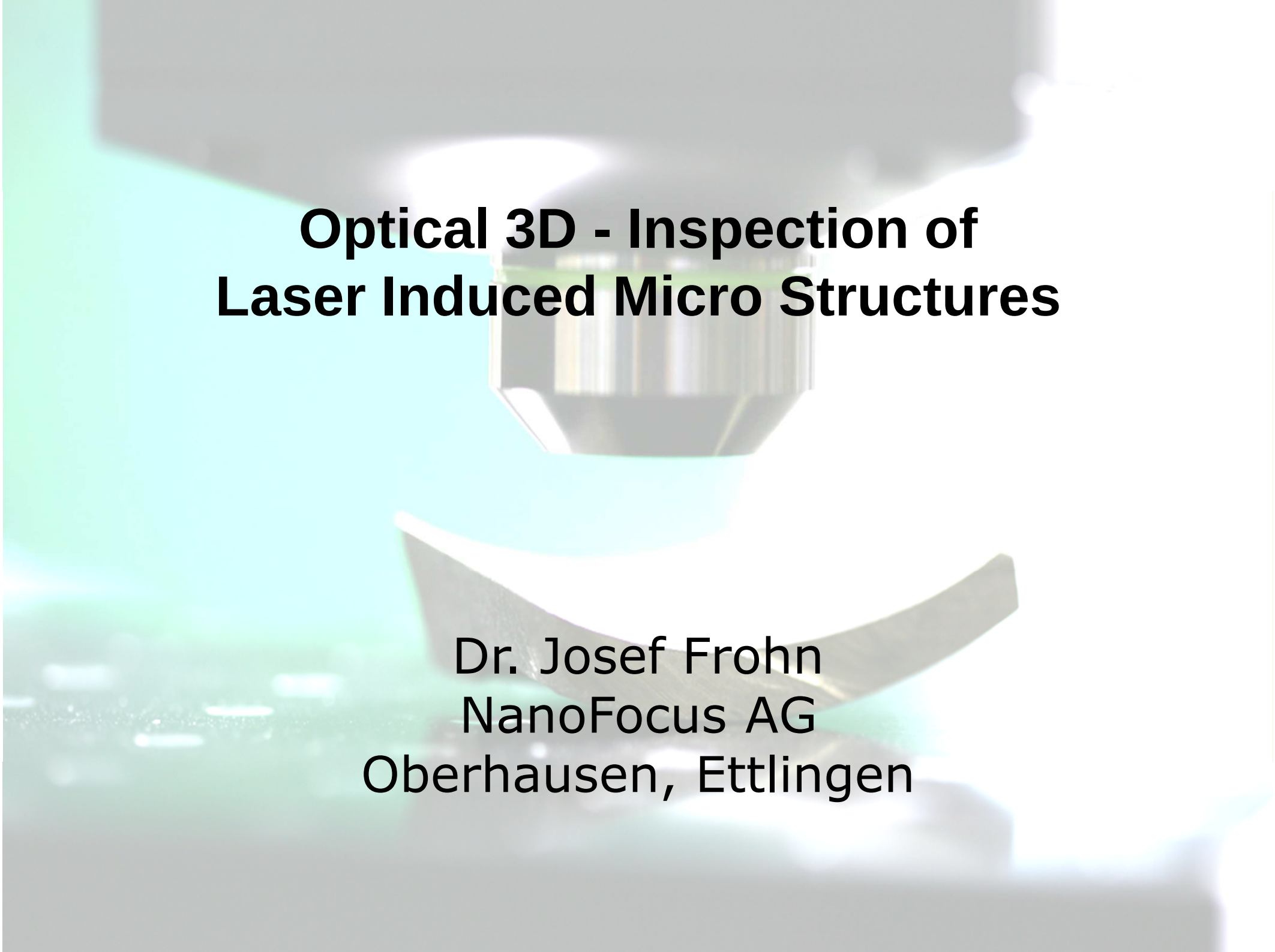


Optical 3D - Inspection of Laser Induced Micro Structures

Dr. Josef Frohn
NanoFocus AG
Oberhausen, Ettlingen

NanoFocus AG

founded in 1994

optical surface inspection:
development & production of
3D laser profilometer µscan® &
3D confocal microscope µsurf®

main markets:
automotive, micro technology,
medical, forensic, electronics,
printig, solar

> 700 installed systems

NanoFocus AG
HQ
Oberhausen
Germany

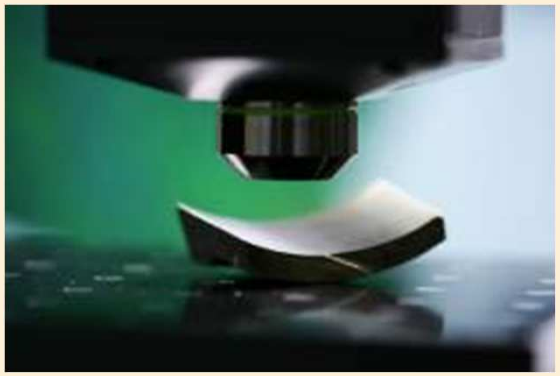
NanoFocus Sales
Ettlingen - Munich
Germany

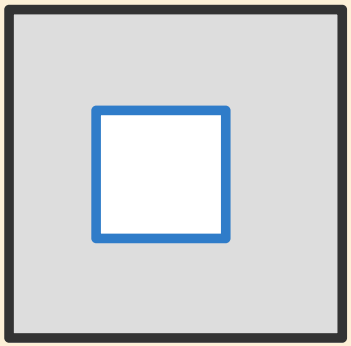
NanoFocus Inc.
Glen Allen, VA
USA

NF Pte. Ltd.
Singapore

Product Categories

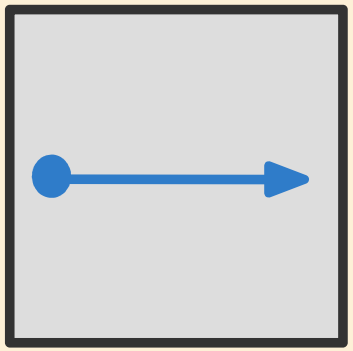
µsurf®
3D-Microscopy





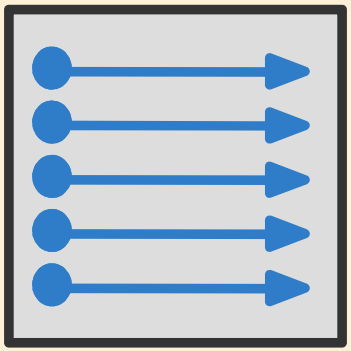
- 3D-Structure
- Wear
- Tribology

µscan®
2D-Profilometry



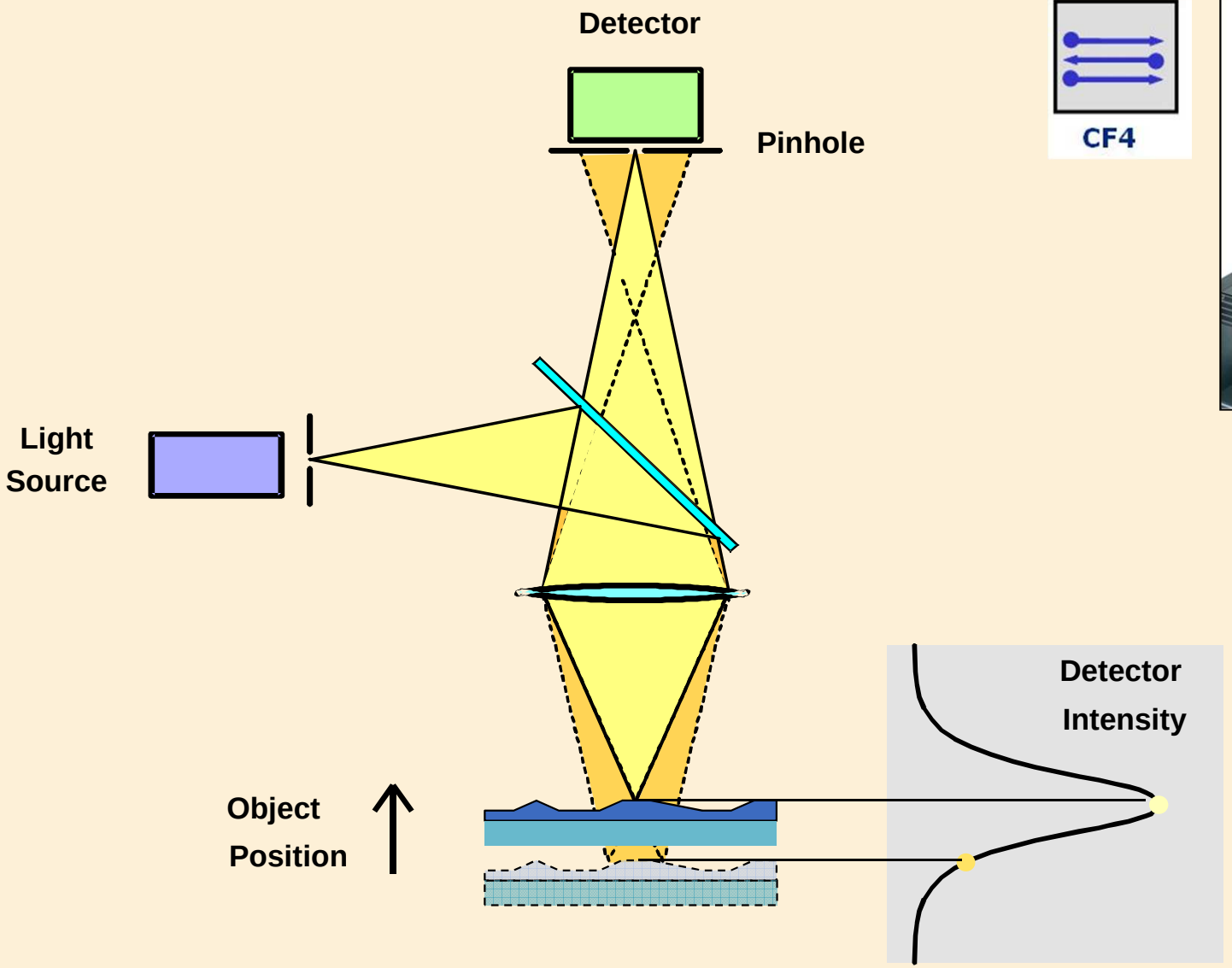
- 2D-Shape
- Roughness

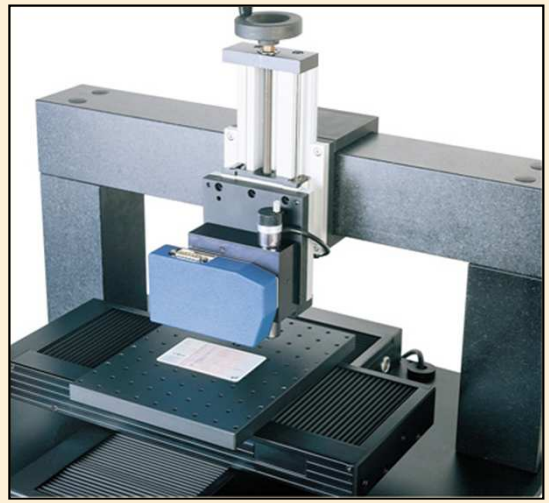
µsprint®
3D-Profilometry



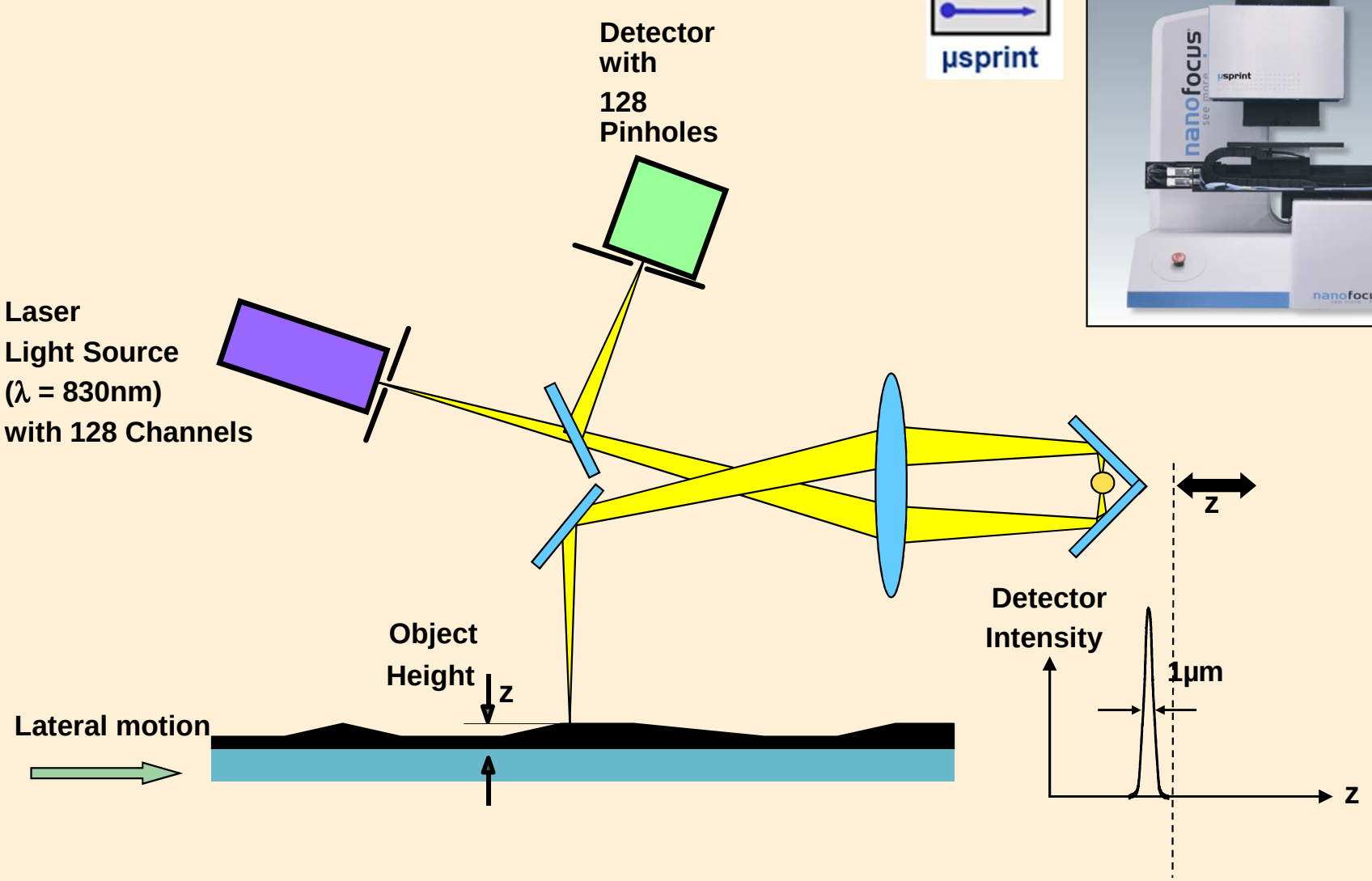
- 3D-Shape
- Defects
- Production Control

