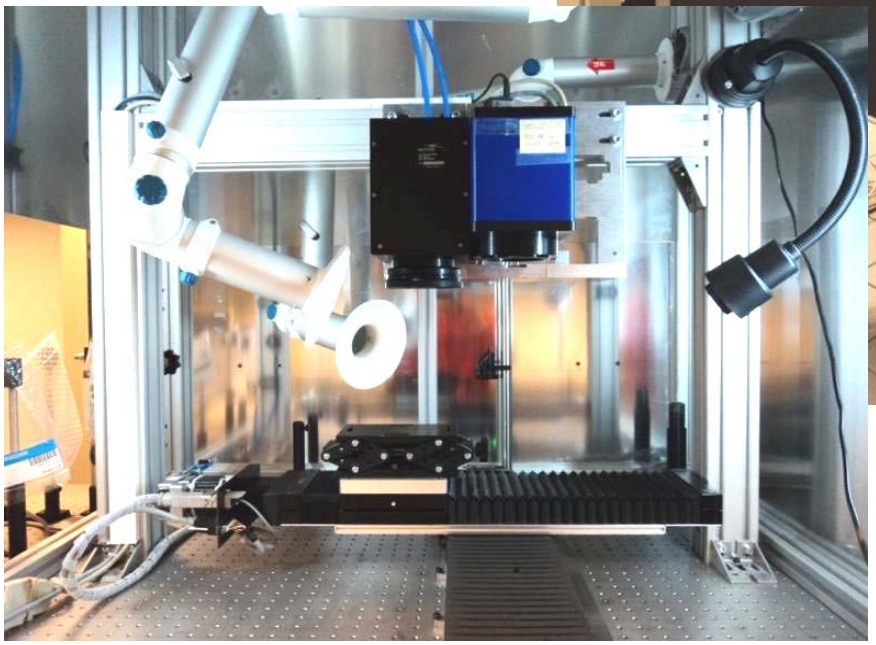
inspire

SUN

Preparations station

Cleaning station

Fume hood station



Microprocessing work station

Microprocessing laboratory

3D-Laser Mikromaterialbearbeitung

Laser:

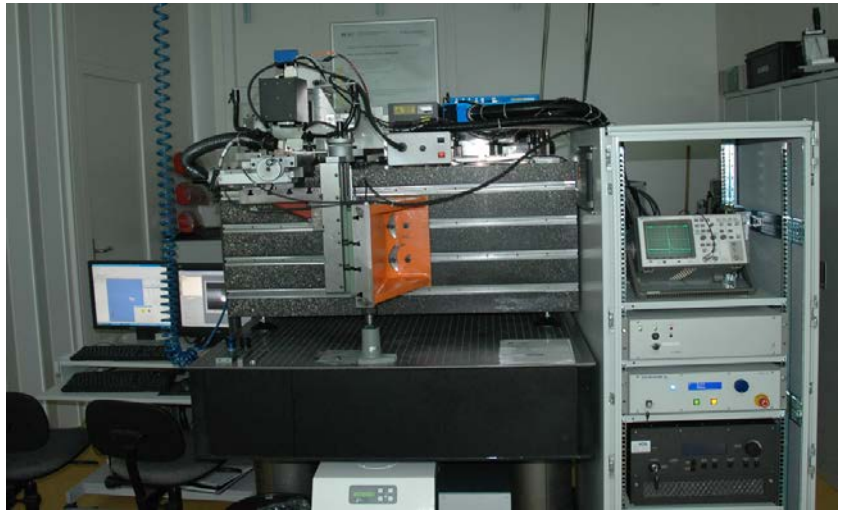
Wellenlänge	355 nm	355 nm	1064 nm	1064 nm
Mittlere Leistung	5 W	7 W	15 W	15 W
Strahlqualität M2	< 1,3	< 1,3	< 1,3	< 1,3
Max. Pulsdauer	< 12 ps	< 12 ns	< 12 ps	< 20 ns
Min. Repetitionsrate	5 kHz	50 kHz	5 kHz	cw
Max. Repetitionsrate	1000 kHz + 8x Burst	300 kHz	1000 kHz + 8x Burst	64 kHz

Strahlführung:

