



SAND2009-2862C

Non-Contact Metrology Capabilities Sandia National Laboratories

**104th IMOG
Measurement Technology Subgroup
Los Alamos National Laboratories
May, 2009**

Nicole T. Yazzie

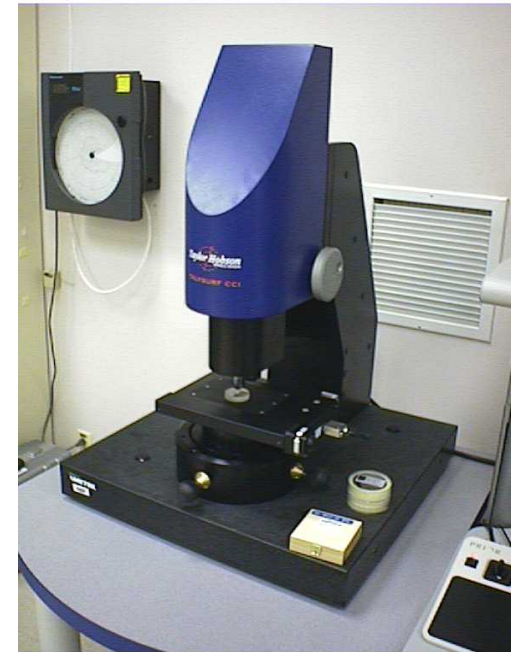
ntyazzi@sandia.gov

(505) 844-4994

CCI Capabilities

This system is capable of:

- Measuring 3D surfaces, step heights, and roughness over areas between, and including, 0.36mm^2 and 7.2mm^2 .
- Maximum resolution in the X and Y axis is $0.36\mu\text{m}$ and Z height to $0.1\text{\AA}$ ($1/100,000,000$ mm).
- Over 1 million points can be acquired in a single measurement (1024×1024 pts.).
- Typical Measurement time: 10 seconds – 3 minutes
- Lenses available (SNL specific): 10x, 20x & 50x





CCI Features

- **No component preparation time required**
 - Components need only be clean
- **Materials that can be measured:**
 - Glass
 - Metal
 - Polymer
 - Photo-resist
 - Liquid inks
 - Pastes
- **Different surface types that can be measured:**
 - Polished
 - Rough
 - Specular
 - Scattering
- **Measurement Area**
 - 1.8mm x 1.8mm x 7.4mm

CLI 2000

- **Large capacity 3D system**

Talysurf CLI 2000 system is a large capacity multi gauging 3D measuring system which is capable of measuring a wide range of features.

These features include:

- Roughness
 - Waviness
 - Form
 - Flatness
 - Step Height
 - Slot Width
- **10mm laser triangulation with 1 μ m vertical resolution**
 - **300 μ m confocal gauge with 10nm vertical resolution**





CLI Overview

- **3D scanning system**
 - **3 different gauge technologies**
 - **Chromatic Length Aberration (confocal)**
 - White light is sent through a beam splitter down a fibre optic cable
 - The light is reflected back up through the cable, this light is then deflected onto the CCD which detects the height of the surface.
 - Scanning envelope on CLI 2000 is 200 x 200 x 200mm
 - **Laser Triangulation**
 - Laser light is focused onto the surface through a focal lens
 - The light is reflected from a point on the surface within the range of the triangulation gauge
 - For the LK 031 gauge used on the Talysurf CLI this angle is 40 degrees.
 - The light shines through an objective lens onto a PSD
 - The position of the reflected light on the PSD indicates the height of the surface.
 - **Inductive (Item not currently installed on SNL system)**