Confocal Principle

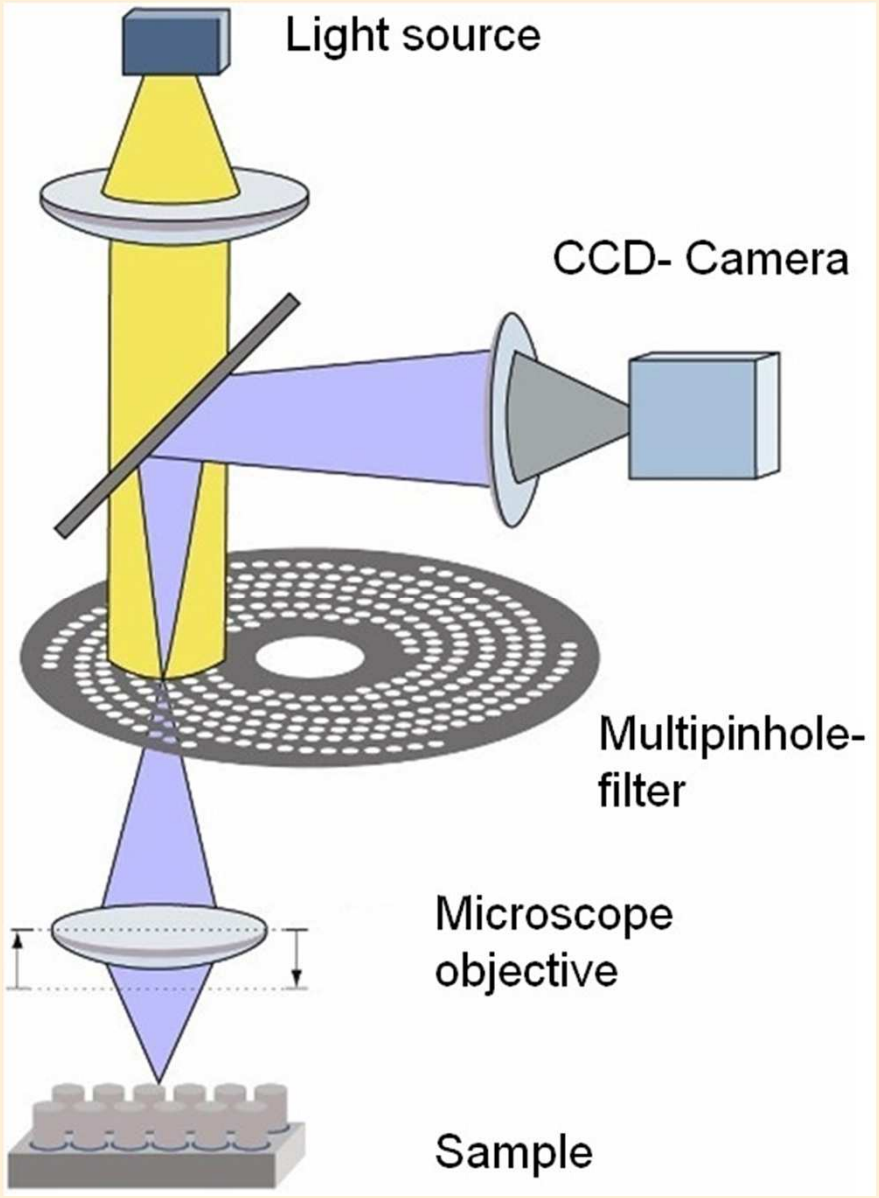




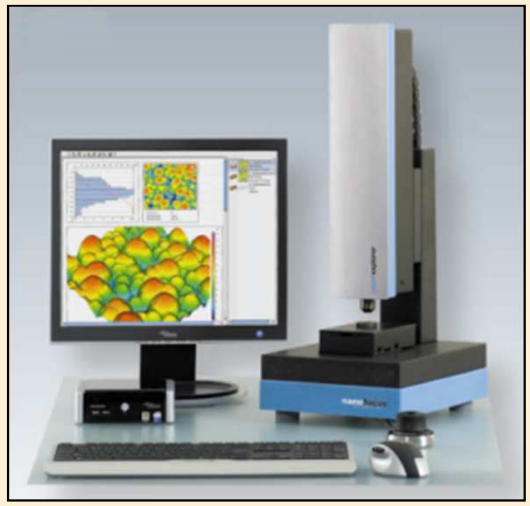
µsprint Technology

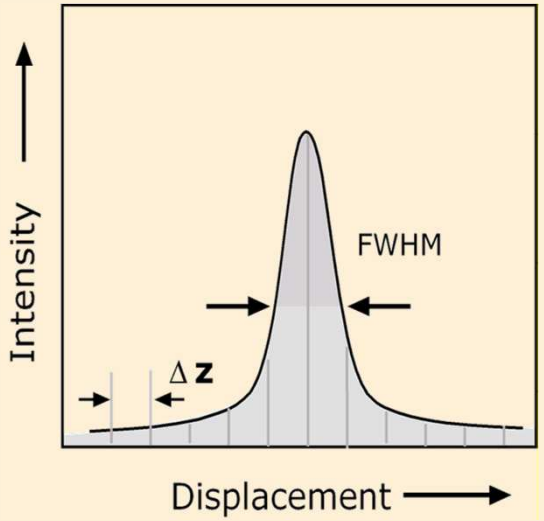


µsurf Technology



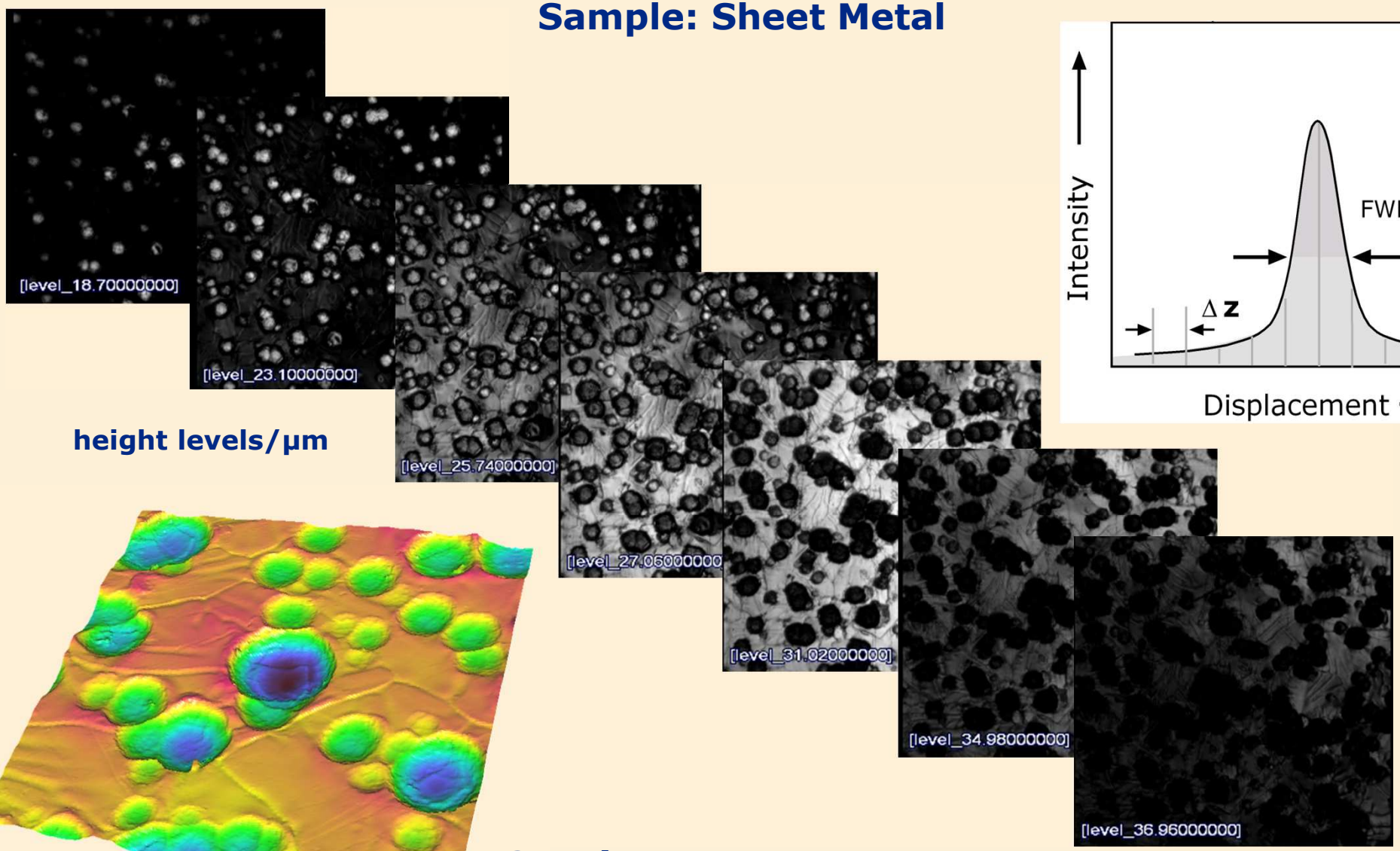
µsurf



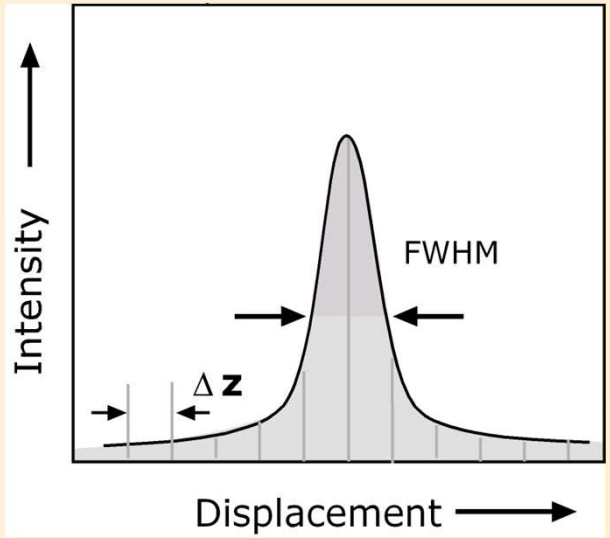


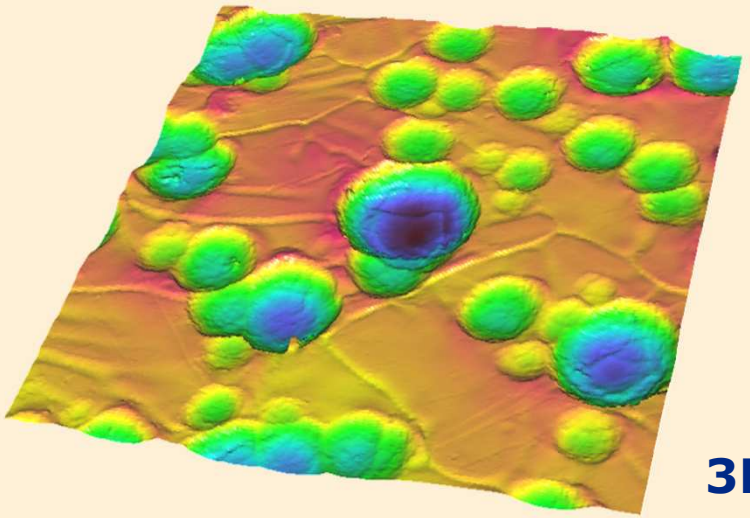
Confocal Imaging Sequence

Sample: Sheet Metal



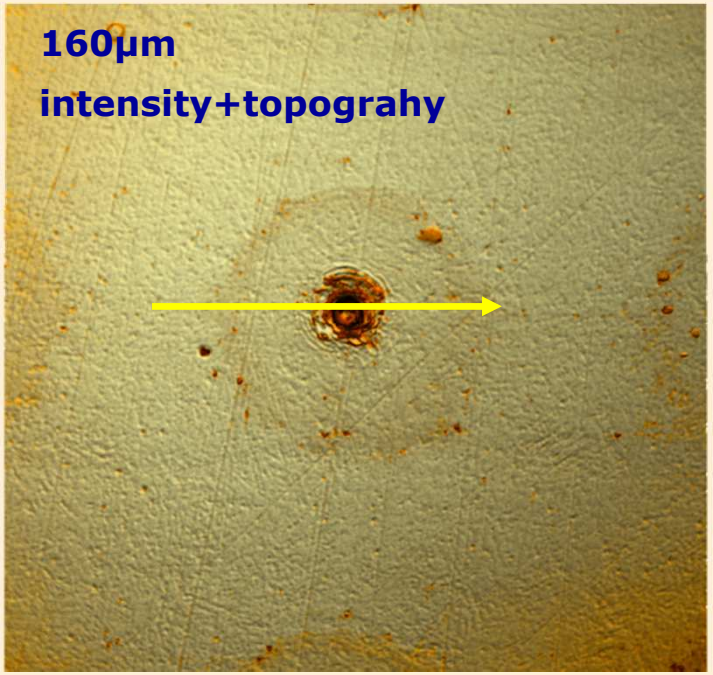
height levels/µm

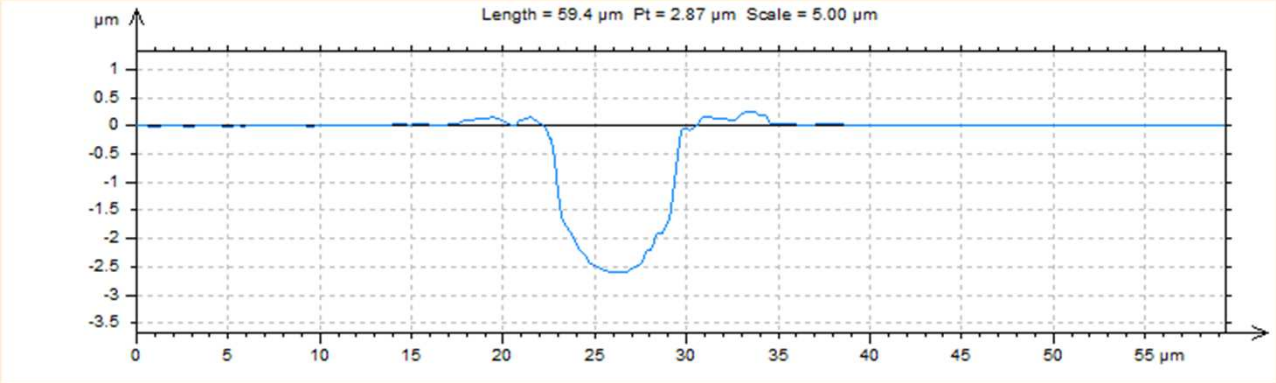




3D View

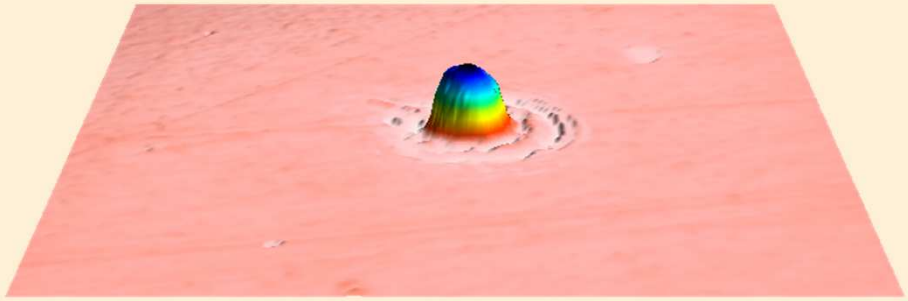
Example Laser Marking





µsurf

3f NdYAG 355nm
3-4µm focus diameter
steel



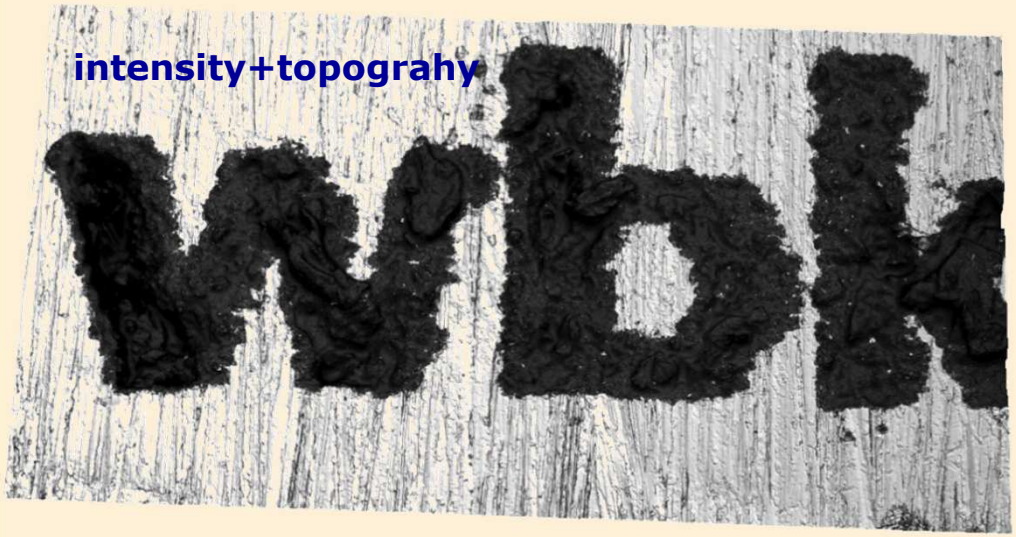
70µm, inverted

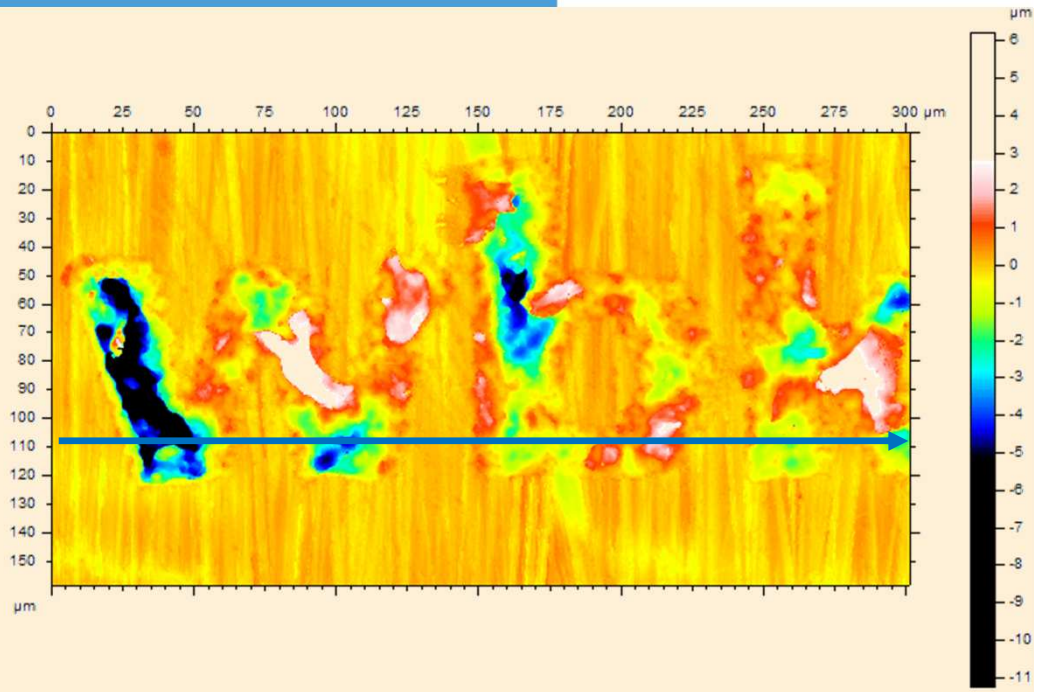
Karlsruhe Institute of Technology

Institute of Production Science

Example Laser Marking

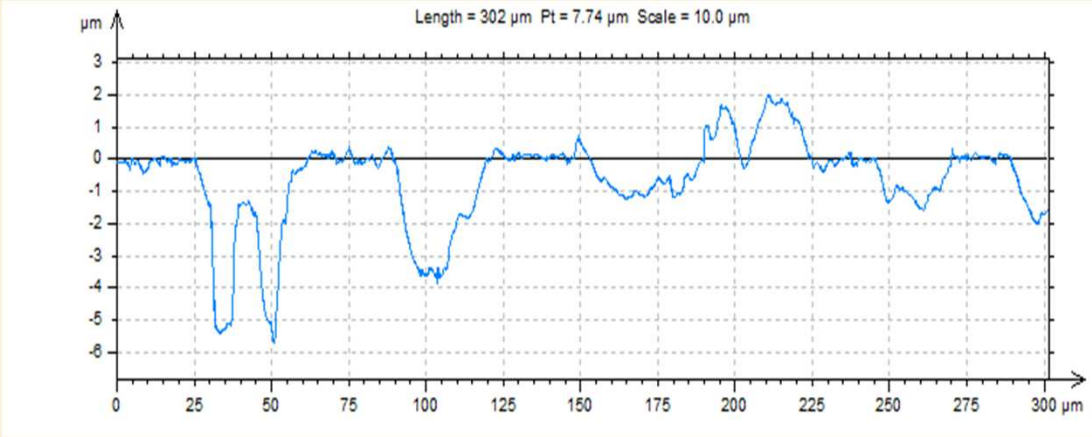
nanofocus
see more





µsurf

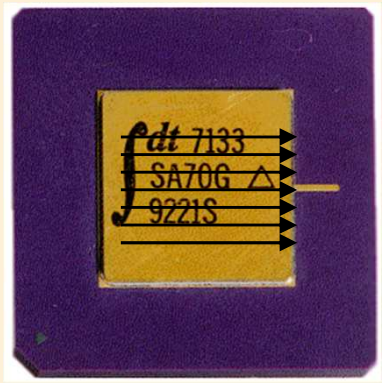
3f NdYAG 355nm
3-4µm focus diameter
steel