- XY Scanner mit Varioscan (digital)
- XYZ Achsen + 4. Achse (Drehachse) als CNC Achsen ausgeführt
- Objektive 32mm bis 250mm

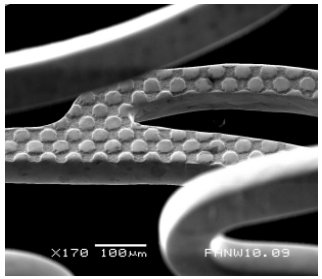
Ansteuerung:

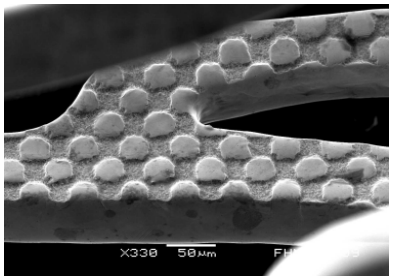
- Steuerkarte: Scanlab RTC5
- Software: Scaps SAM3D

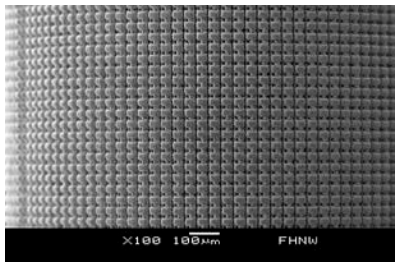


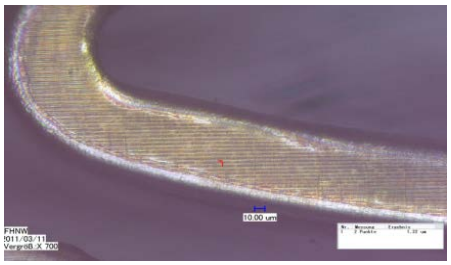
Anwendungsbeispiele

3-D Kavitäten in Metallen, Kunststoffen, …

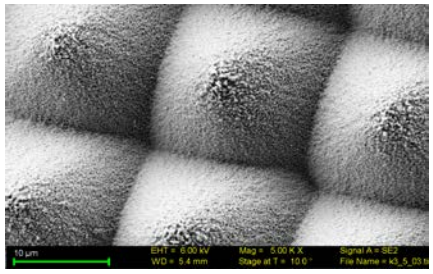


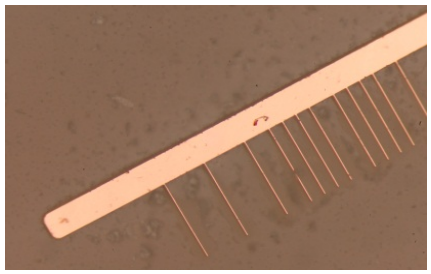






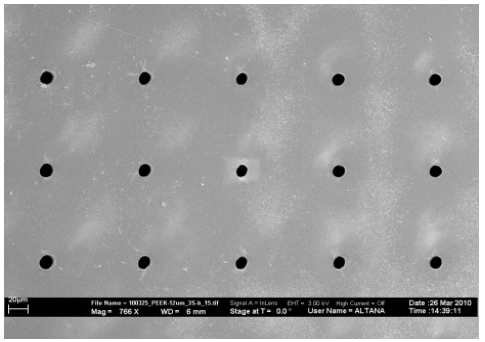
Mikrostrukturen in Stents 1 – 20 µm



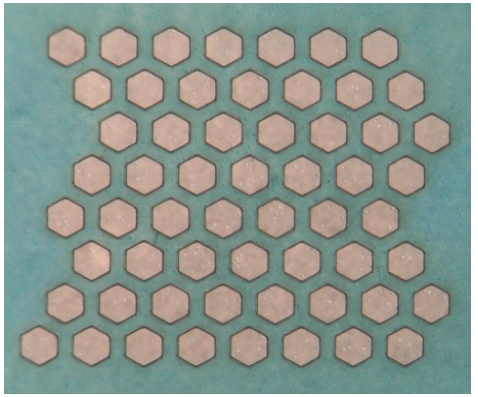


Mikrostrukturen in Keramik 20 µm

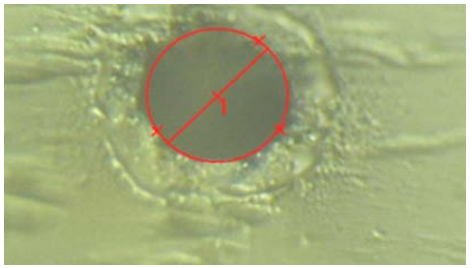
Bearbeitung von Kunststoffen + Folien



Löcher in PEEK 20 µm



Mikrostrukturierung von Hochleistungs-polymeren 100-800 µm



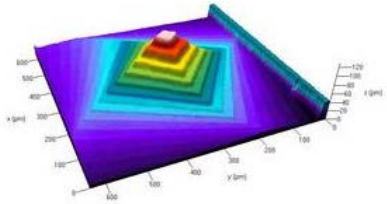
Löcher in PC 12µm 300µm tief