CCI & CLI Analysis Software

“TalyMap Mountains” 3D analysis software package

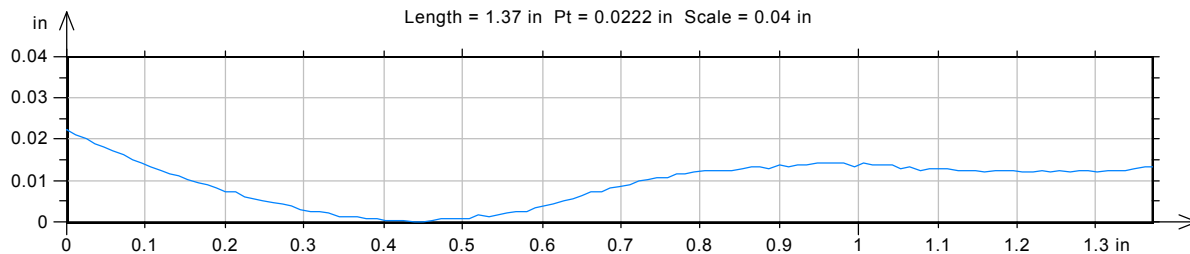
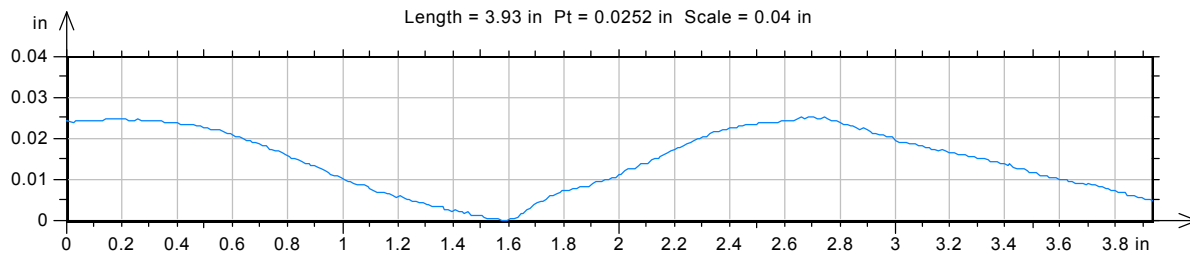
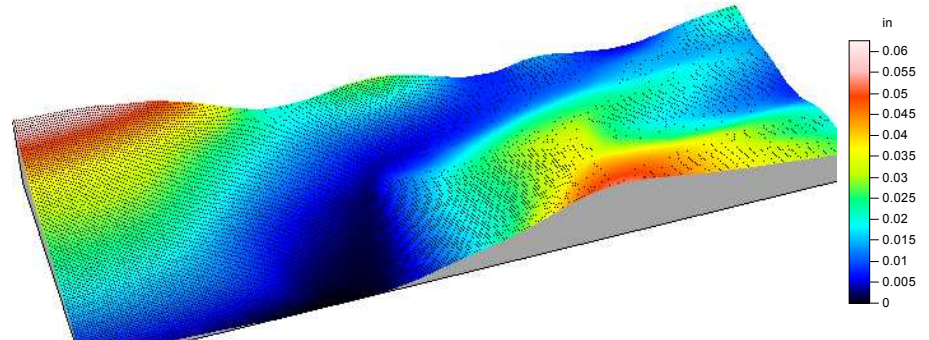
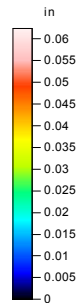
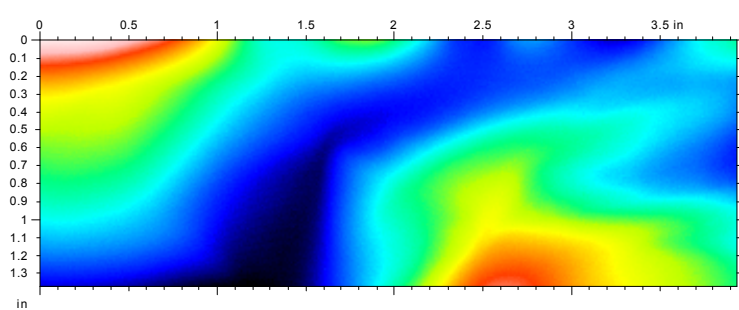
Features Include:

- **High resolution zooming.**
- **Photo-realistic imaging provides natural view of 3D surfaces.**
- **Automatic measurement of features:**
 - ✓ **Diameter**
 - ✓ **Distance**
 - ✓ **Depths**
 - ✓ **Volume**
 - ✓ **Area**
 - ✓ **Feature count**
 - ✓ **Automatic sorting of features**