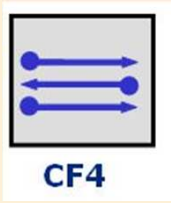


Karlsruhe Institute of Technology

wbk
Institute of Production Science

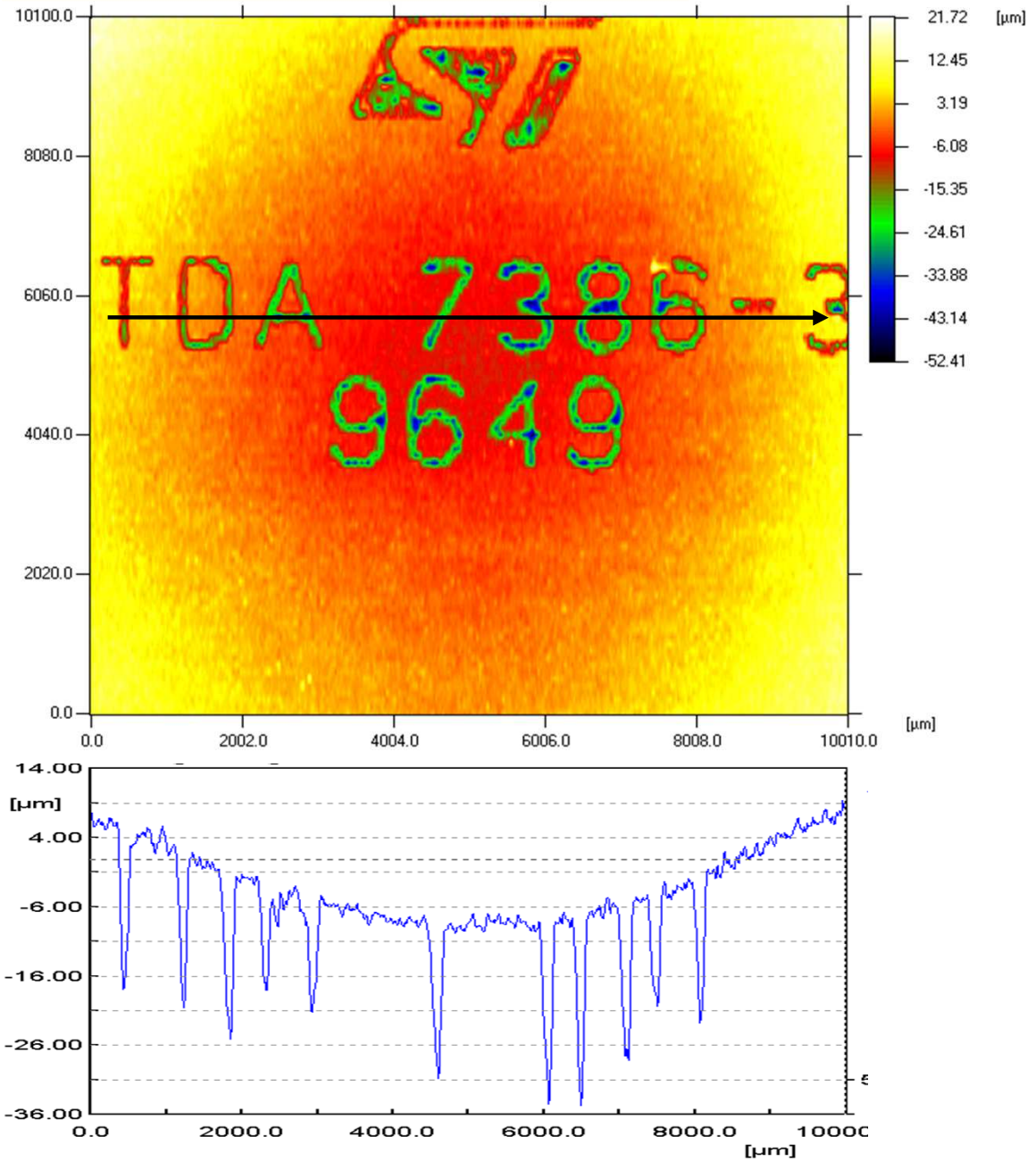
Example Laser Marking



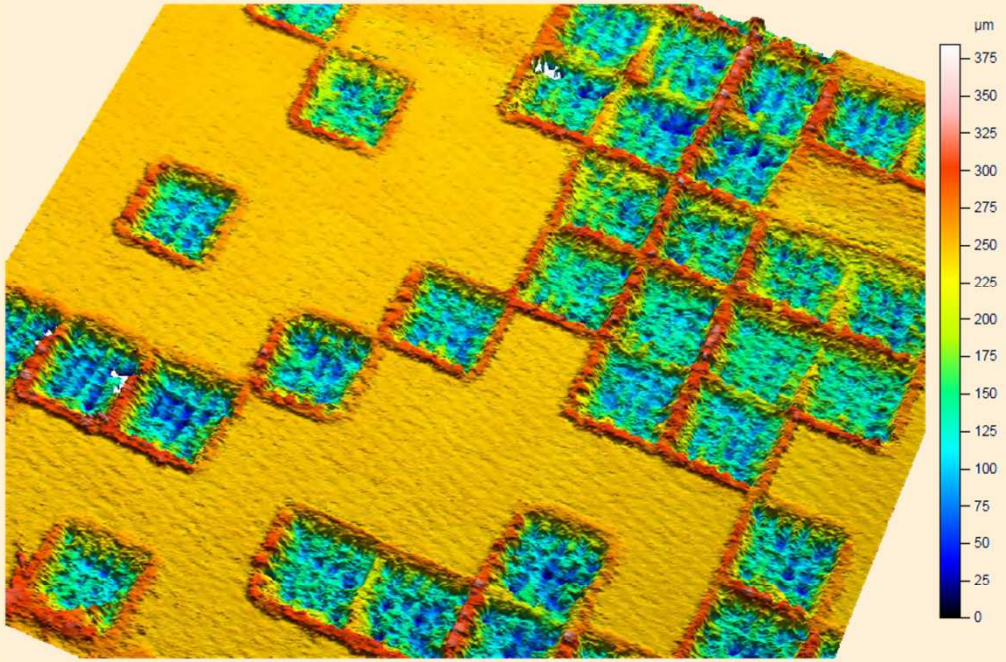


Warpage

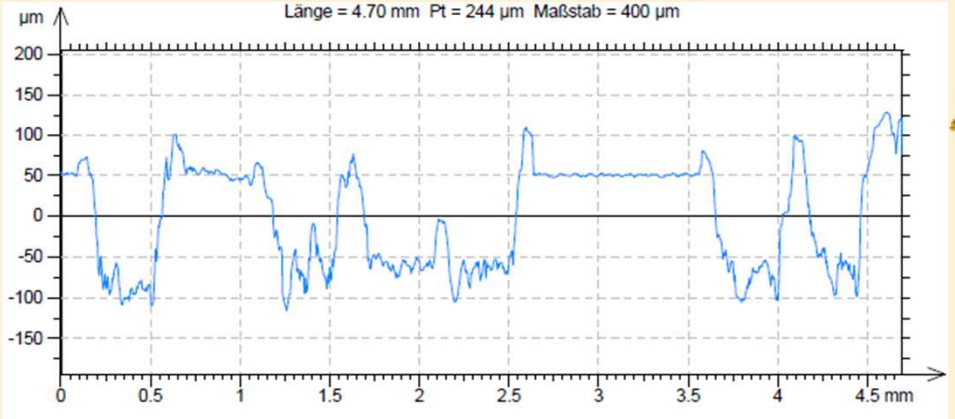
Lasermarking Profile

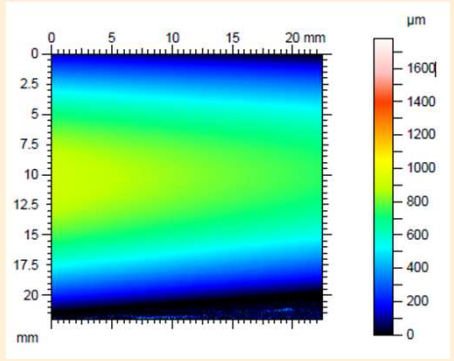


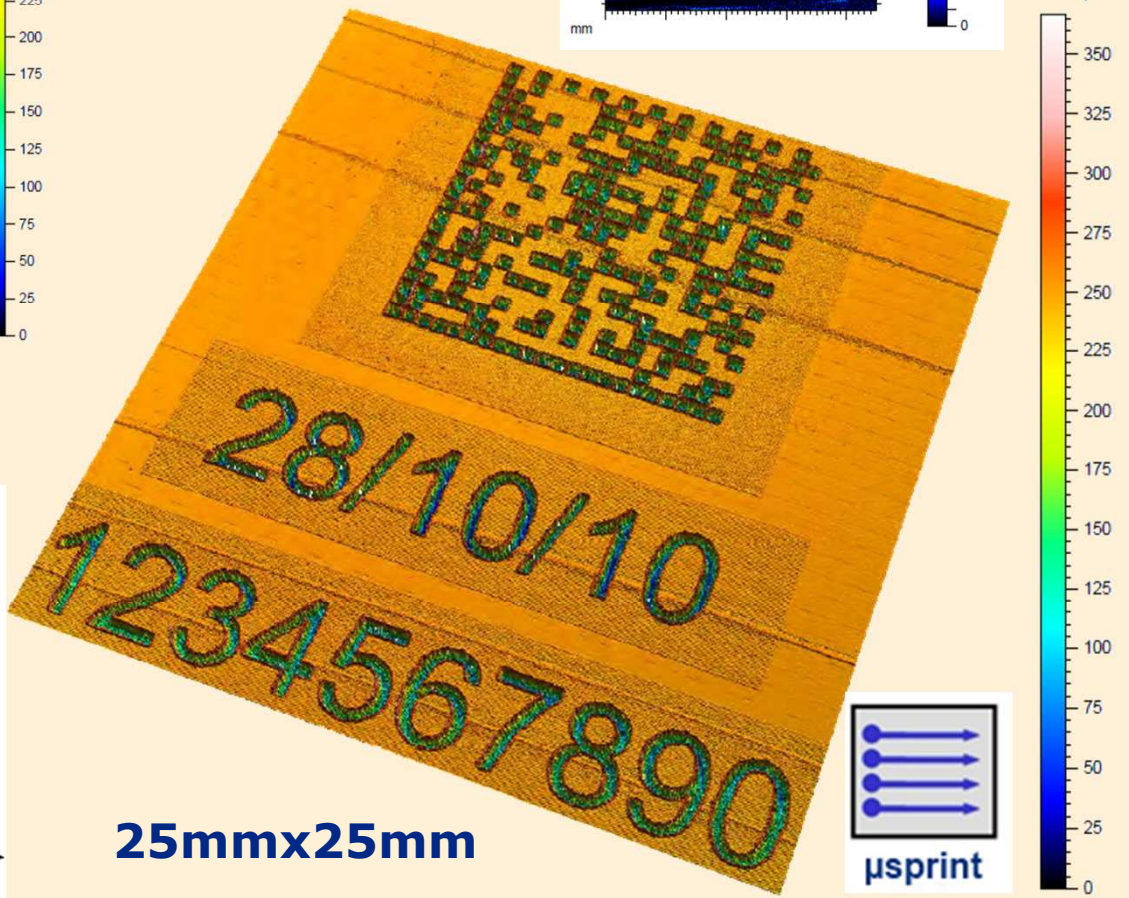
Example Laser Marking



5mmx5mm



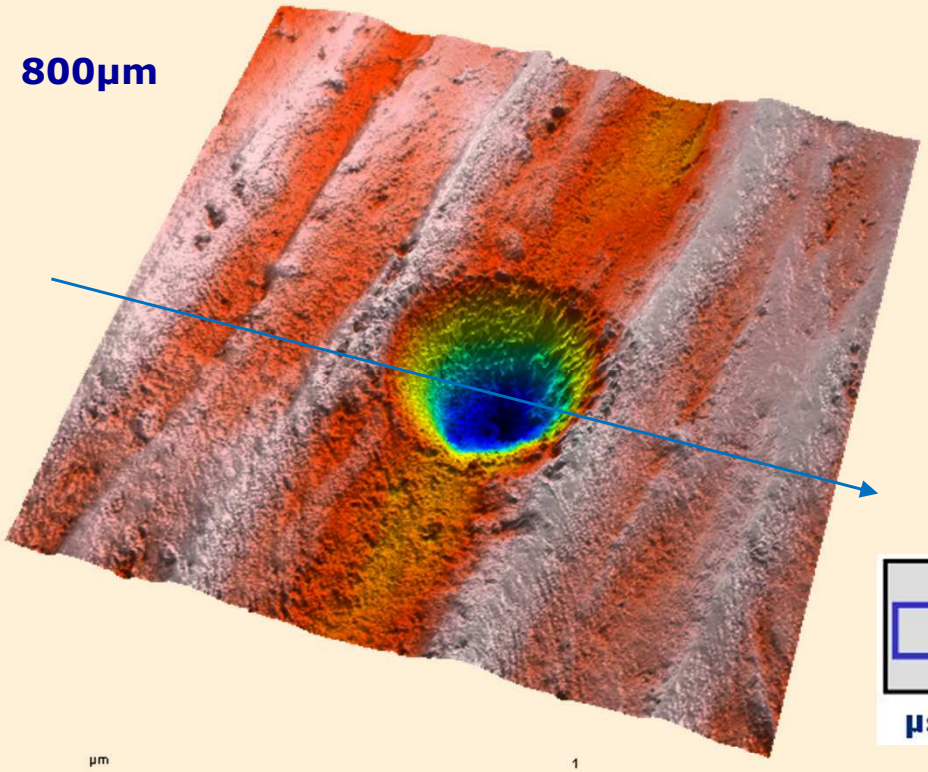




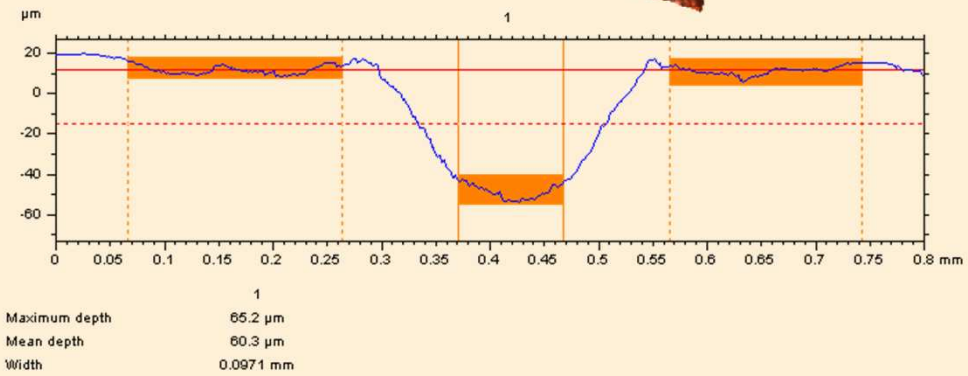
25mmx25mm

µsprint

Laser Ablation of Bone Material

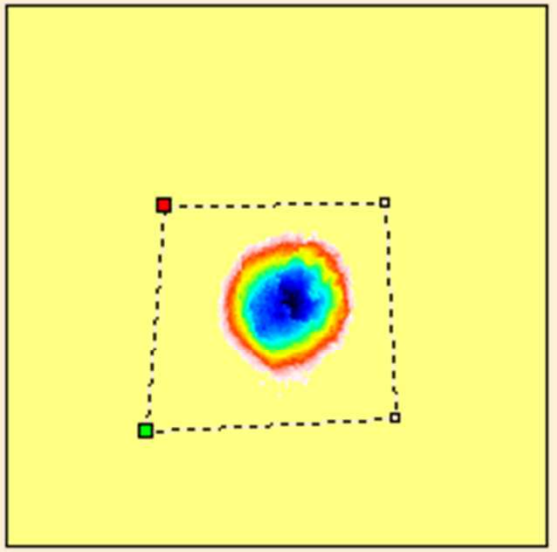


µsurf



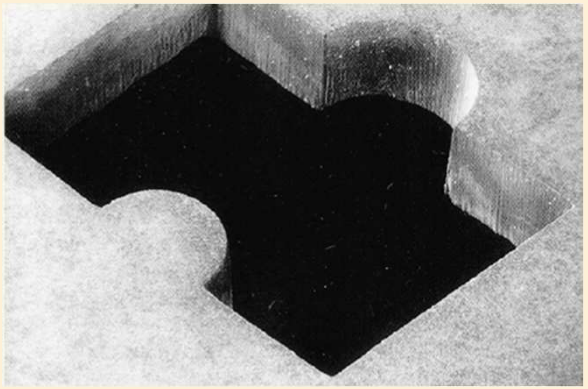
1	
Maximum depth	65.2 µm
Mean depth	60.3 µm
Width	0.0971 mm

process evaluation by depth and volume evaluation

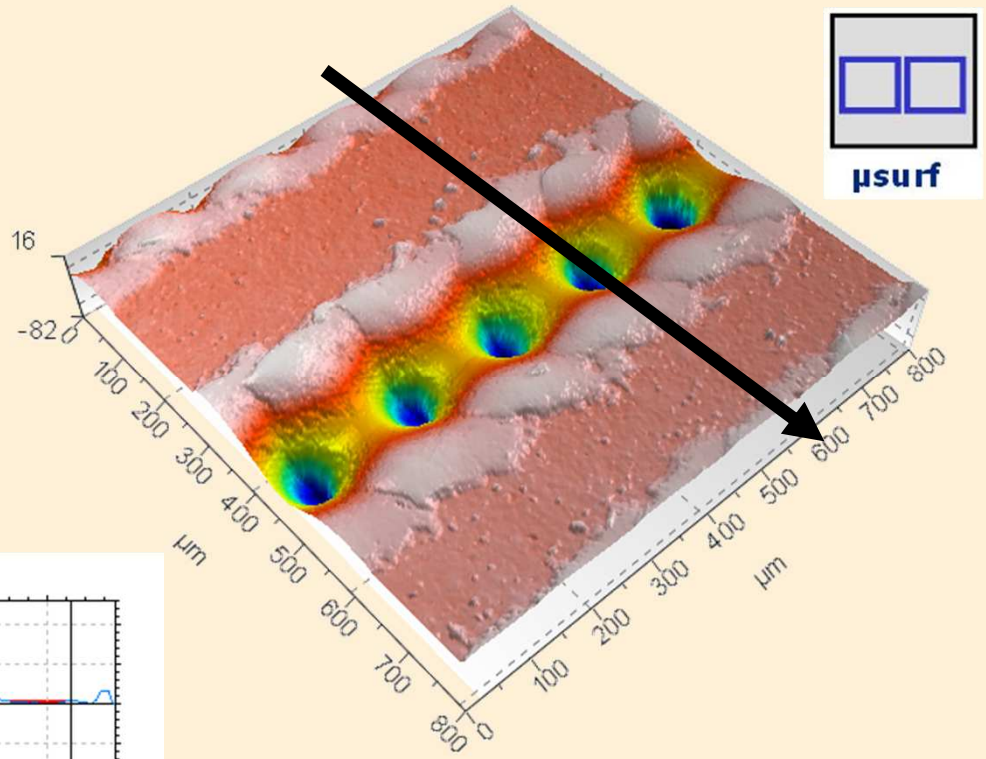


	Hole
Volume (µm³)	757608
Max. depth/height (µm)	51

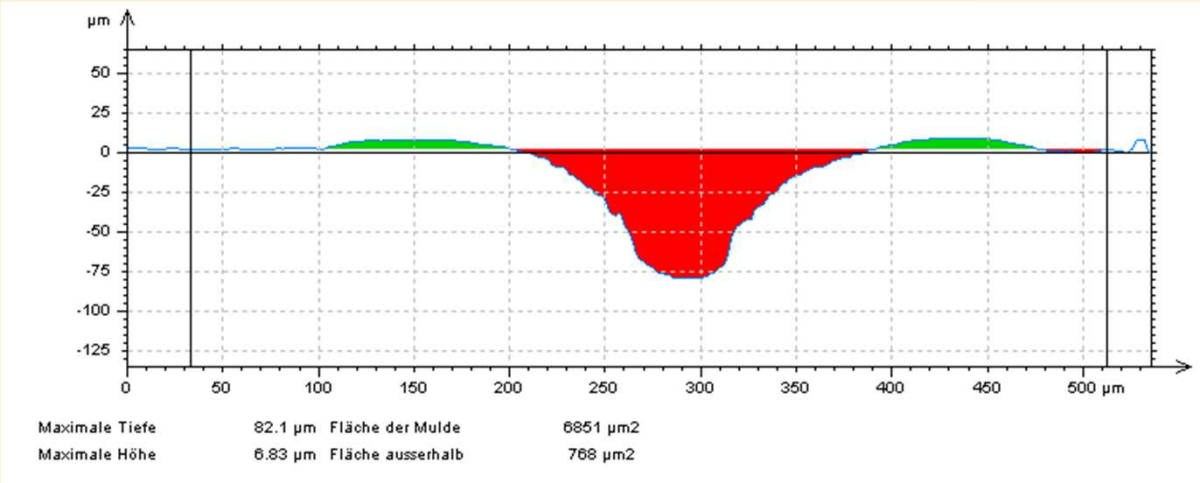
Laser Ablation of Ceramics



Quelle: LPKF.de



profile analysis

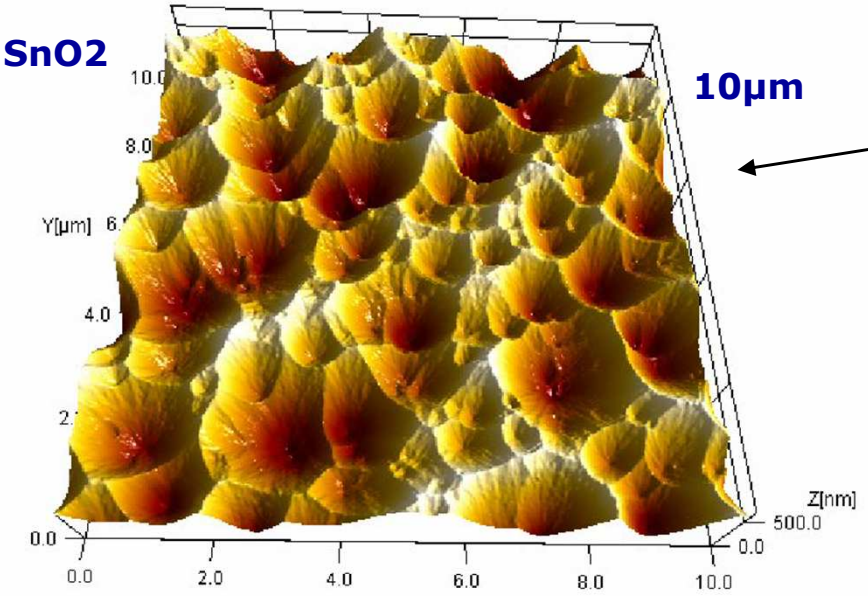


height measurement and melt area characterisation

Solar Cells (FZJ-IPV)