Institute for Applied Laser, Photonics and Surface Technologies ALPS

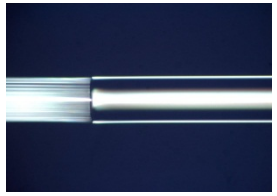
Cometencies and Research Groups:

Site Burgdorf:

- Laser Surface Engineering
  B. Neuenschwander



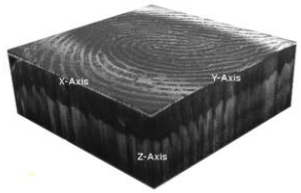
- Fiber Laser Development
  V. Romano



- Thin Films & Surfaces
  P. Schwaller

Site Biel:

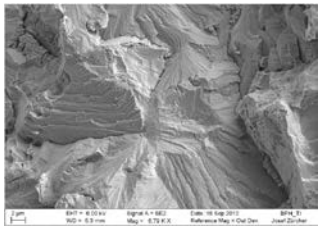
- Photonics
  Ch. Meier



- Heat Treatment of Materials
  J. Rufer

- Nanometrology
  P. Walter

- Lab for Material and Surface Analysis (M. Baak, J. Zürcher)



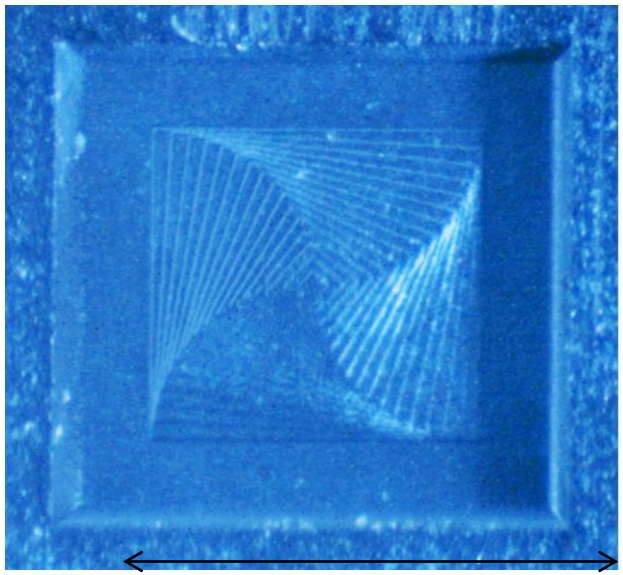
Laser Surface Engineering

- **Pulsed Laser Processing**
  Laser Microprocessing and surface structuring of all kind of materials
  - Focus on ultrashort laser pulses (fs, ps)
  - Process development and process optimization
  - Feasibility studies
  - Laser-Material interaction studies
  - Automation and Control
  - Laser induced Processes (LIPAA, LIBWE)