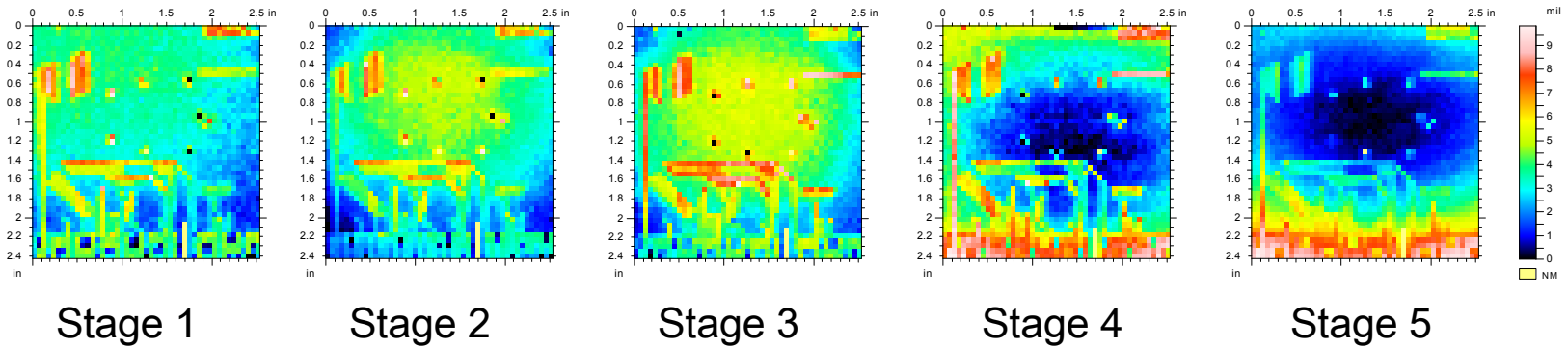


Samples Jobs and Applications

Non Contact Form Scanning



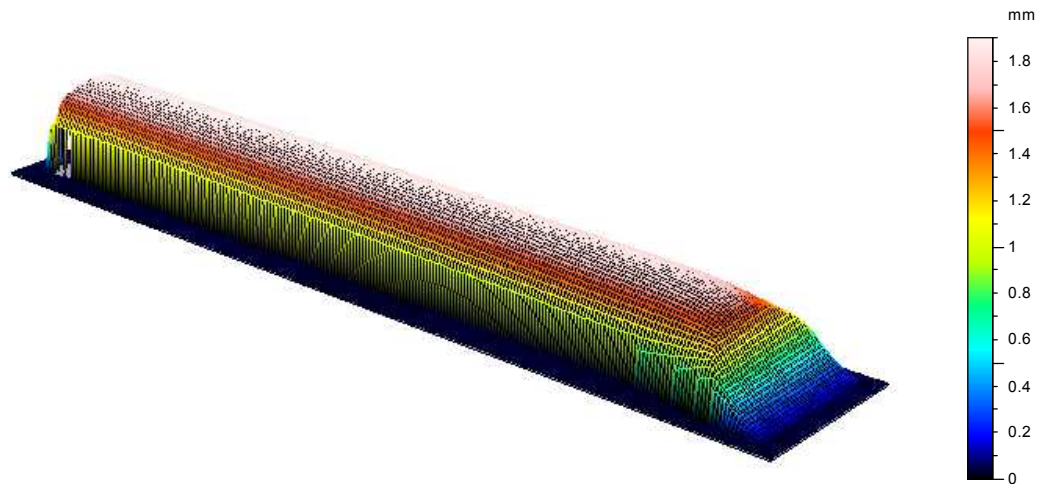
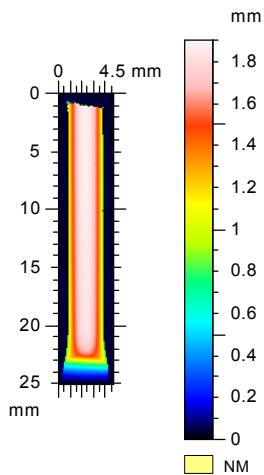
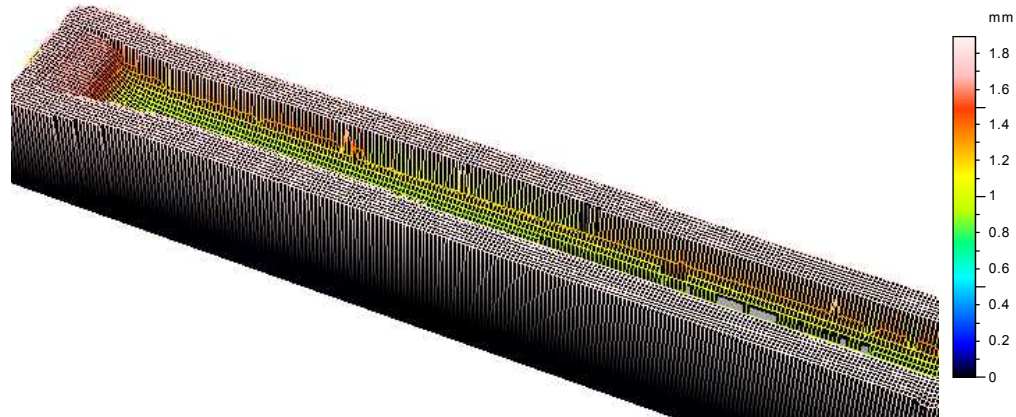
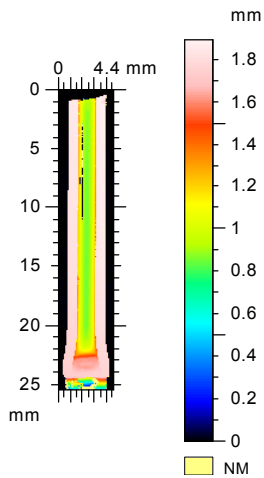
Form Trending