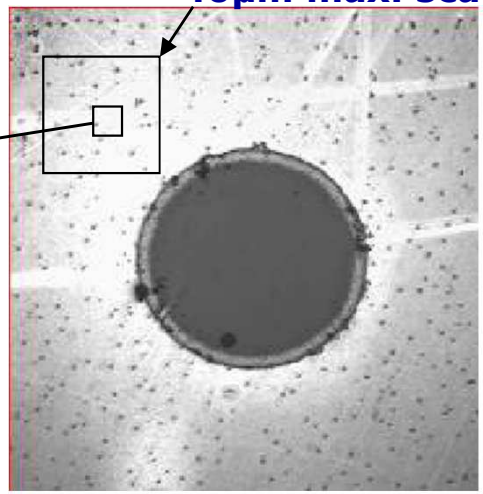
nanofocus
see more

SnO2

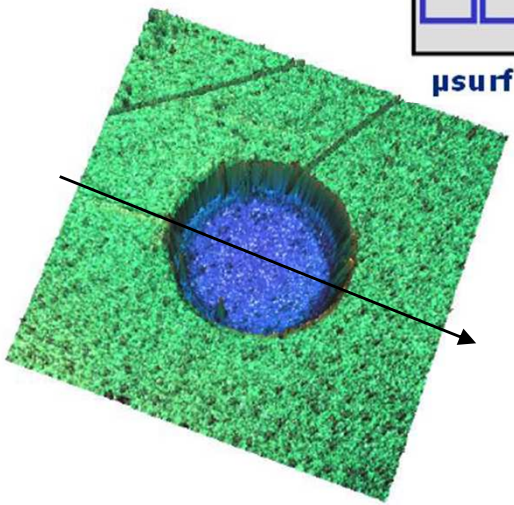


10µm

40µm max. scan range AFM



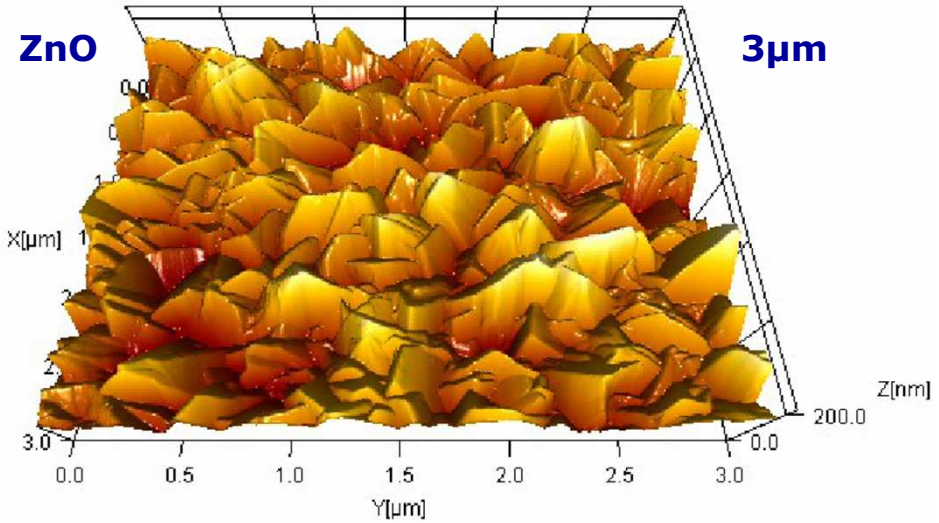
µsurf

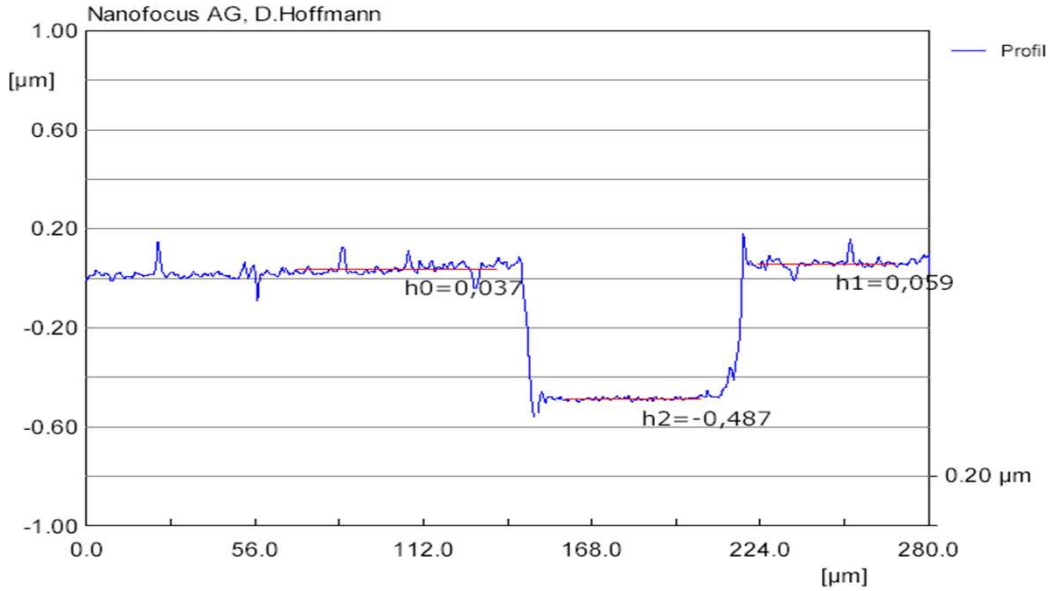


160µm

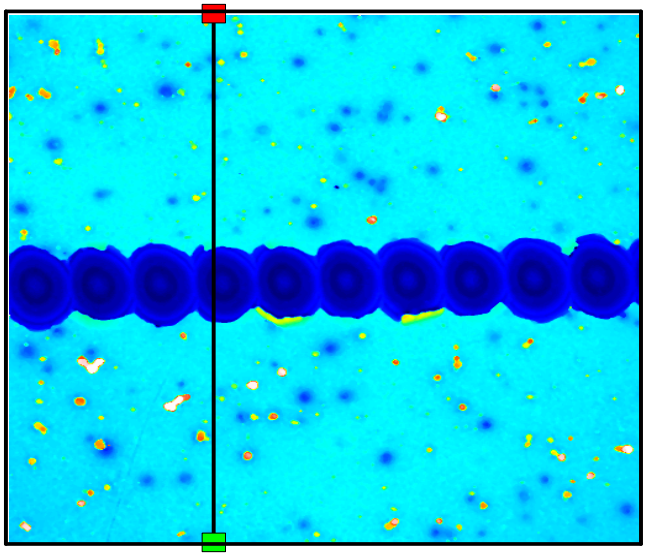
ZnO

3µm

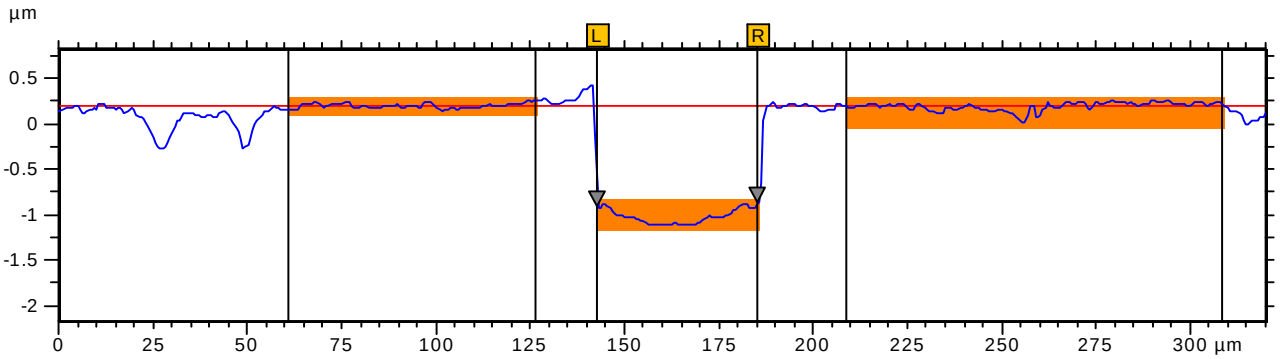




Thin-Film: Laser Scribes on Mo



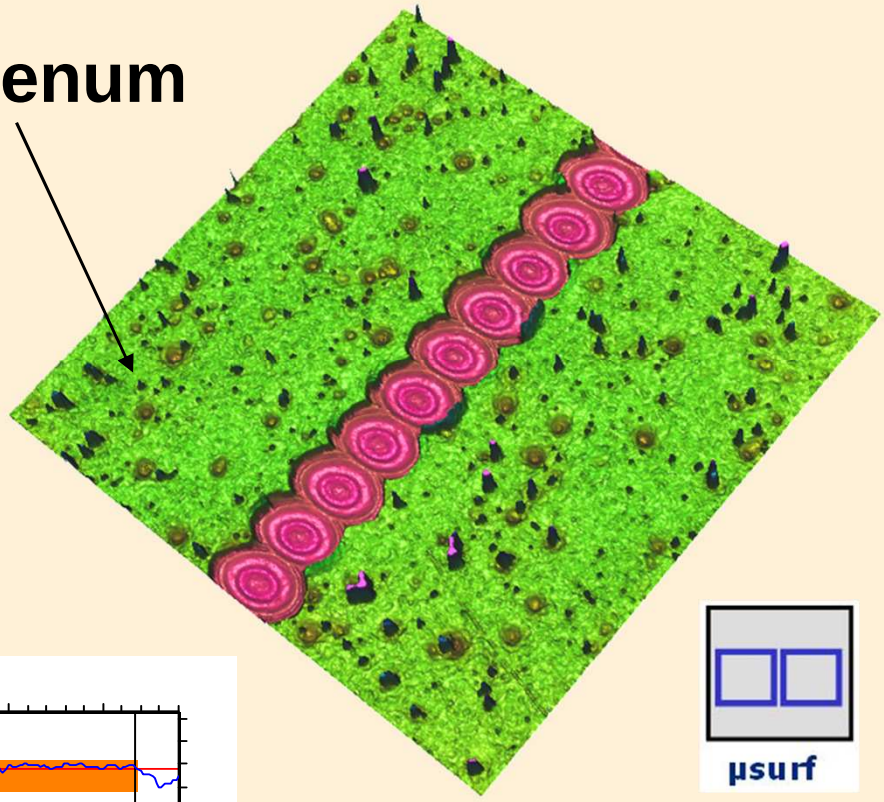
Extracted profile



	1
Maximum height	1.31 µm
Mean height	1.21 µm
Width	43.2 µm

quality assurance of laser texture

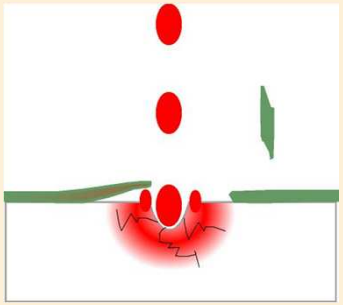
Molybdenum



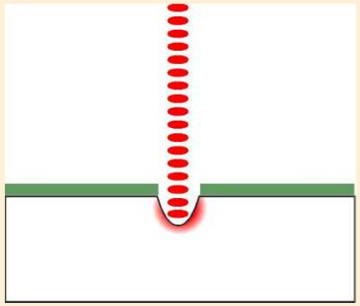
µsurf

320S

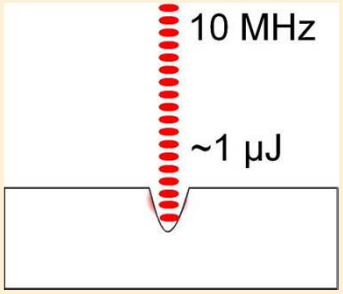
Laser Direct Patterning

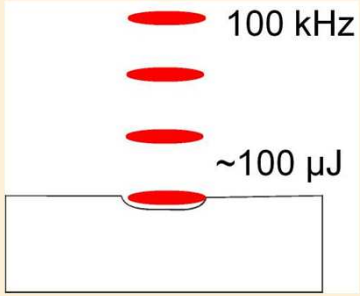


Nano second



Ultra short

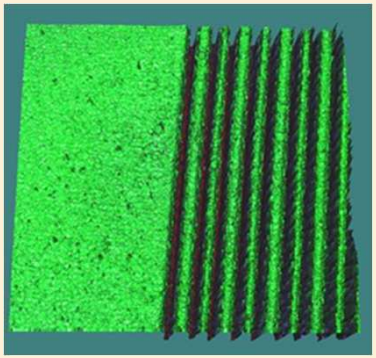




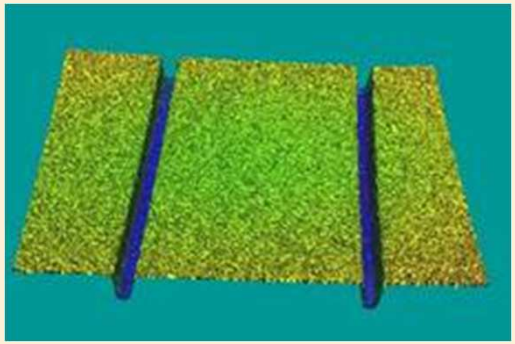
Traditional way to process thin films
- Lithographical process
- Typical Multi step process
  - High investment cost
  - Masks required
  - Inflexiable
  - Chemicals required

Laser assisted patterning process
- Typical 1-2 step process
  - Lower investment cost
  - No masks required, Flexiable
  - No chemicals required

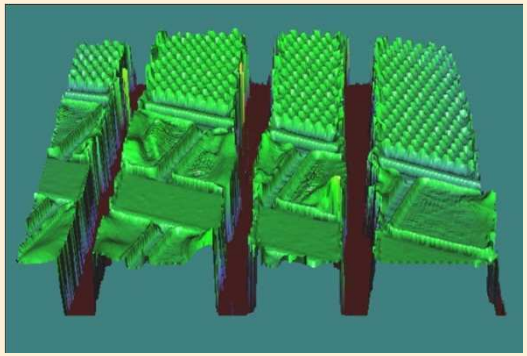
ITO on Glass
- Groove depth: 0.25µm
- Groove width: ~8µm