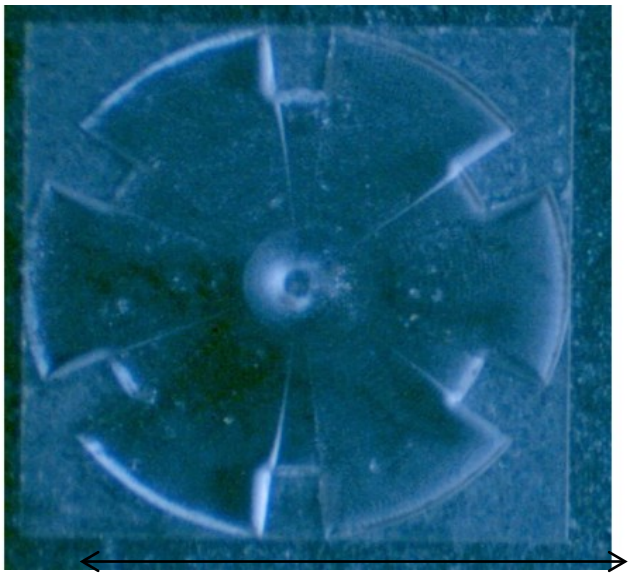
- **Infrastructure**
  Fully equipped “dust free” optical laboratory
  - 1 standard DUETTO ps-System
  - 1 DUETTO ps-System with additional Amplifier and variable pulse duration up to 50ps
  - IPG ns NIR Fiber Laser ($\Delta\tau$ = 4, 8, 14, 20, 30, 50, 100, 200 ns; P_{av} = 20W)
  - IPG ns Green Fiber Laser ($\Delta\tau$ =1.5ns, P_{av} = 5W)
  - Coherent Verdi V6
  - Coherent Diamond E150 CO_2 – Laser
  - Q-switched laser with high pulse energy (several 100 mJ)
  - Scanner Systems for 1064nm, 532nm and 355nm, Intelliscan 14 from Scanlab

Dielectric Materials: Structuring of Sapphire

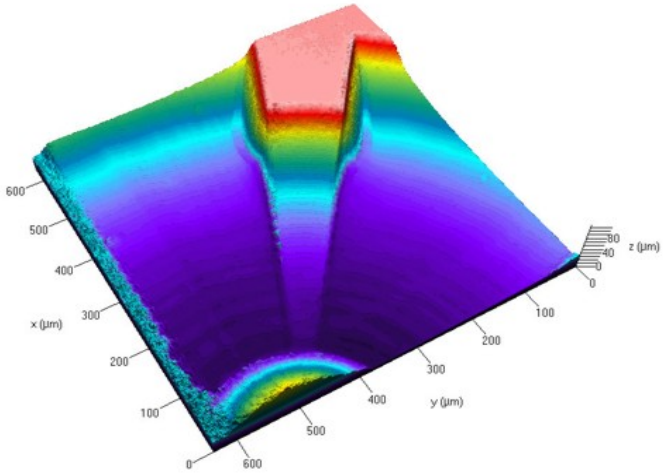
λ = 355 nm; $\Delta\tau$ < 10 ps, w_0 = 5 μm