Flatness

Stage 1	1.52mil
Stage 2	2.64mil
Stage 3	2.10mil
Stage 4	1.03mil
Stage 5	3.21mil

Reverse Engineering

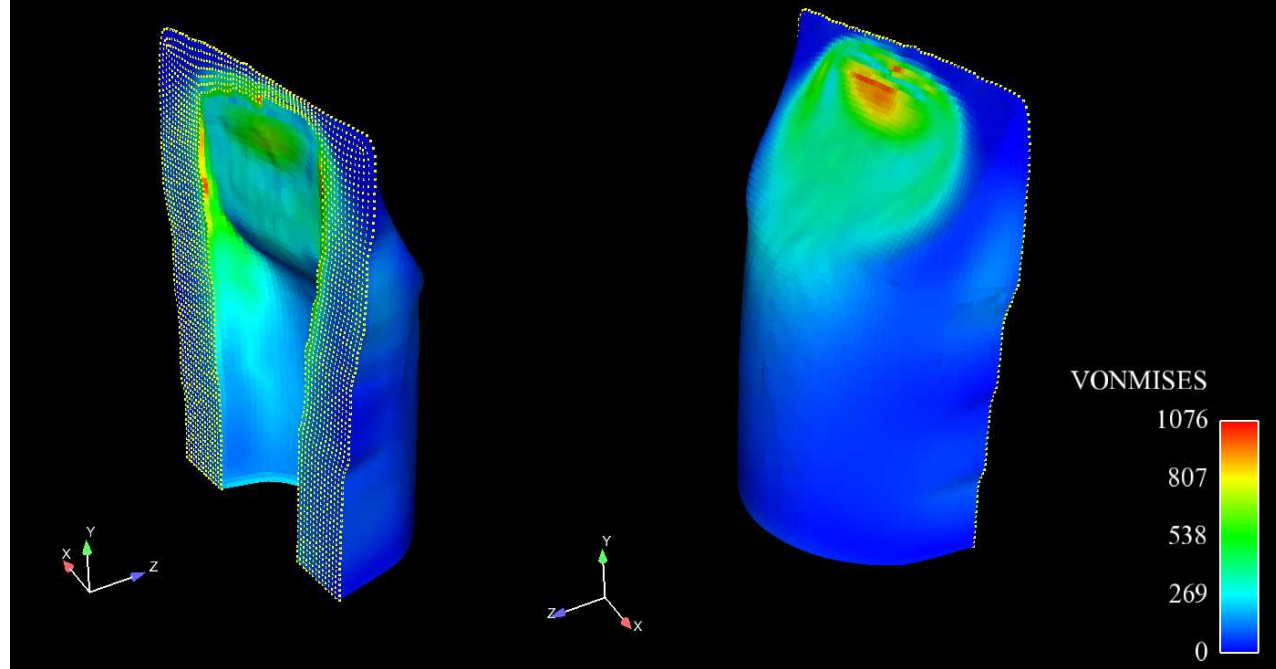


Reverse Engineering

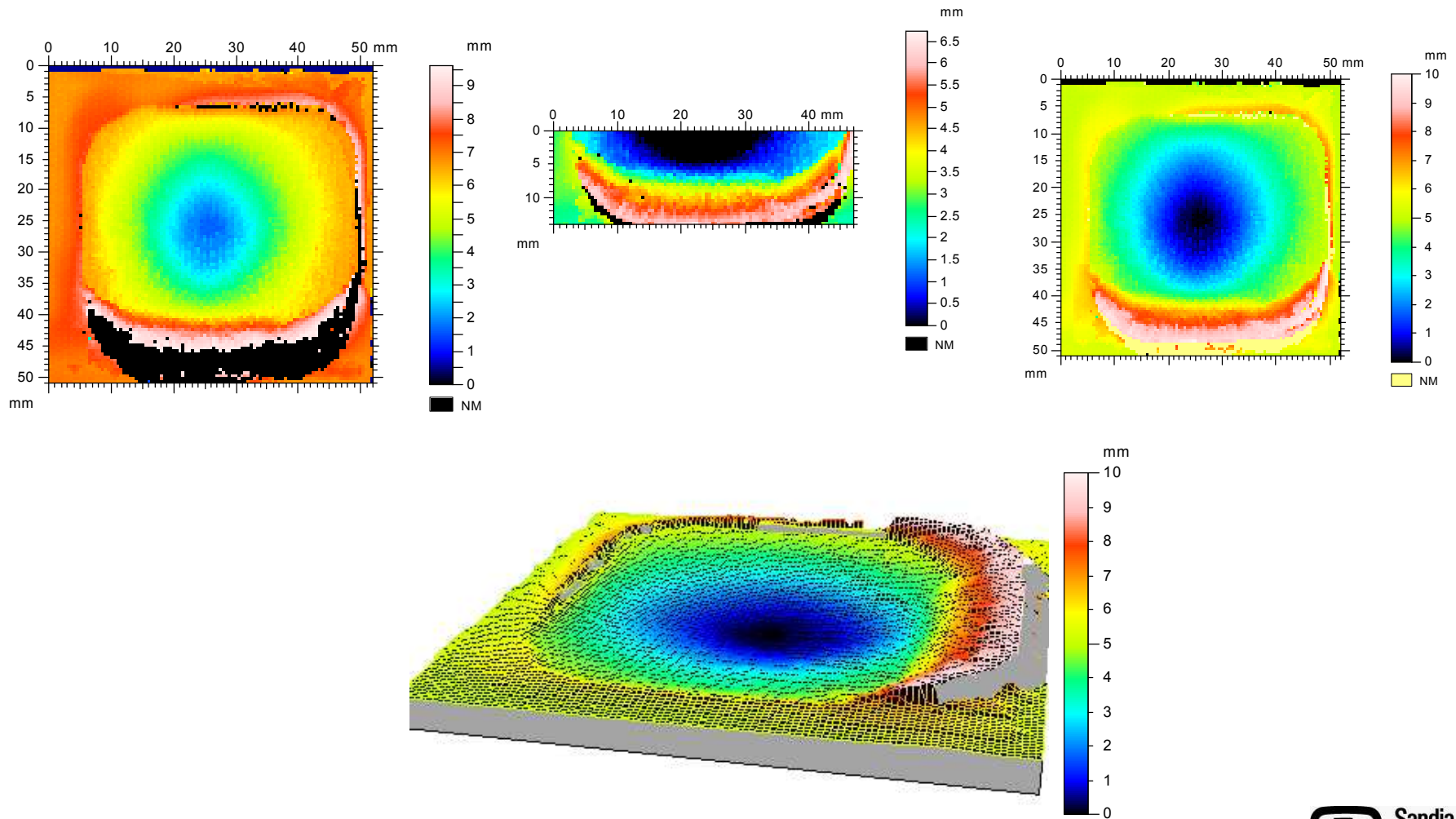
Pipe Top - Notepad

0.000000e+000	0.000000e+000	-1.258557e+003
1.000000e+002	0.000000e+000	-1.259398e+003
2.000000e+002	0.000000e+000	-1.256035e+003
3.000000e+002	0.000000e+000	-1.250316e+003
4.000000e+002	0.000000e+000	-1.243084e+003
5.000000e+002	0.000000e+000	-1.245943e+003
6.000000e+002	0.000000e+000	-1.246448e+003
7.000000e+002	0.000000e+000	-1.240729e+003
8.000000e+002	0.000000e+000	-1.241739e+003
9.000000e+002	0.000000e+000	-1.246111e+003
1.000000e+003	0.000000e+000	-1.243420e+003
1.100000e+003	0.000000e+000	-1.246784e+003
1.200000e+003	0.000000e+000	-1.240898e+003
1.300000e+003	0.000000e+000	-1.235516e+003
1.400000e+003	0.000000e+000	-1.245607e+003
1.500000e+003	0.000000e+000	-1.246784e+003
1.600000e+003	0.000000e+000	-6.653552e+002
1.700000e+003	0.000000e+000	-1.252166e+003
1.800000e+003	0.000000e+000	-1.233497e+003
1.900000e+003	0.000000e+000	-1.262426e+003
2.000000e+003	0.000000e+000	-1.123165e+003