SnO on Polymer
- Groove depth: 0.6µm
- Groove width: ~12µm



low-k + Al pads
- Groove depth: 8.7µm
- Groove width: 28.3µm

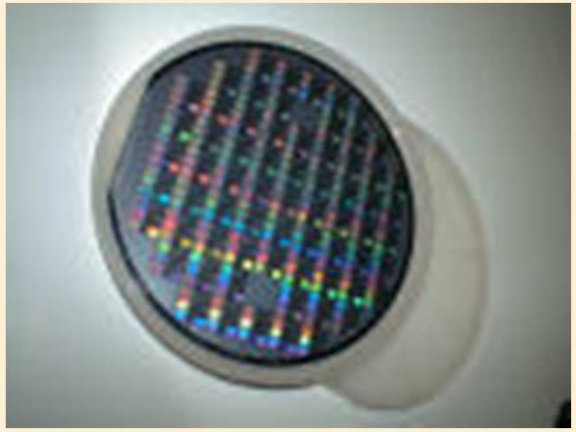


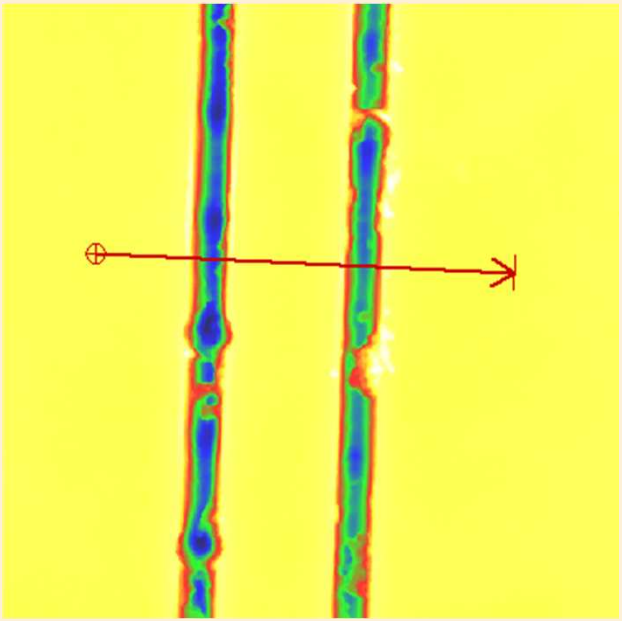
µsurf

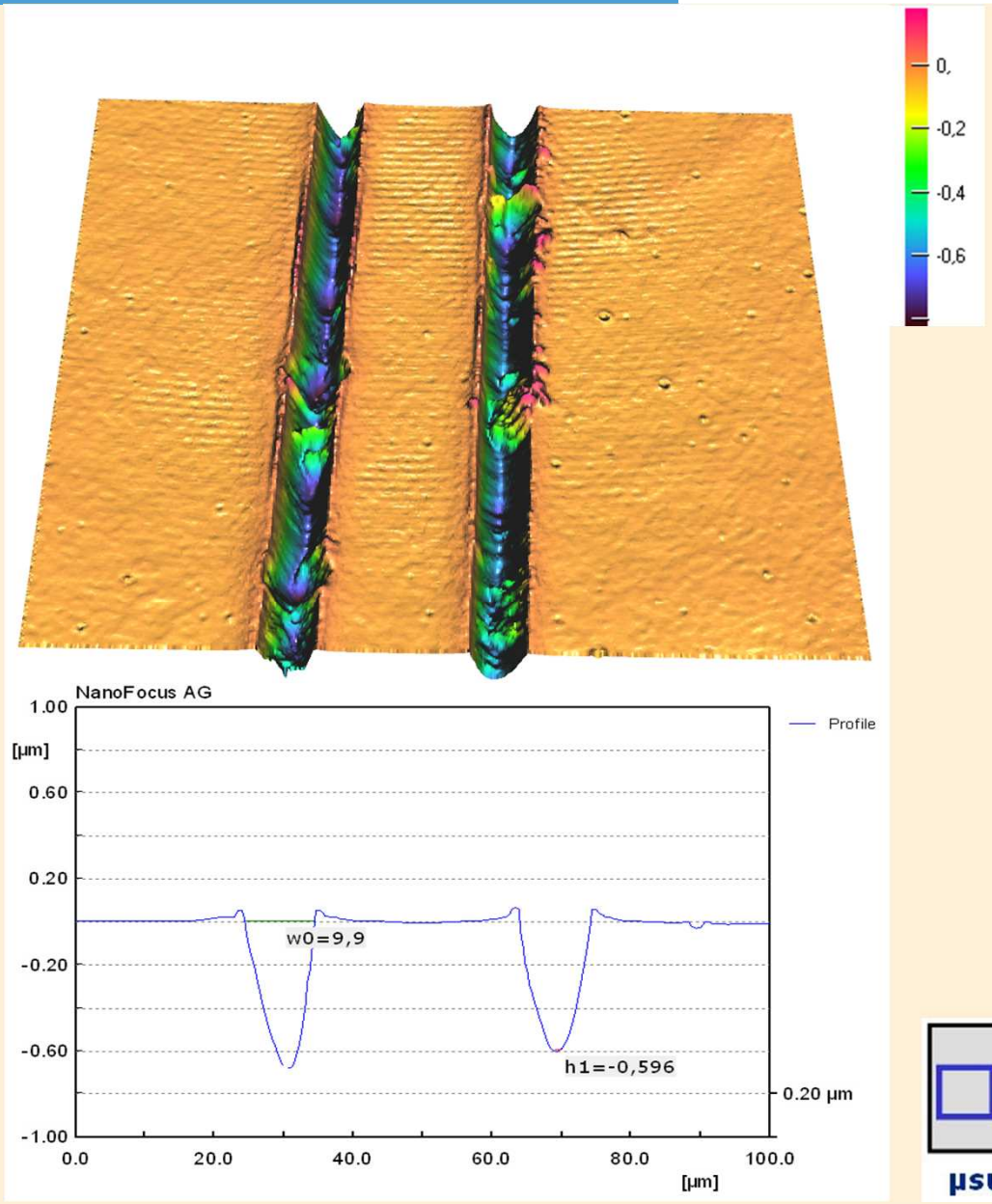
CORELASE

Rofin

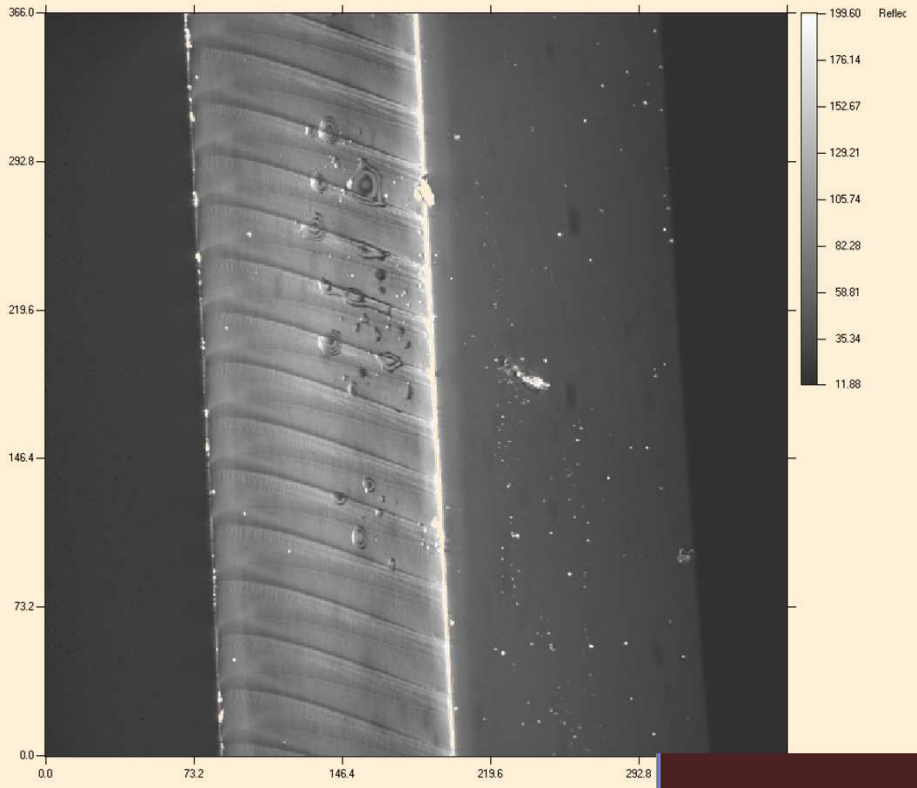
Wafer Laser Cutting

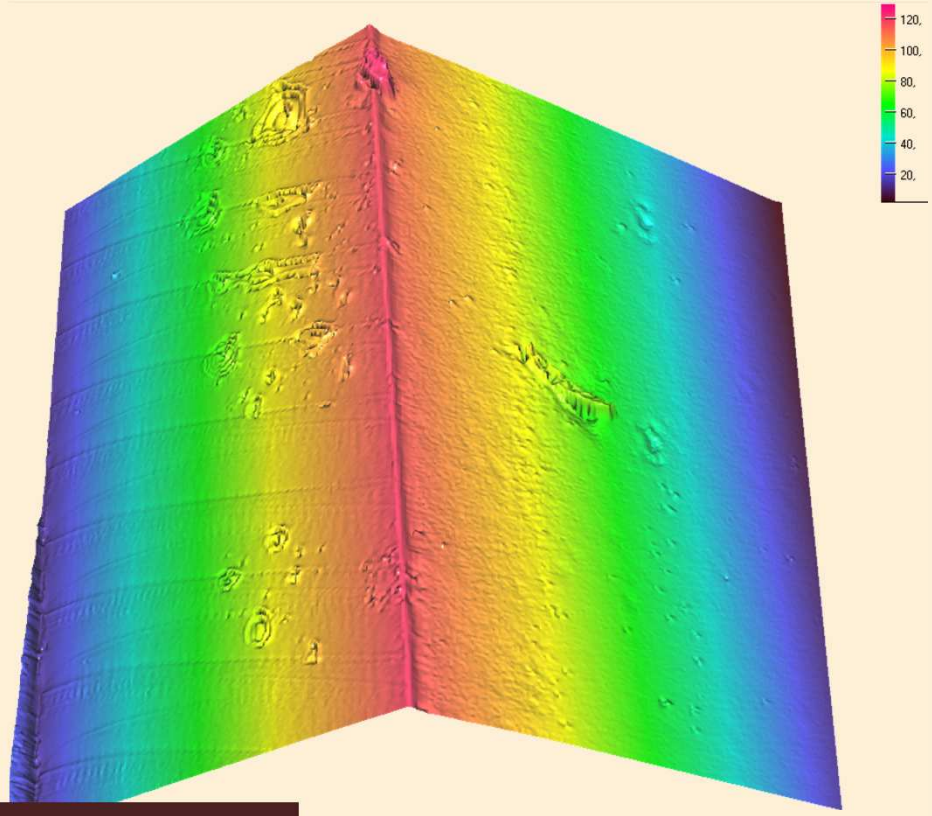




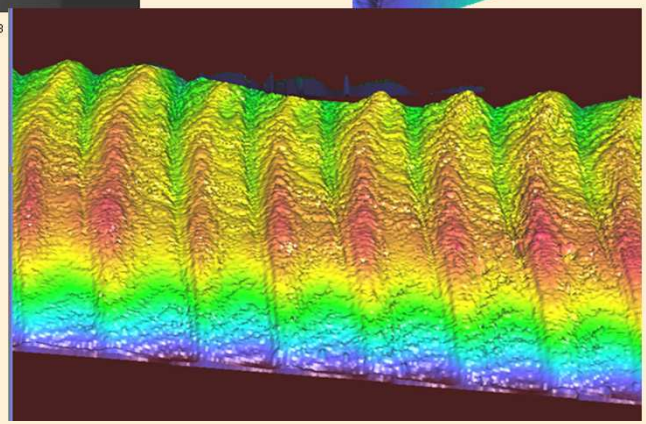


Laser Cutting (thermal stress)





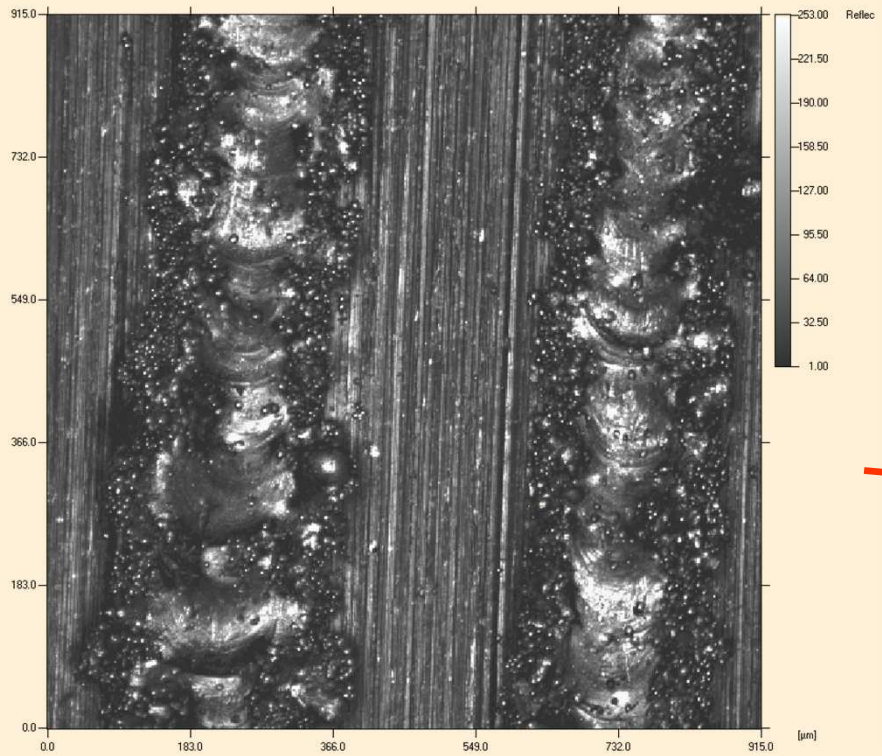
320S

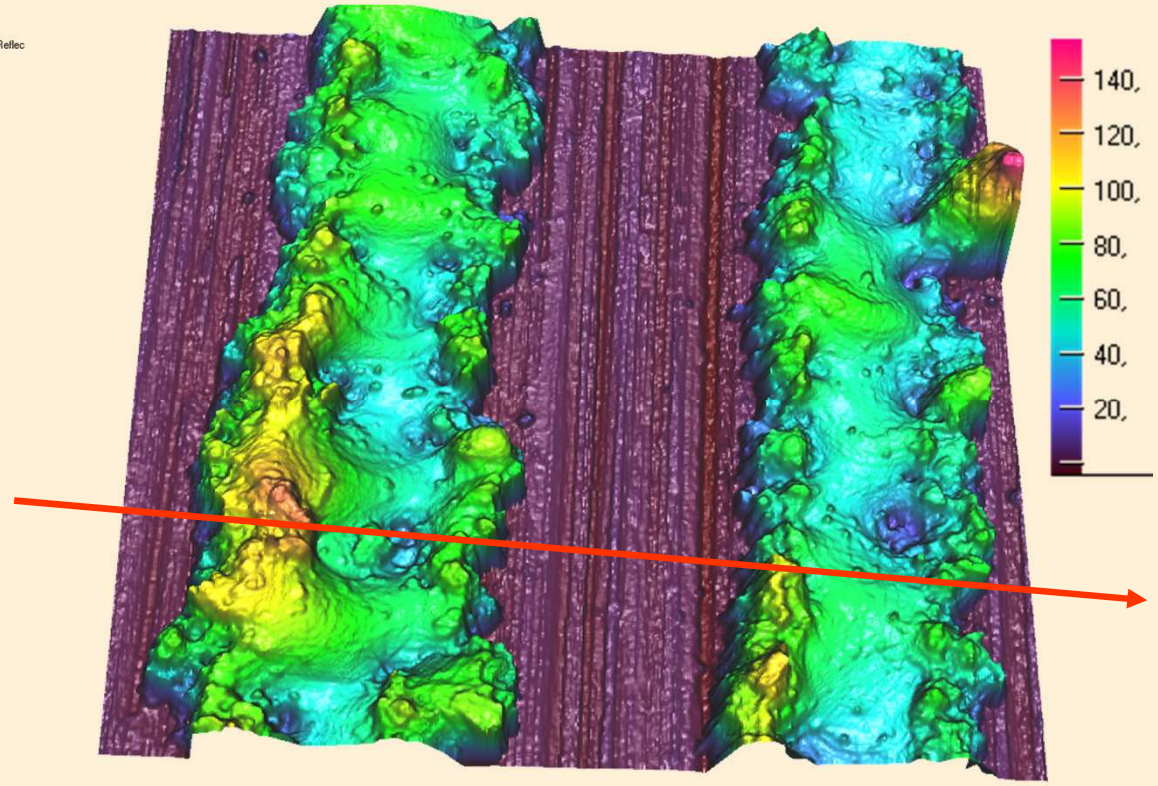


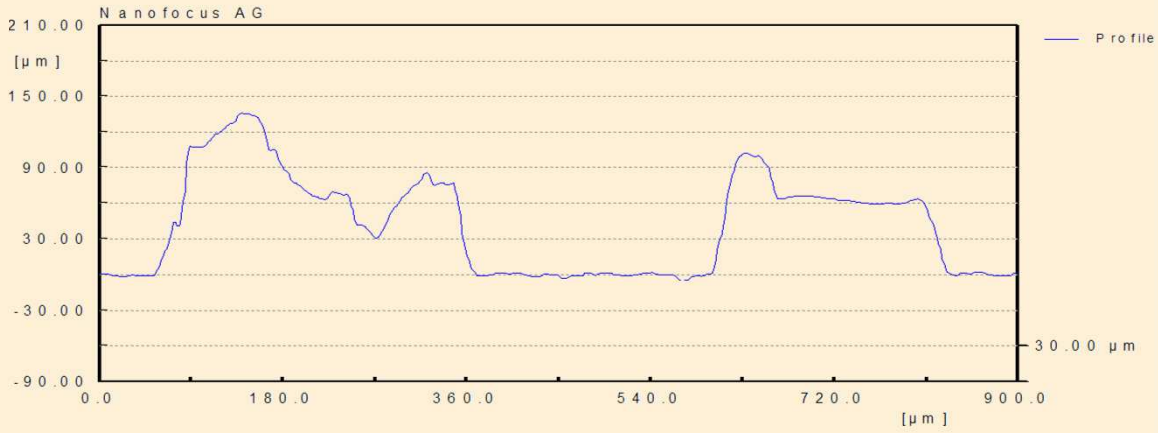
160S

µsurf

Laser Welding

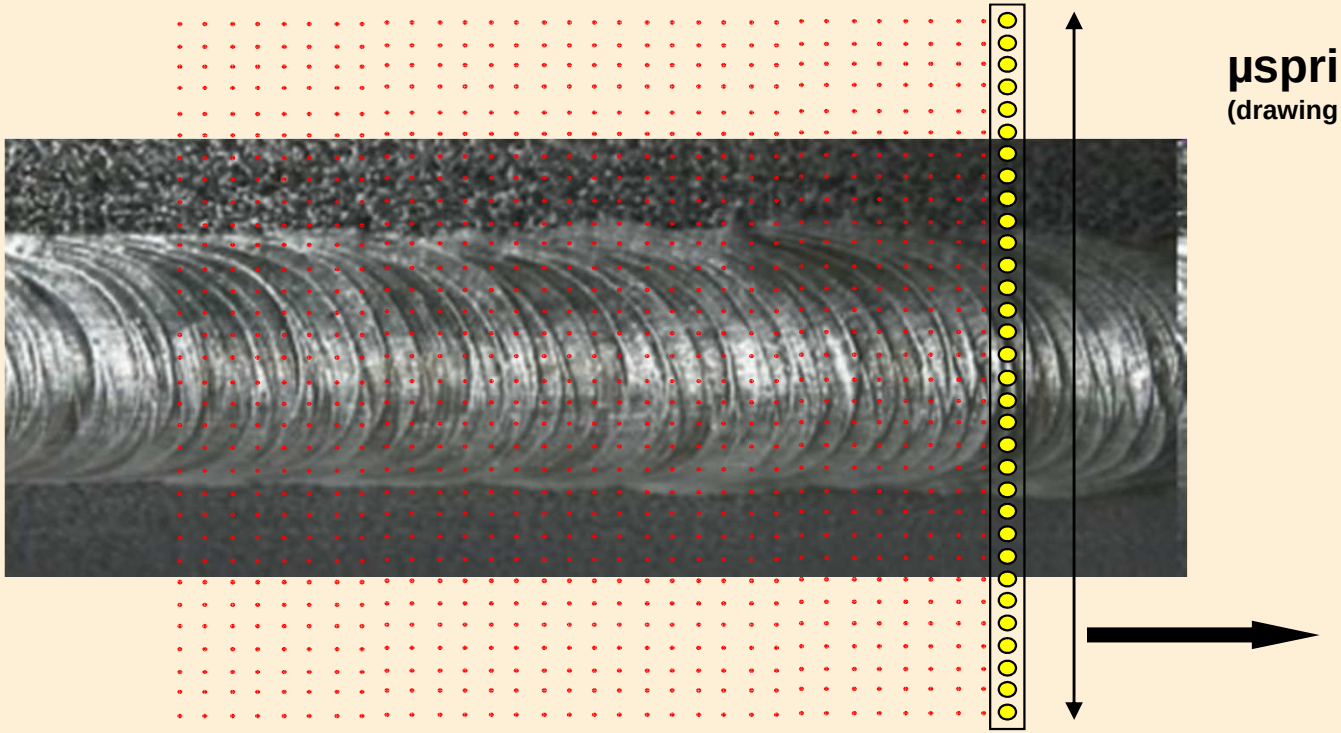






µsprint Technology

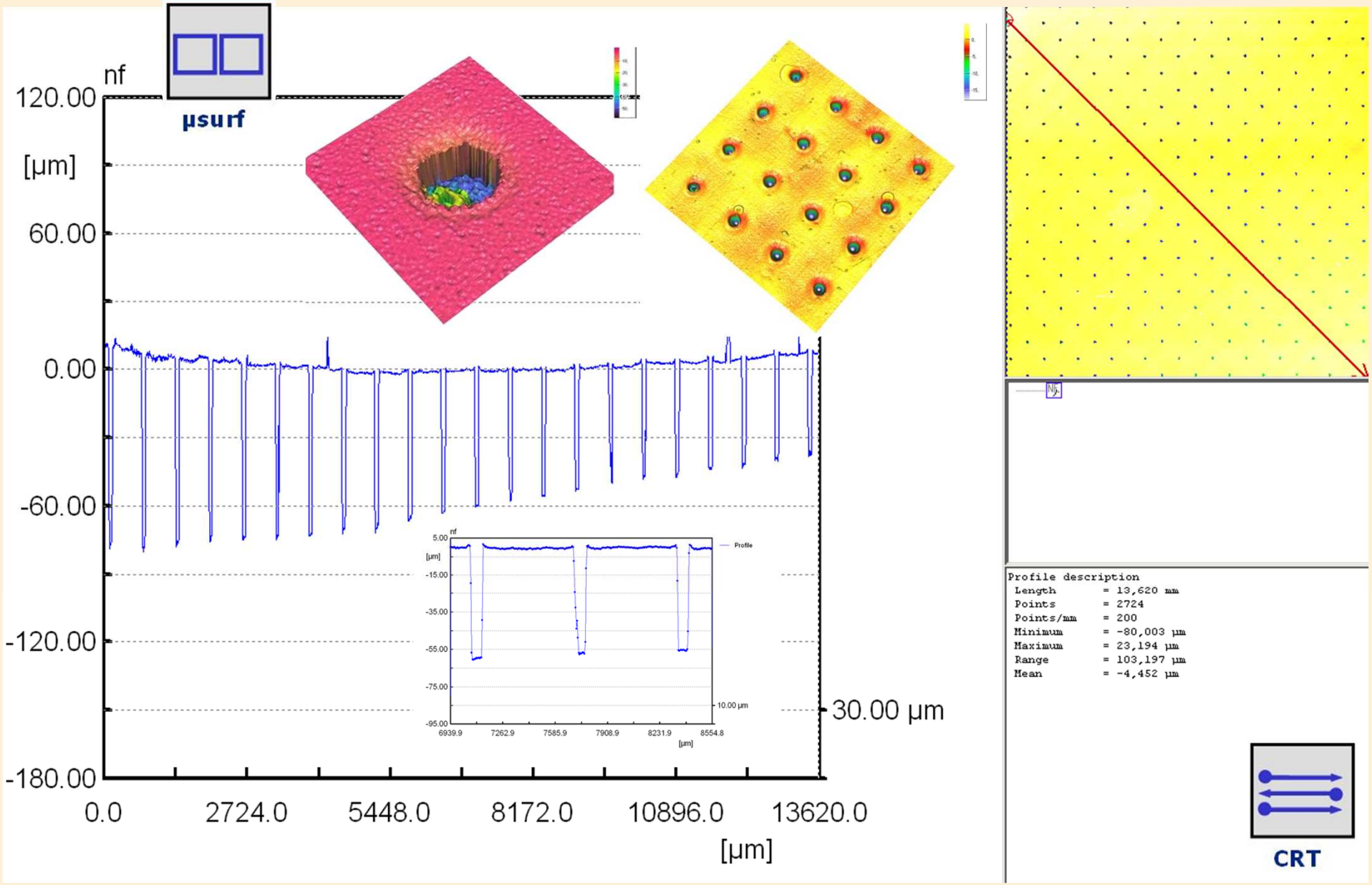
- 128 parallel channels
- Standard scanning velocity 54mm/s
- Measurement spot diameter 1µm