1mm



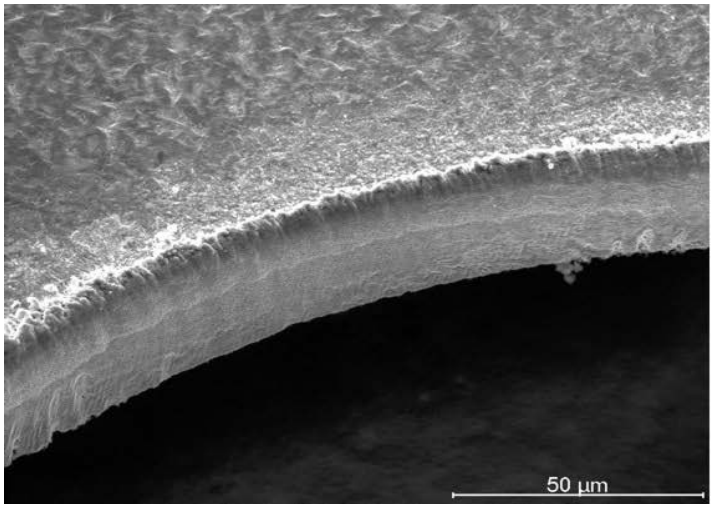
1.5 mm

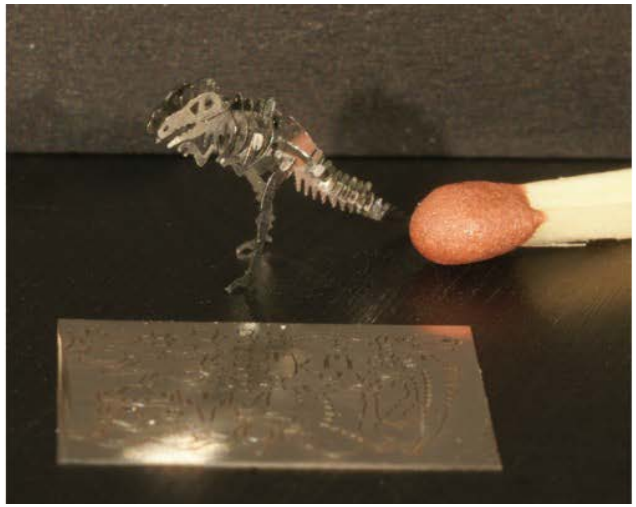


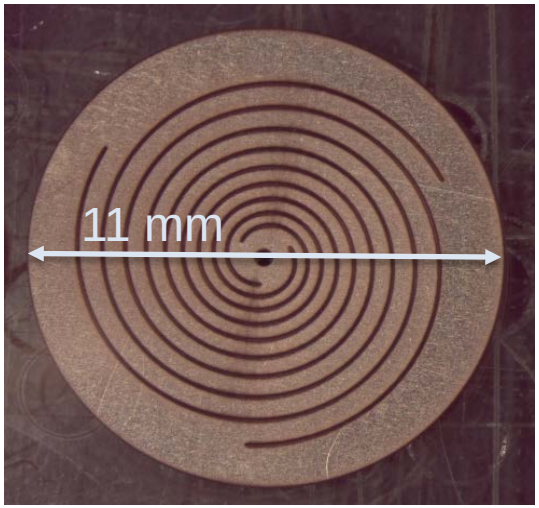
Almost “arbitrarily” shaped 3-d structures can be machined into transparent materials (sapphire and glasses).

Metals: Cutting of thin sheets

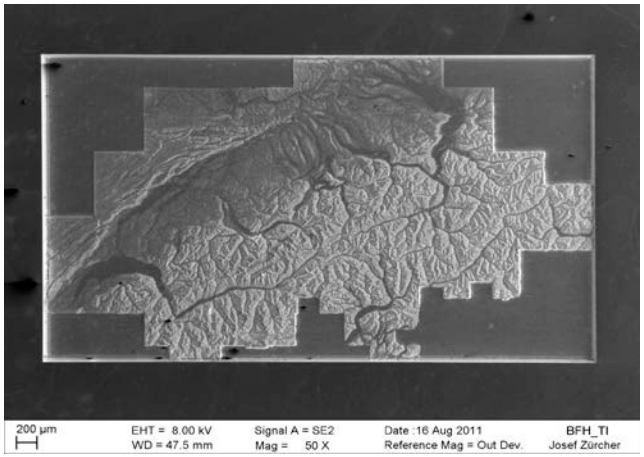
λ = 532 nm; $\Delta\tau$ < 10 ps, w_0 = 7 µm

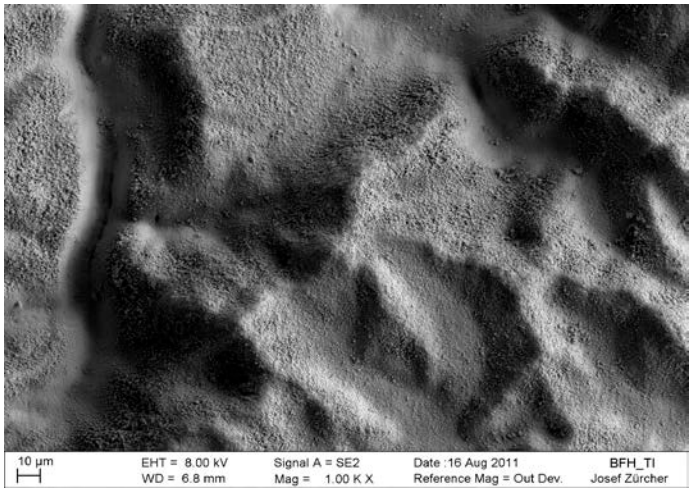






Metals: High precision surface structuring





SNAPP General Guidelines

- **Exploit synergies**
- **small and efficient administration**
- **4 thematic meetings per year (Organisation: B. Lüscher)**
- **1 workshop / year (with direct SLN support)**

Thematic meetings

- Processing of hard materials (Diamond) with Laser
- **Tribology (e.g. when laser structured)**
- Nano- / Pico- / Femtosecond pulses
- Processing of thin films (for photovoltaics)