2.100000e+003	0.000000e+000	-1.294213e+003
2.200000e+003	0.000000e+000	-1.301614e+003
2.300000e+003	0.000000e+000	-2.078815e+002
2.400000e+003	0.000000e+000	-1.377467e+002
2.500000e+003	0.000000e+000	1.513700e+000
2.600000e+003	0.000000e+000	6.310447e+002
2.700000e+003	0.000000e+000	6.345767e+002
2.800000e+003	0.000000e+000	6.379404e+002
2.900000e+003	0.000000e+000	6.402951e+002
3.000000e+003	0.000000e+000	6.419770e+002
3.100000e+003	0.000000e+000	6.433225e+002
3.200000e+003	0.000000e+000	6.157395e+002
3.300000e+003	0.000000e+000	6.418088e+002
3.400000e+003	0.000000e+000	-1.245439e+003
3.500000e+003	0.000000e+000	-1.245607e+003
3.600000e+003	0.000000e+000	-1.242243e+003
0.000000e+000	1.000000e+002	-1.254016e+003
1.000000e+002	1.000000e+002	-1.248466e+003
2.000000e+002	1.000000e+002	-1.242243e+003
3.000000e+002	1.000000e+002	-1.240561e+003
4.000000e+002	1.000000e+002	-1.247625e+003
5.000000e+002	1.000000e+002	-1.244934e+003
6.000000e+002	1.000000e+002	-1.239047e+003
7.000000e+002	1.000000e+002	-1.271844e+003
8.000000e+002	1.000000e+002	5.743650e+002
9.000000e+002	1.000000e+002	5.772242e+002