µsprint Scanning Principle
(drawing not true to scale)

µsprint

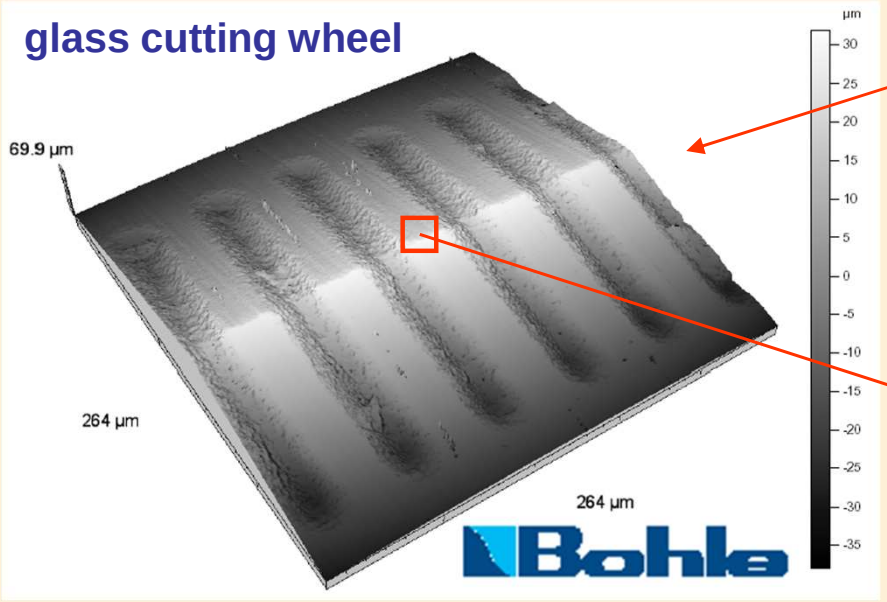
PCB: Laser Drilling Microvias

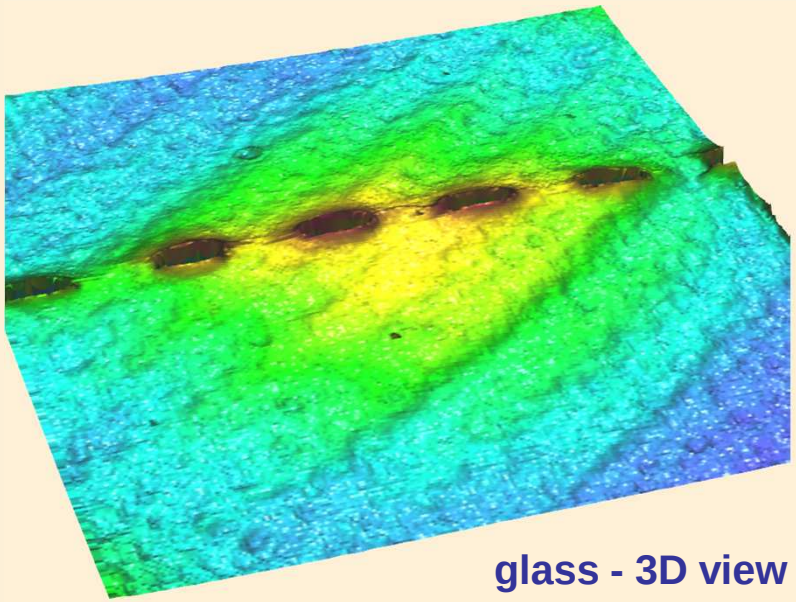


Laser Machining

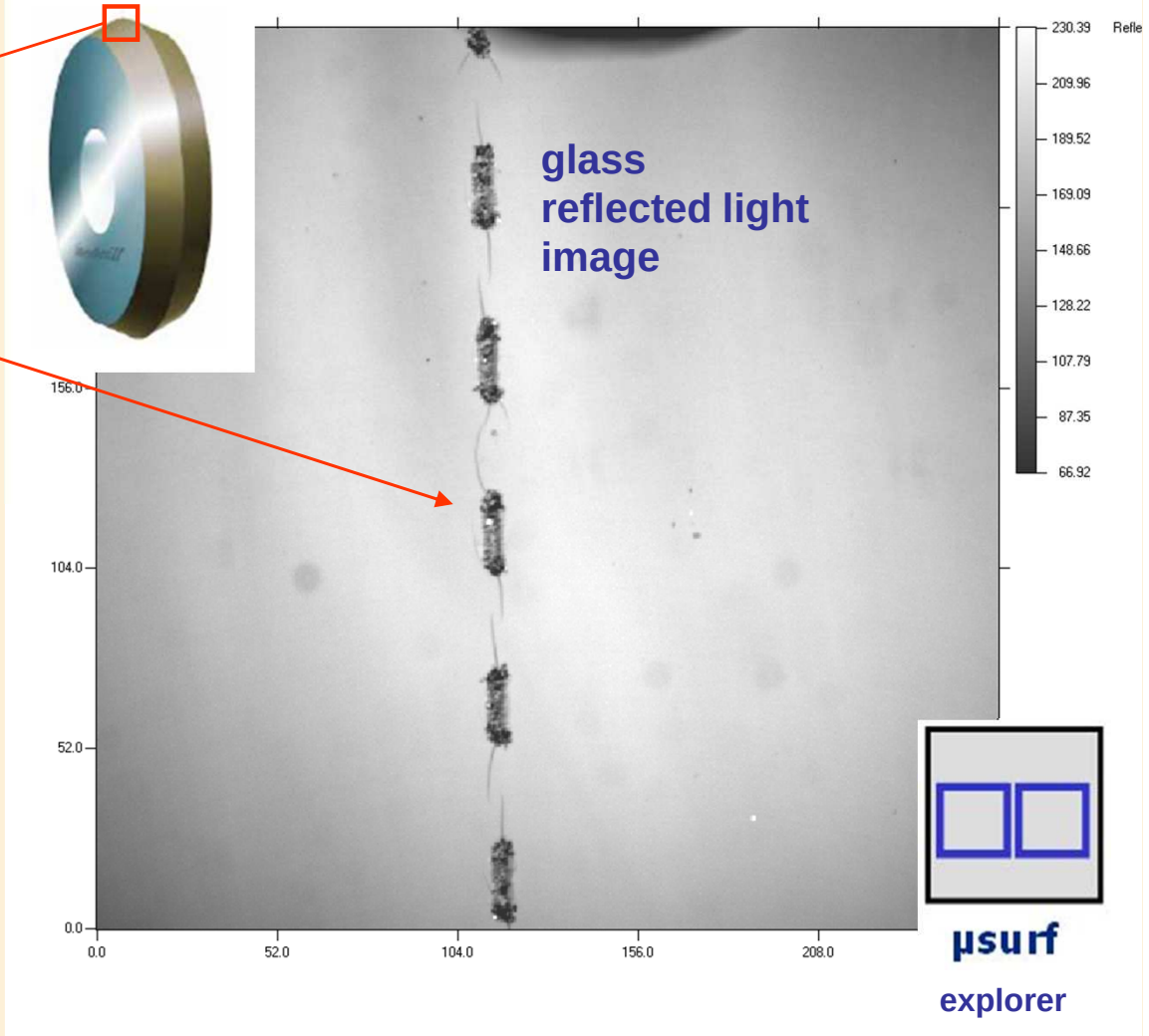
nanofocus
see more

glass cutting wheel

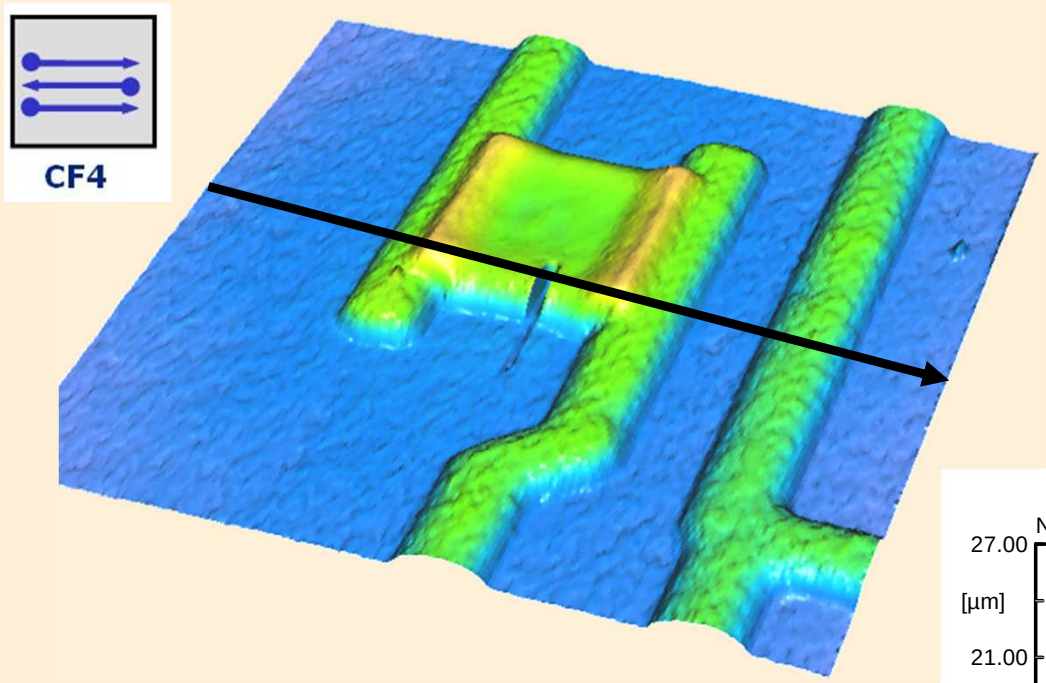




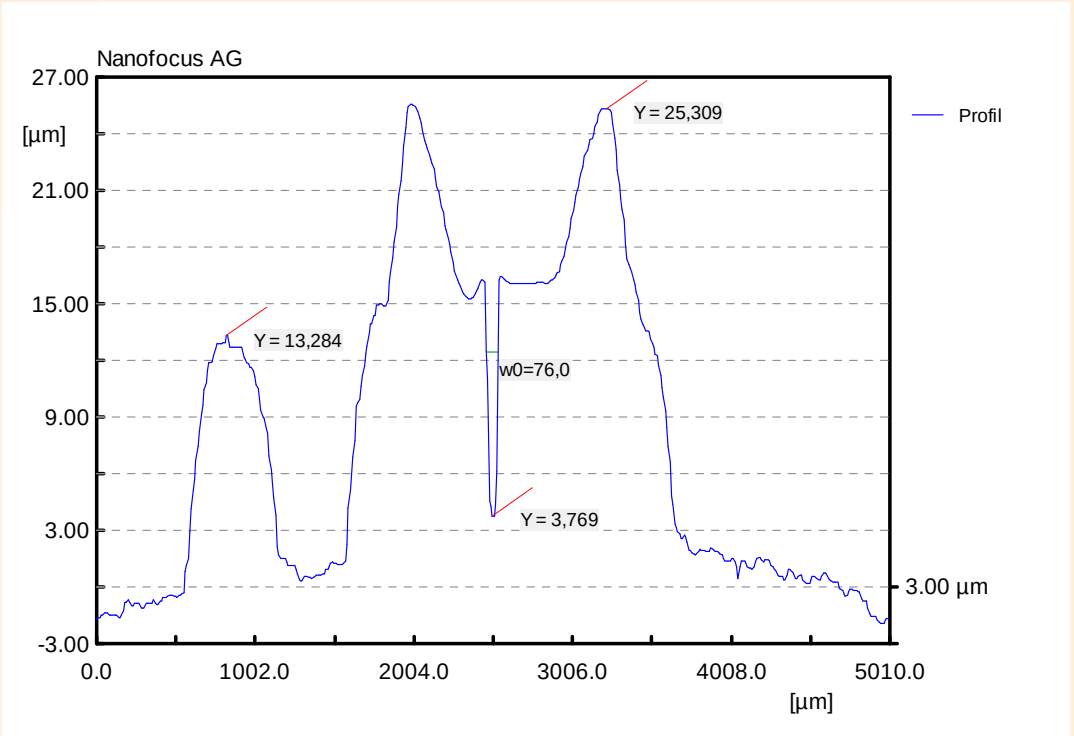
glass - 3D view



Thickfilm application



Laser trimming of resistor

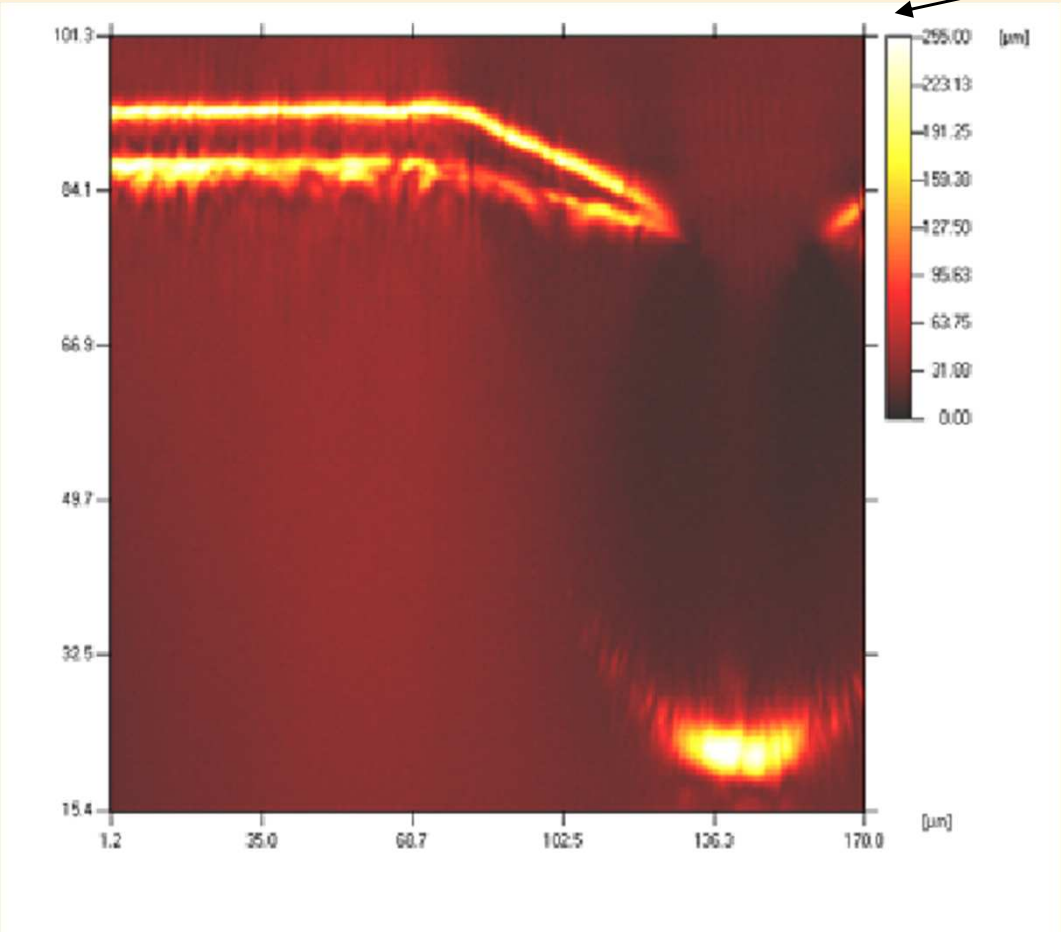


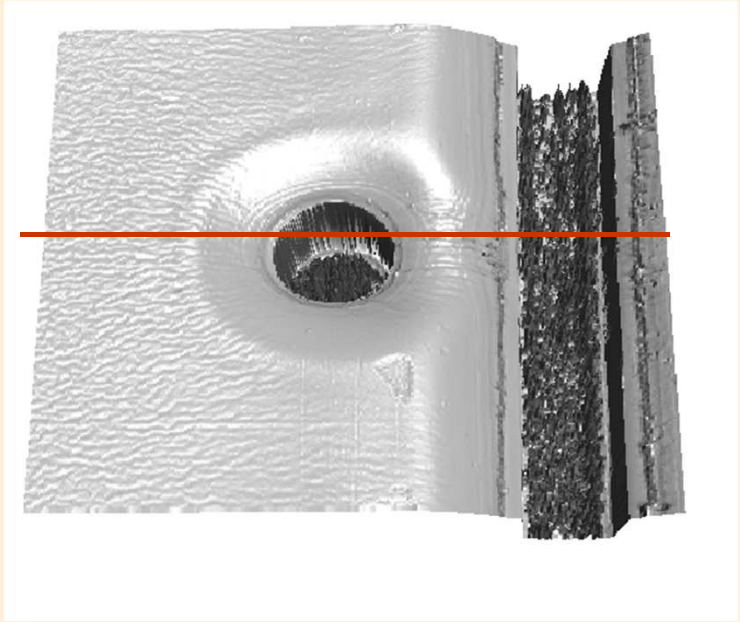
Measurement of thickfilm resistors and conductor lines

- **height**
- **width**
- **volume**

Glass with Coating and Hole

confocal cross section



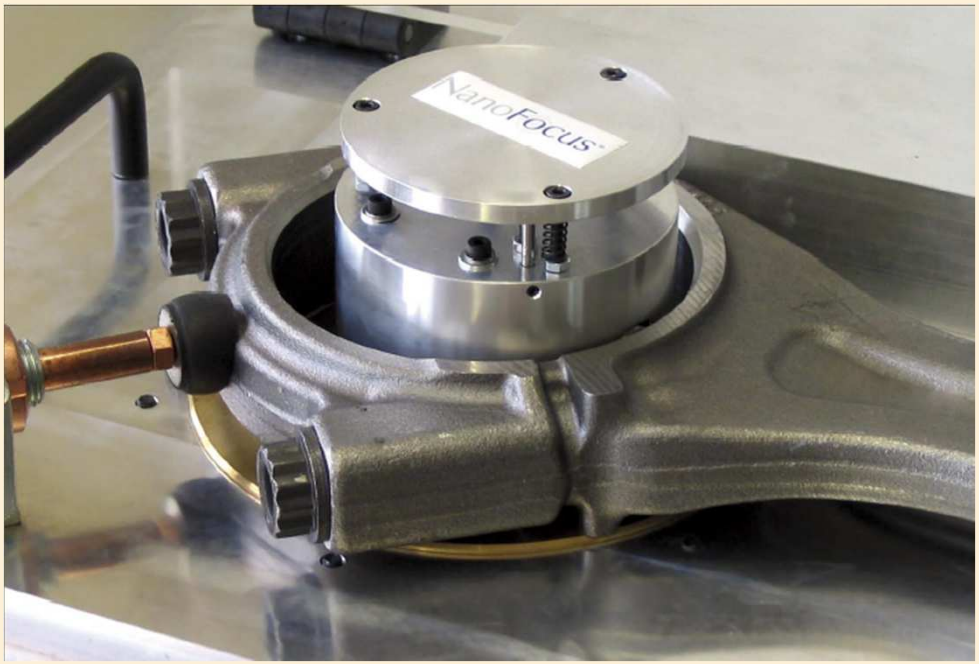


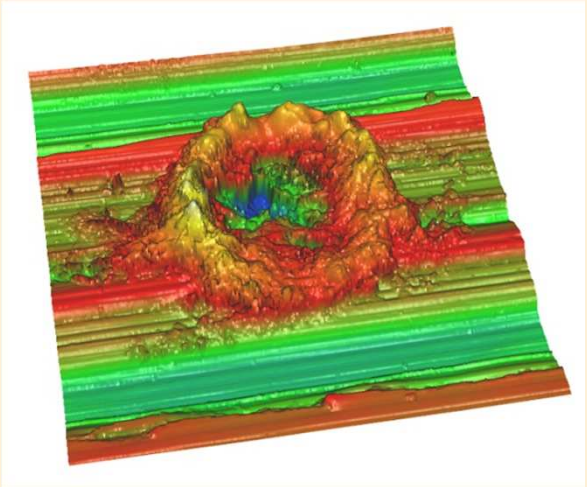
hole in coated glass

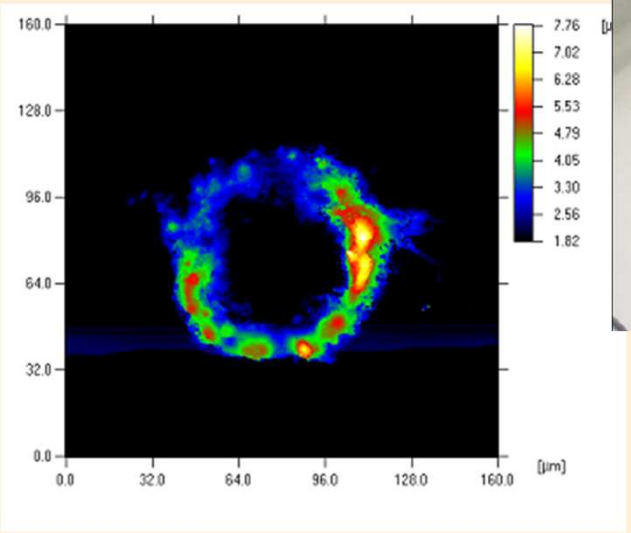
- decreasing thickness of coating
- slope around hole
- depth of hole
- surface structure