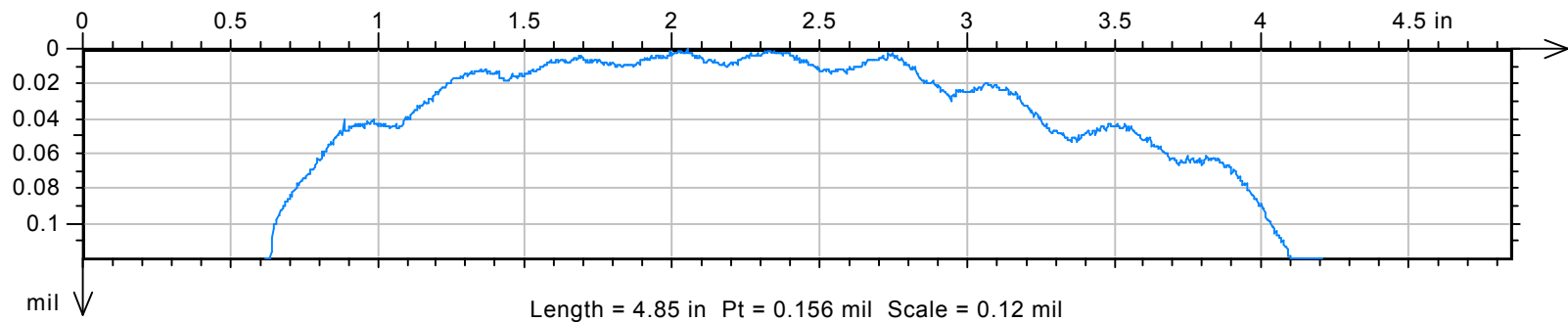
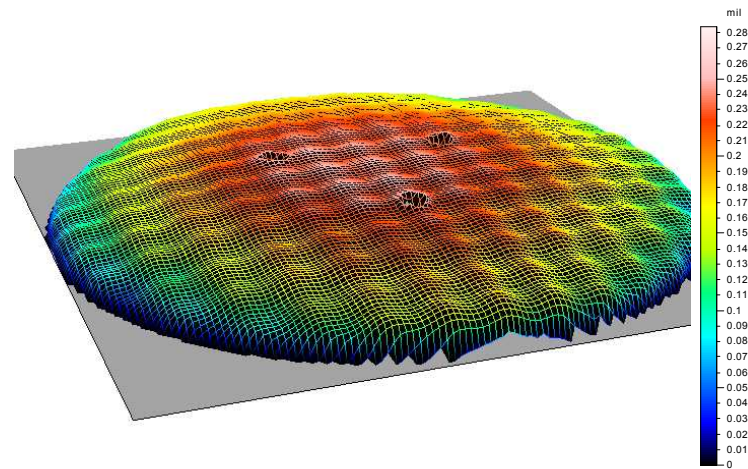
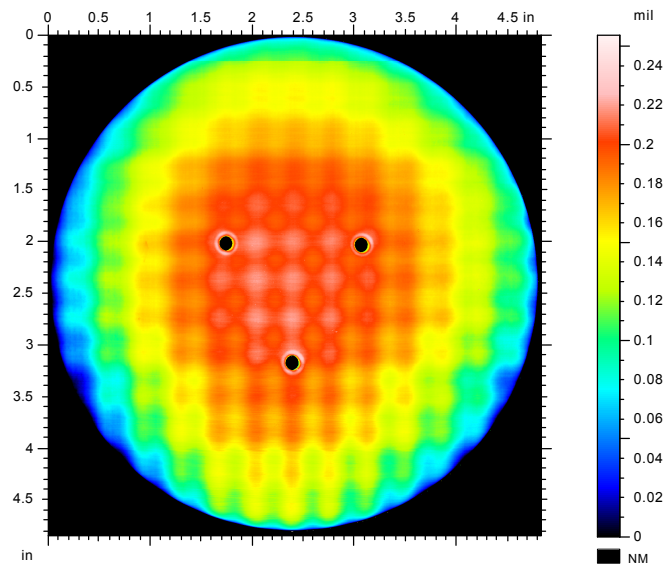
Time = 1.00



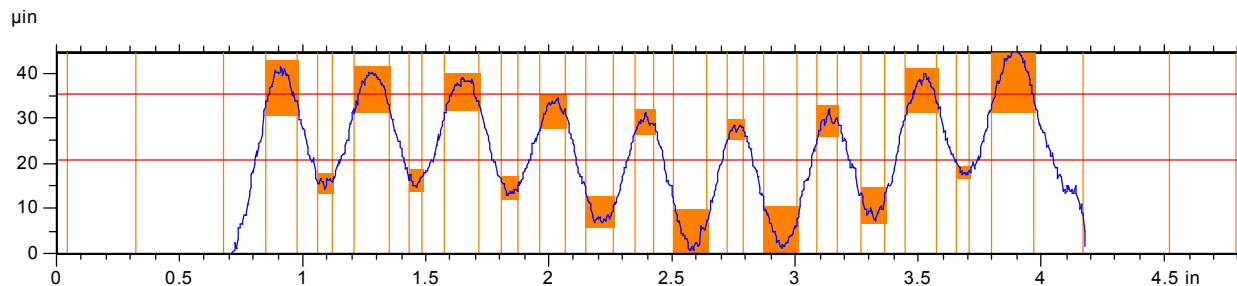
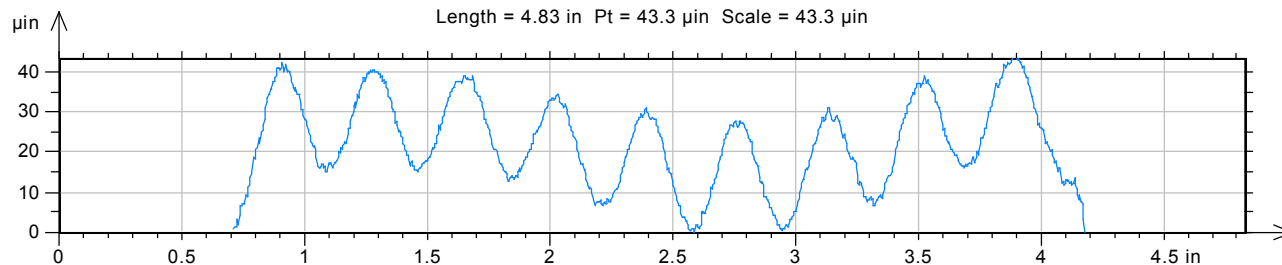
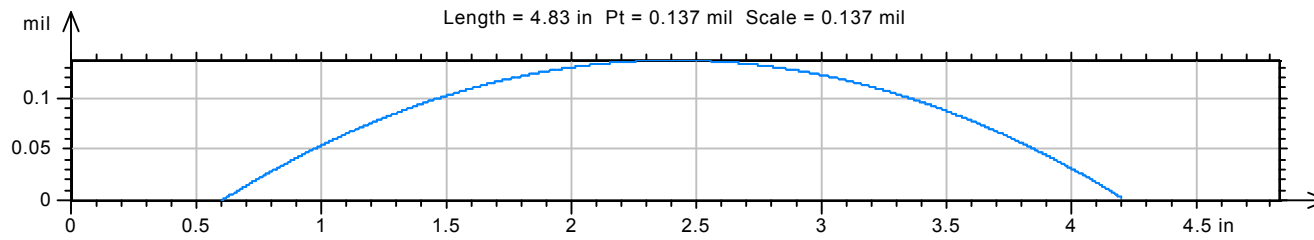
Vertical Surface Patching