µsurf

Laser Texturing of Piston Rod







Piston Rod Inspection (Pleuel)

Laser Texturing of Cylinder Wall

nanofocus
see more

ISO 25178		
Höhen-Parameter		
Sa	0.877	um

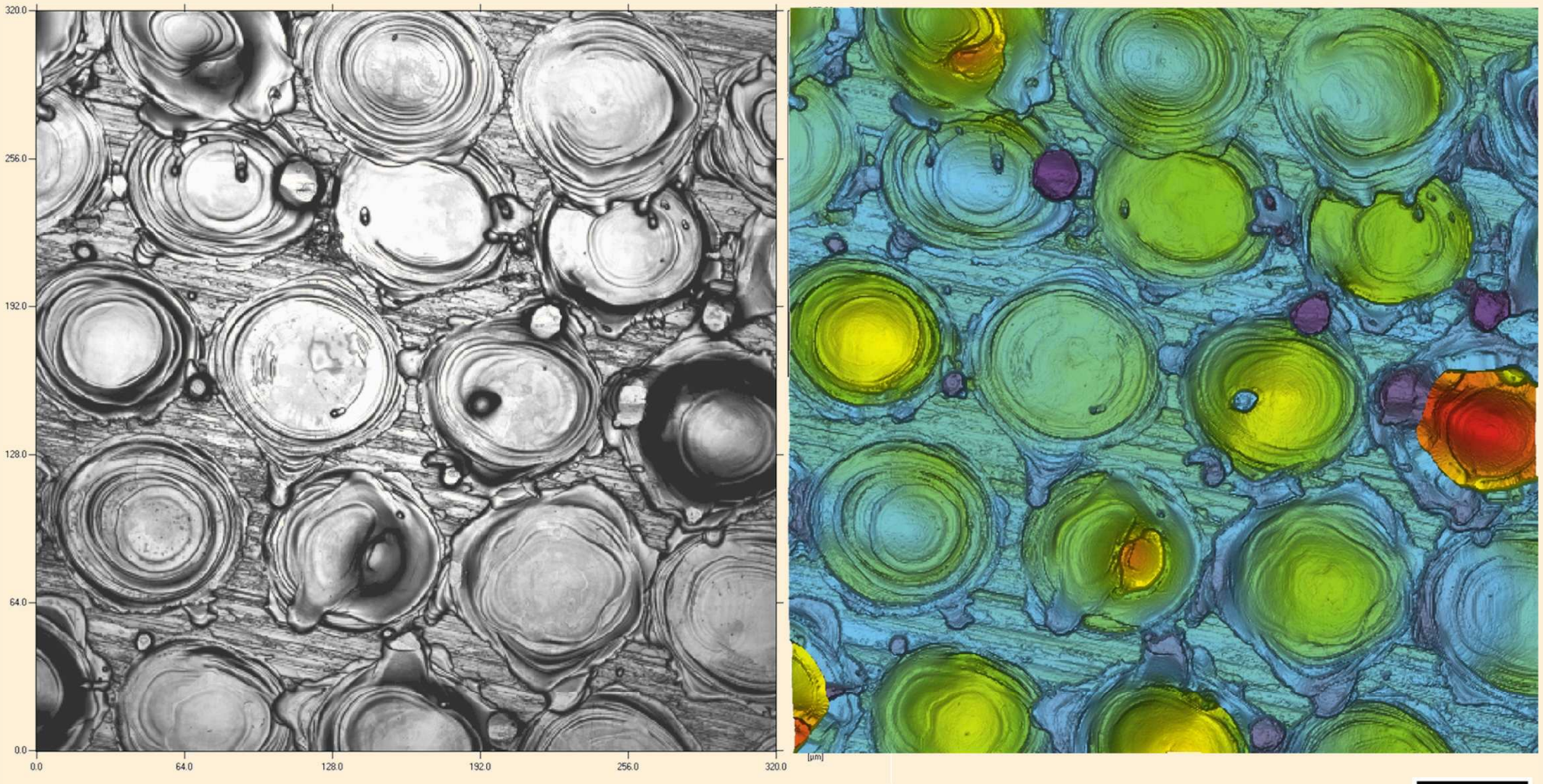
HP

LP

ISO 25178		
Höhen-Parameter		
Sa	1.32	um

µsurf
cylinder

Laser Textured Surface



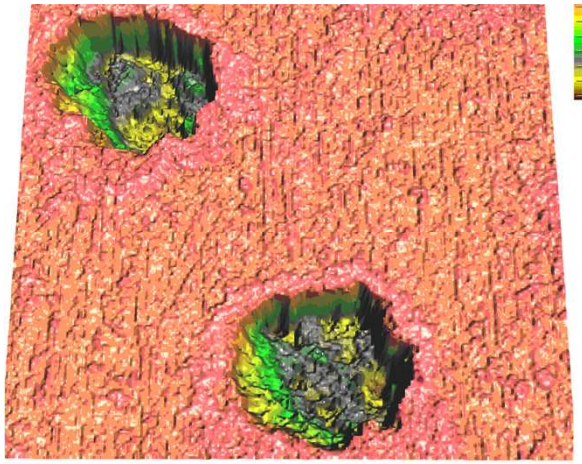
Intensity Topography

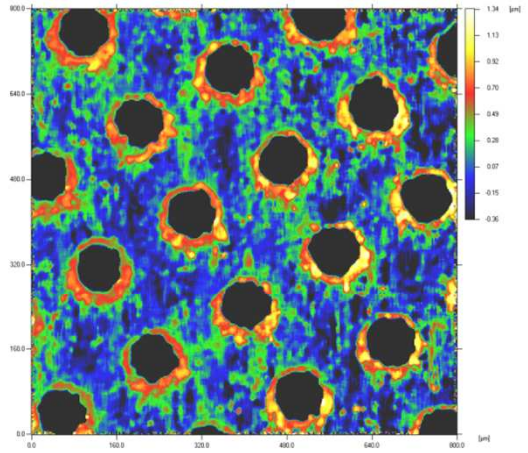
blood pump tube

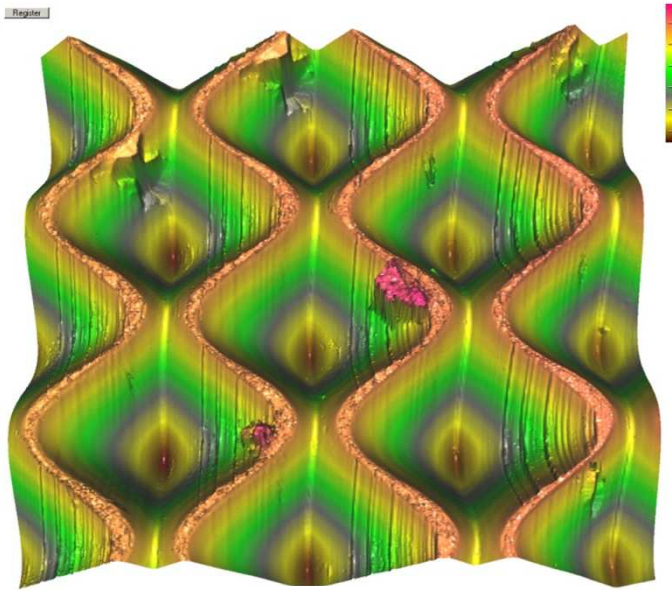
µsurf

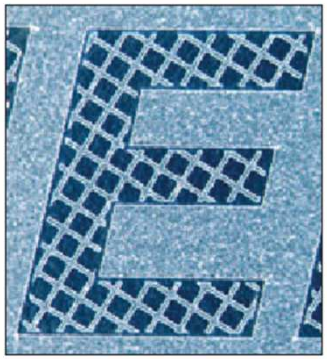
Printing Cylinder

Laser (800S, Zoom)





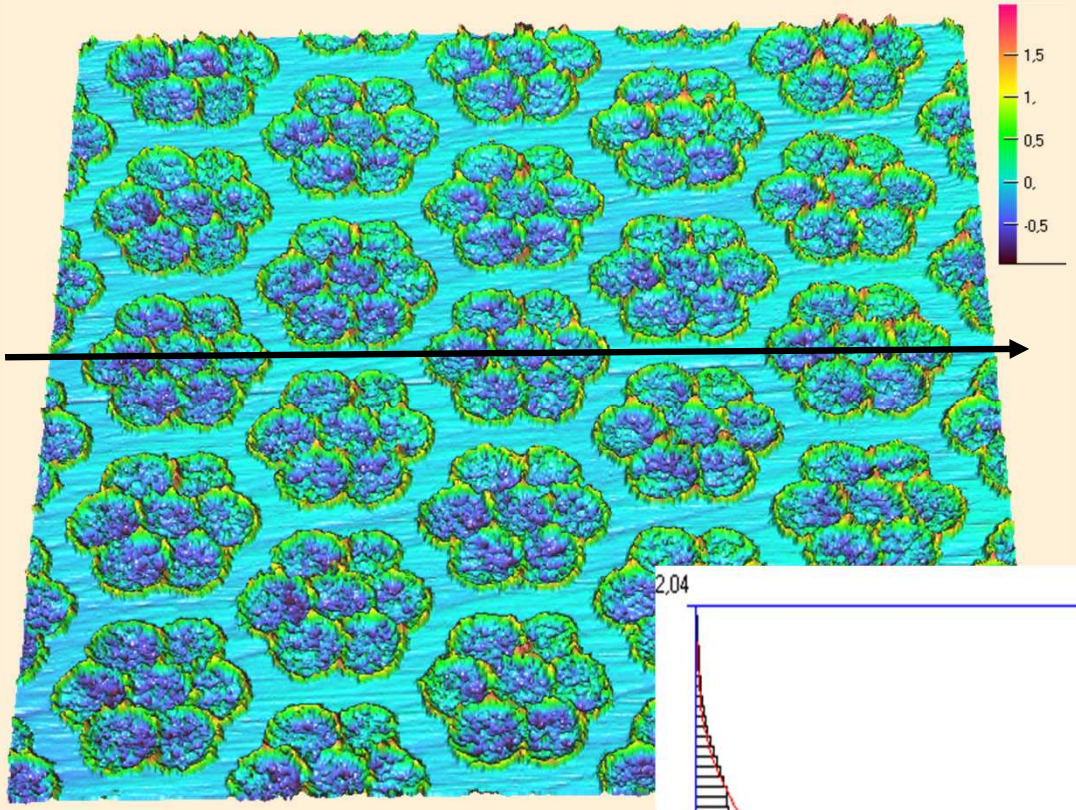


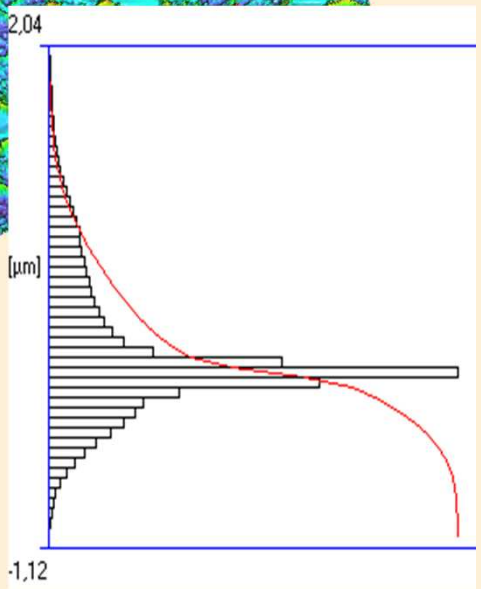


Stylus (320S)

Gravure – Multiple Shot

Master Screen 10% (Zinc)