Analysis of Surface Form and Waviness

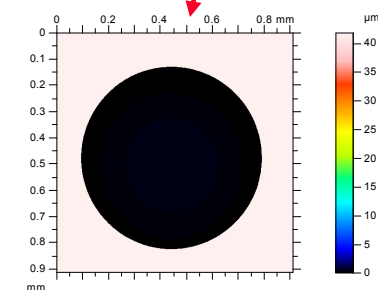
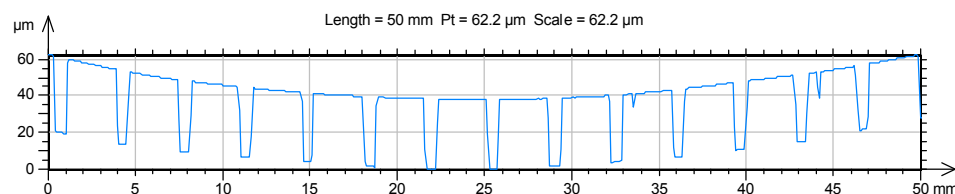
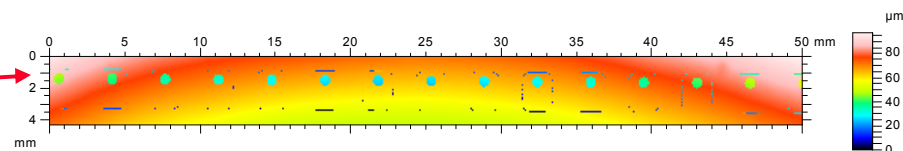
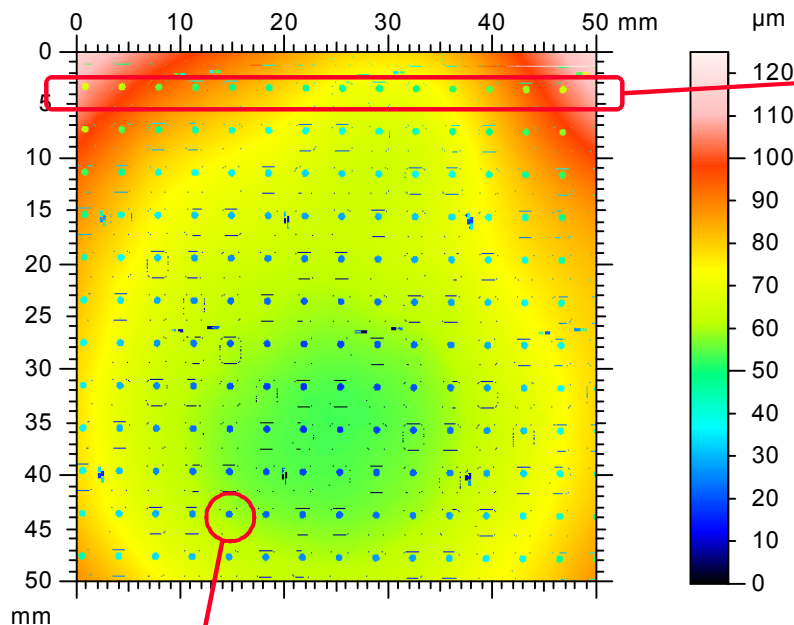