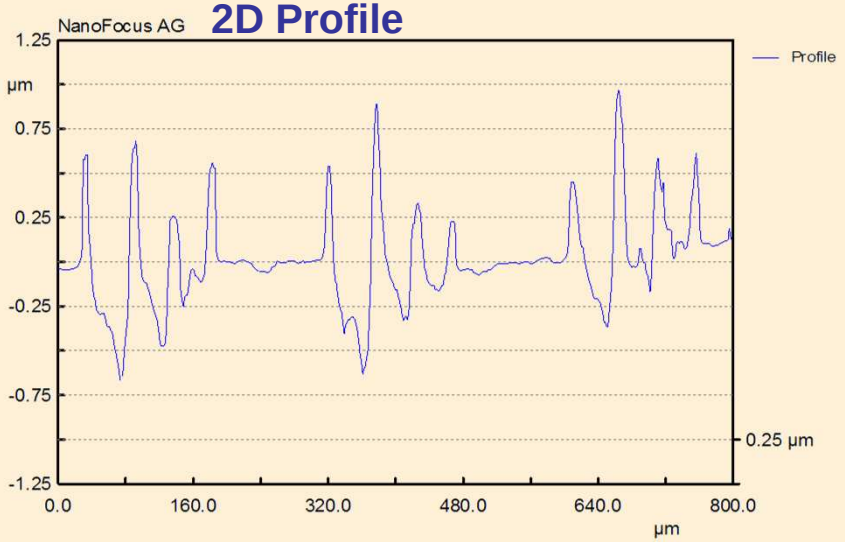


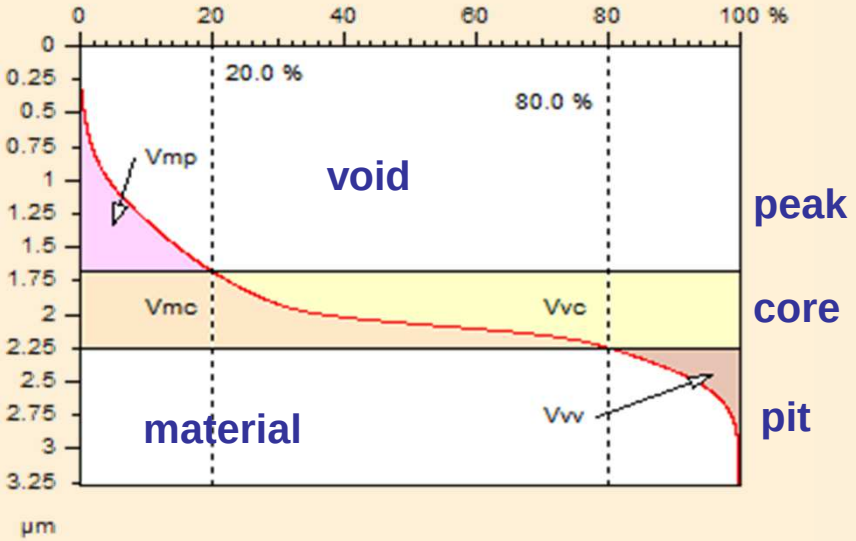


800S **Sa=0,304µm**

µsurf

2D Profile



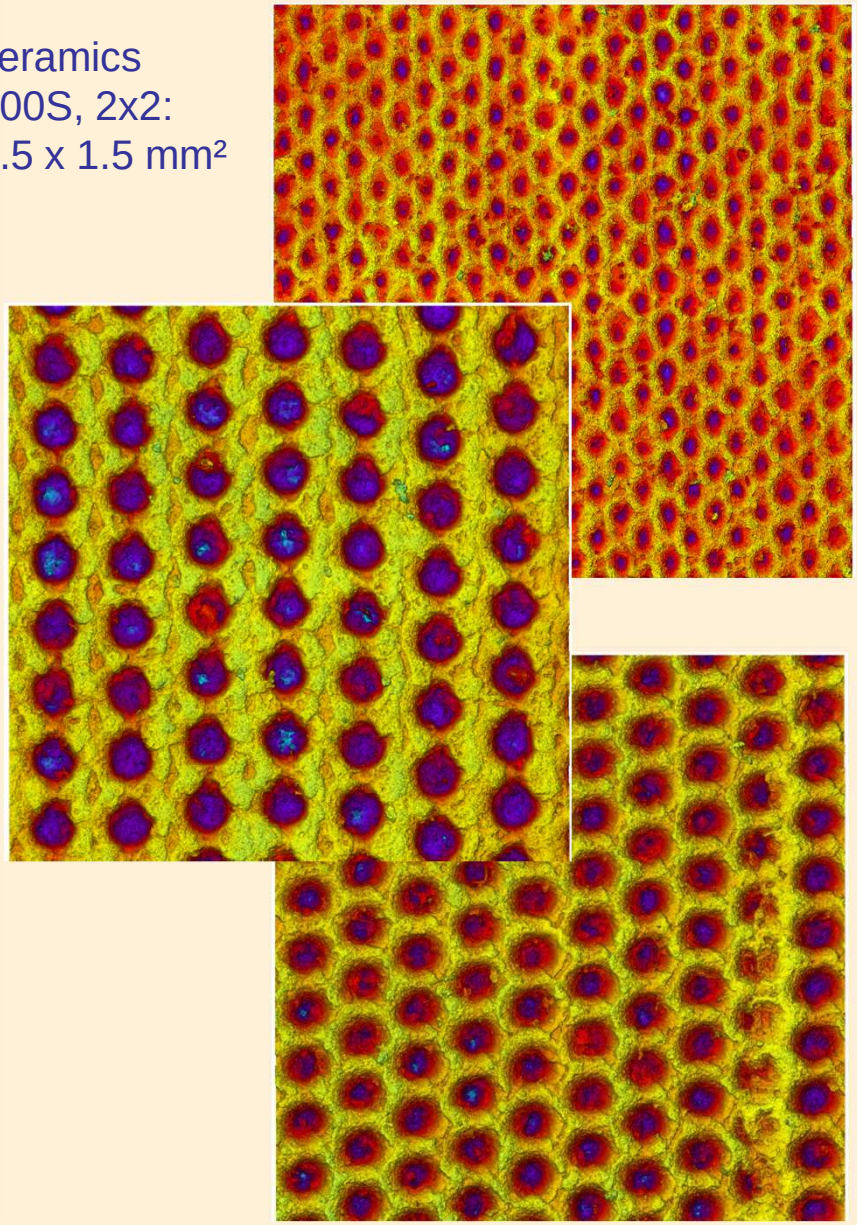


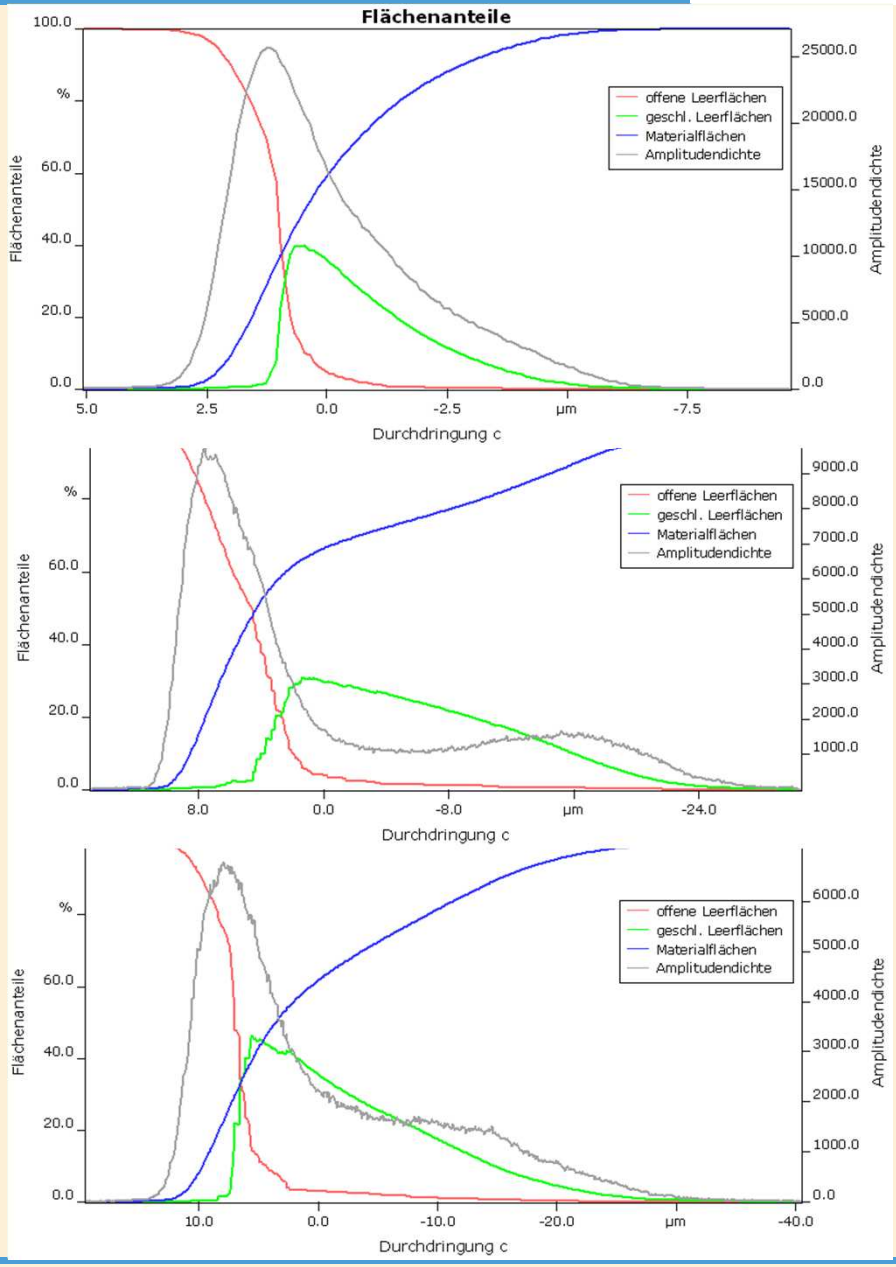
Vmp = 0.0888 ml/m2 Vmc = 0.237 ml/m2

Vvc = 0.337 ml/m2 Vvv = 0.0417 ml/m2

Gravure – Single Shot

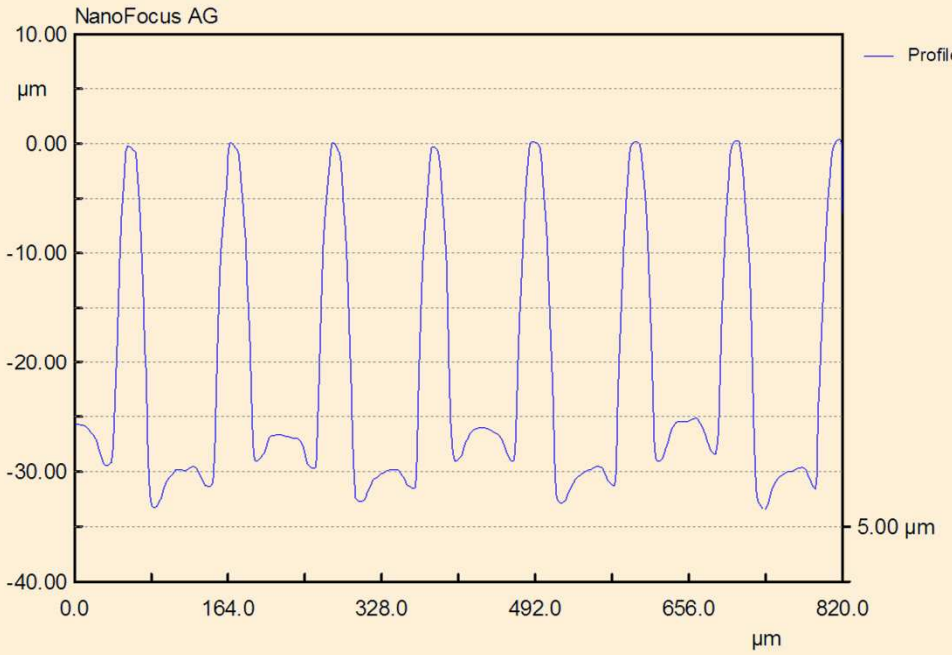
ceramics
800S, 2x2:
1.5 x 1.5 mm²

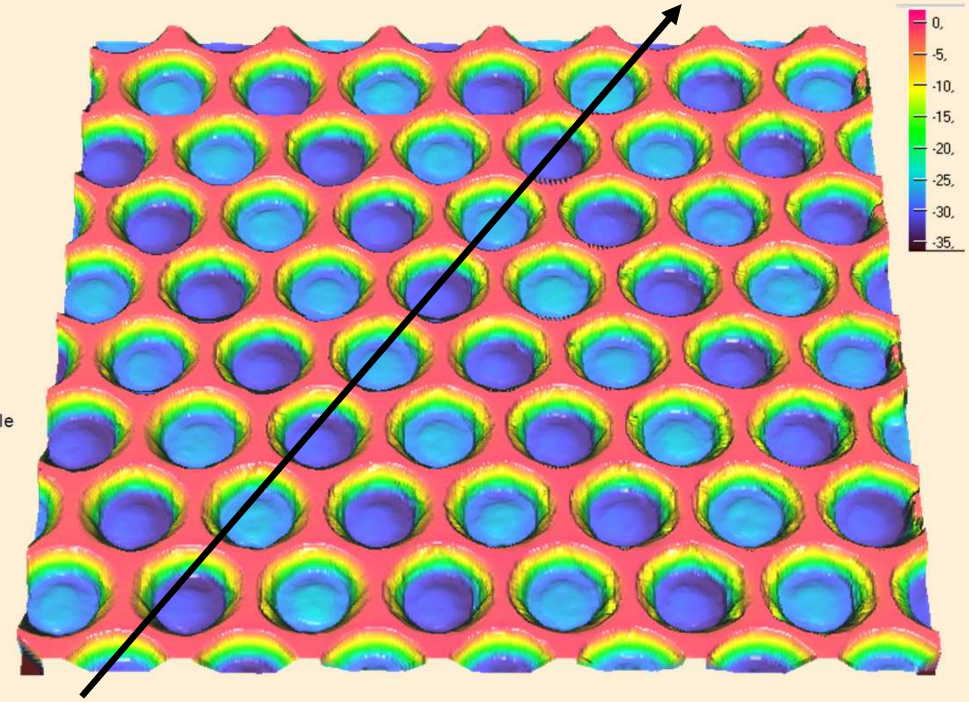




Two laser Single Shot

800S – Laser single shot

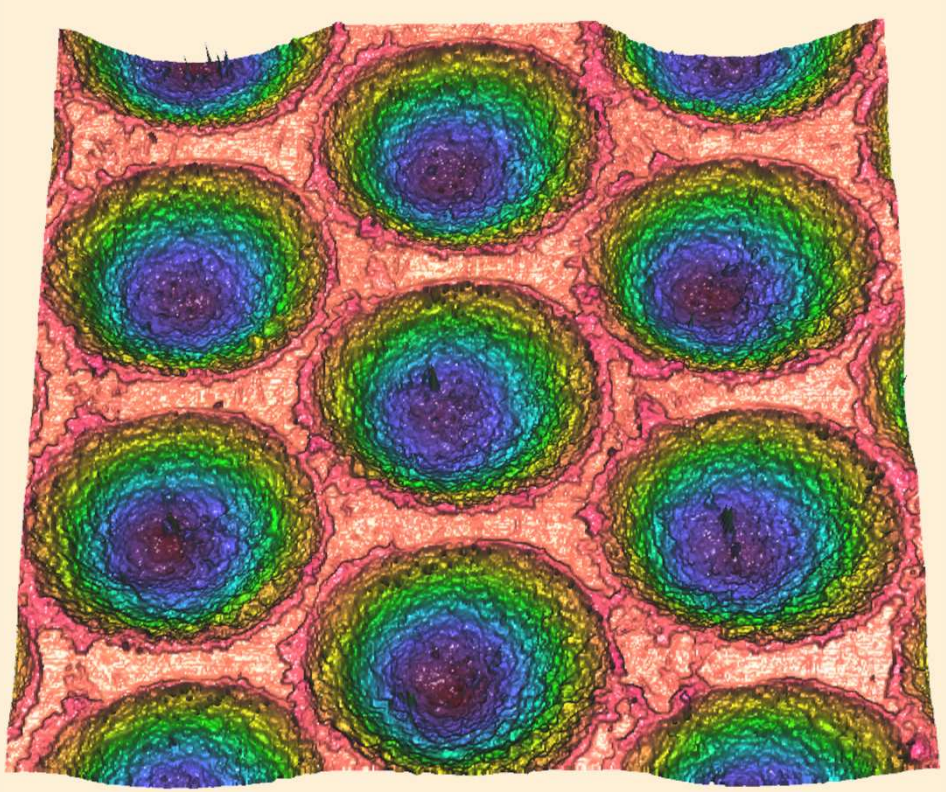




µsurf

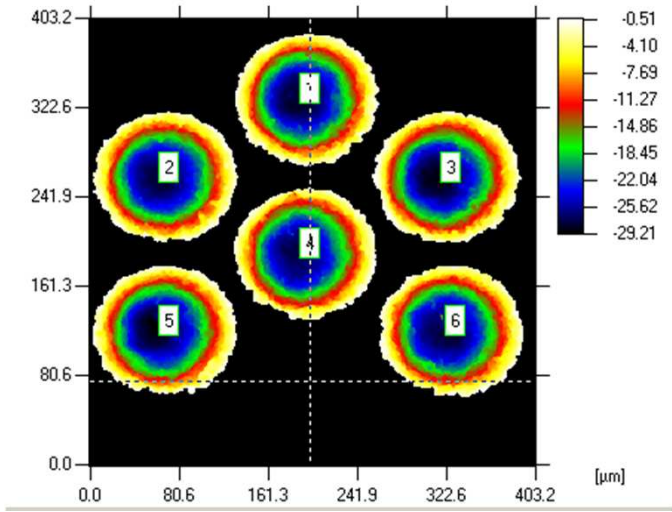
Gravure on Printing Roll

Laser Gravure 320S



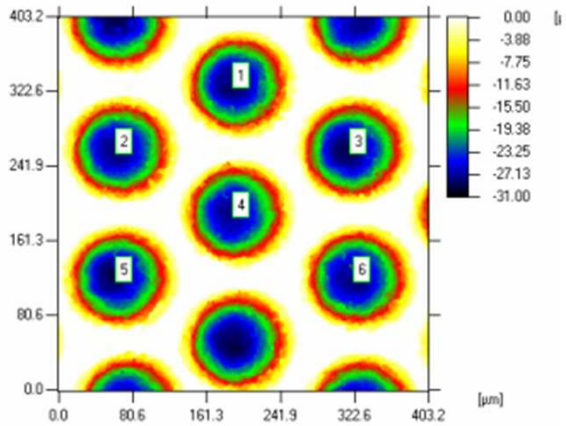
1. Measurement

2. Segmentation

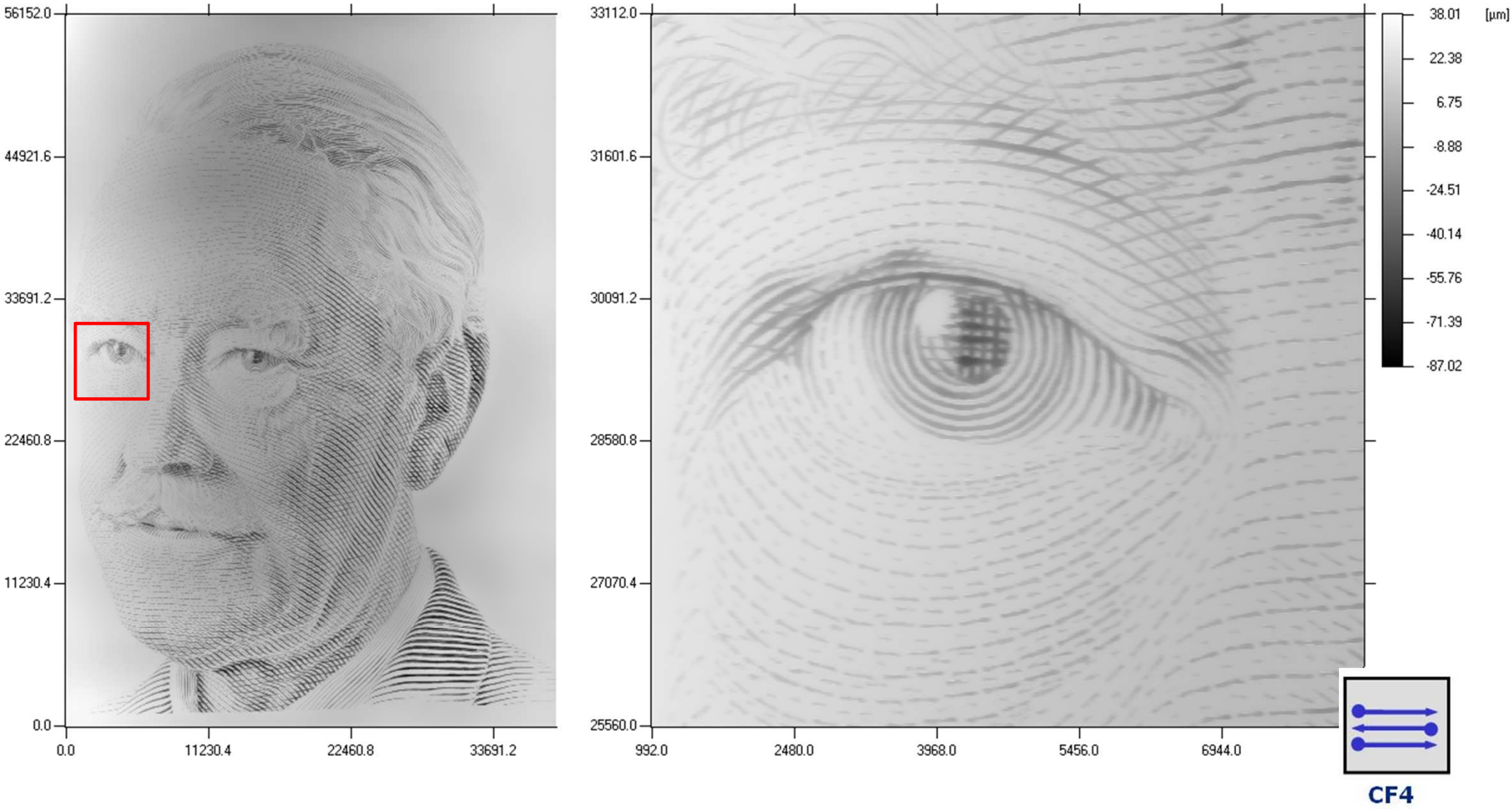


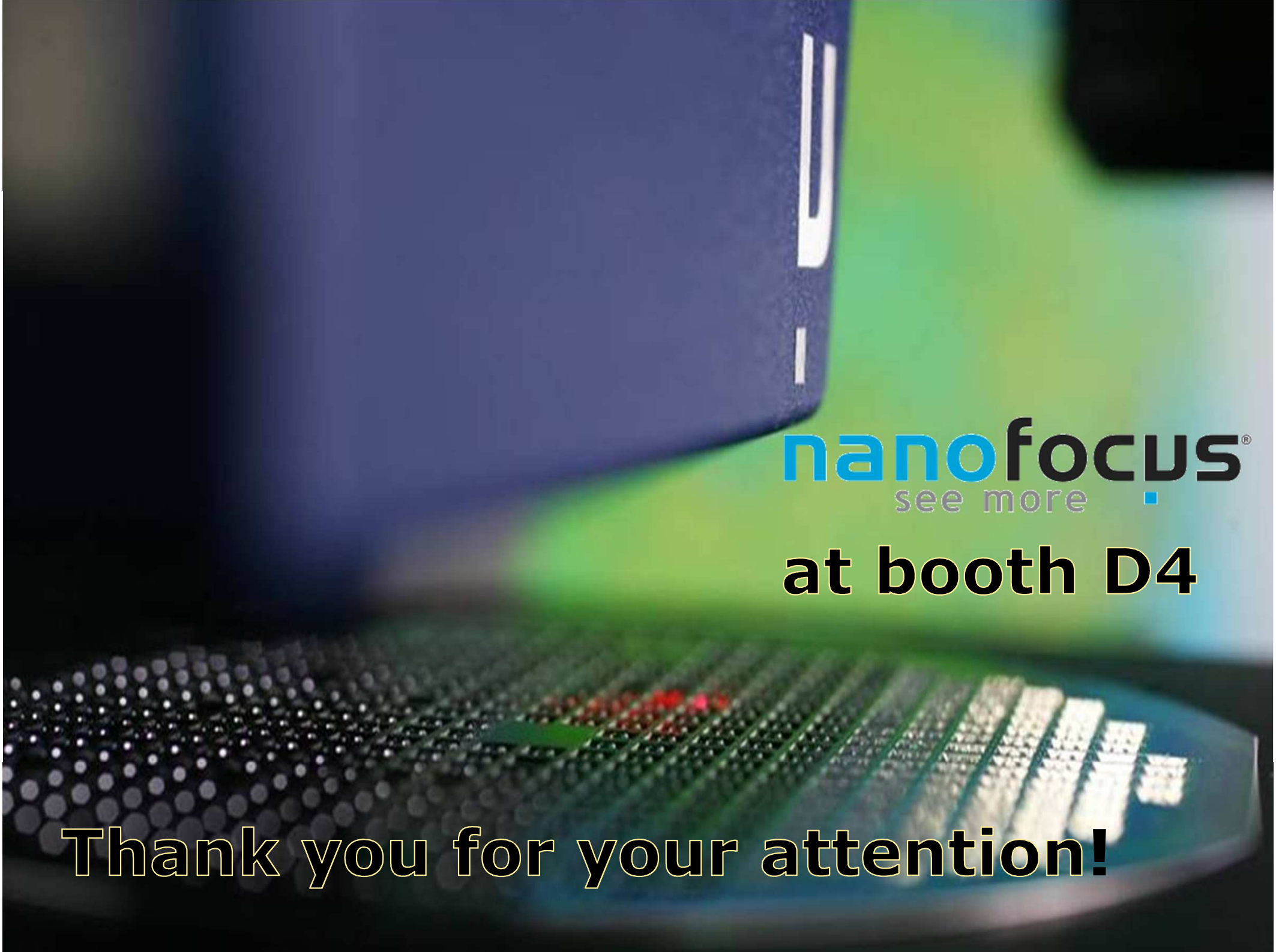
3. Report Sheet

Raster	74,94				
Fläche	11944,1	µm²			
Tiefe	28,60	µm			
Volumen	9,59	ml/m²			
Breite	130,47	µm	Länge	117,58	µm



µscan CF: Printing Plate




nanofocus
see more
at booth D4
Thank you for your attention!