Form Removal for Analysis



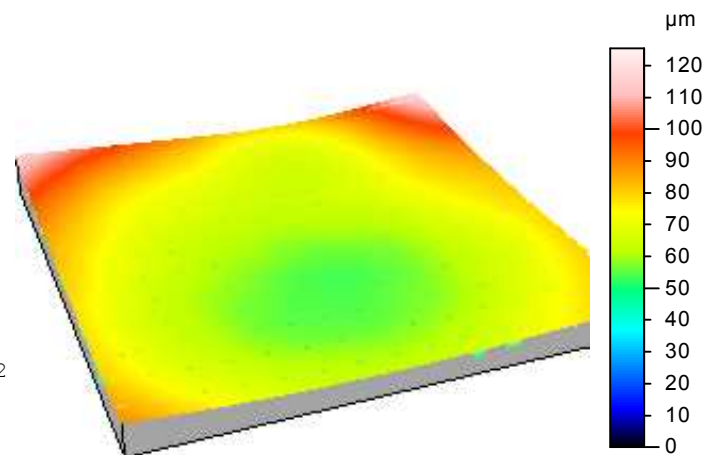
	1	2	3	4	5	6	7	8	9	10
Maximum depth	*****	20.8 μ in	20.5 μ in	22.3 μ in	28.3 μ in	34.4 μ in	34 μ in	27.7 μ in	17.7 μ in	*****
Mean depth	*****	19.3 μ in	19.1 μ in	21.1 μ in	26.5 μ in	31.2 μ in	30.5 μ in	25.3 μ in	17.2 μ in	*****
Width	*****	0.0591 in	0.0512 in	0.0669 in	0.114 in	0.13 in	0.138 in	0.0984 in	0.0472 in	*****

Detail Scanning (CLI + CCI)

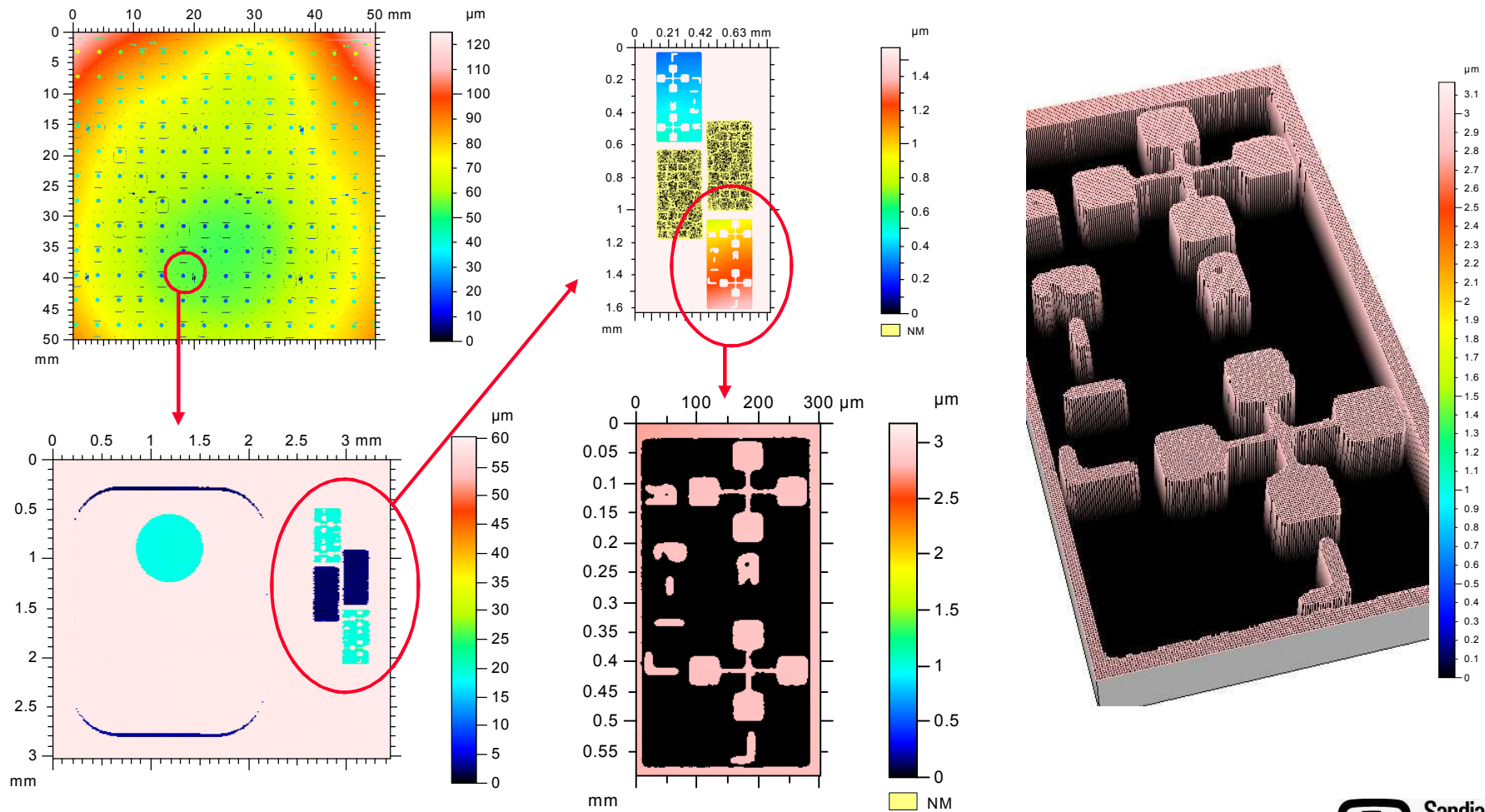


Mean parameters on Etched Hole

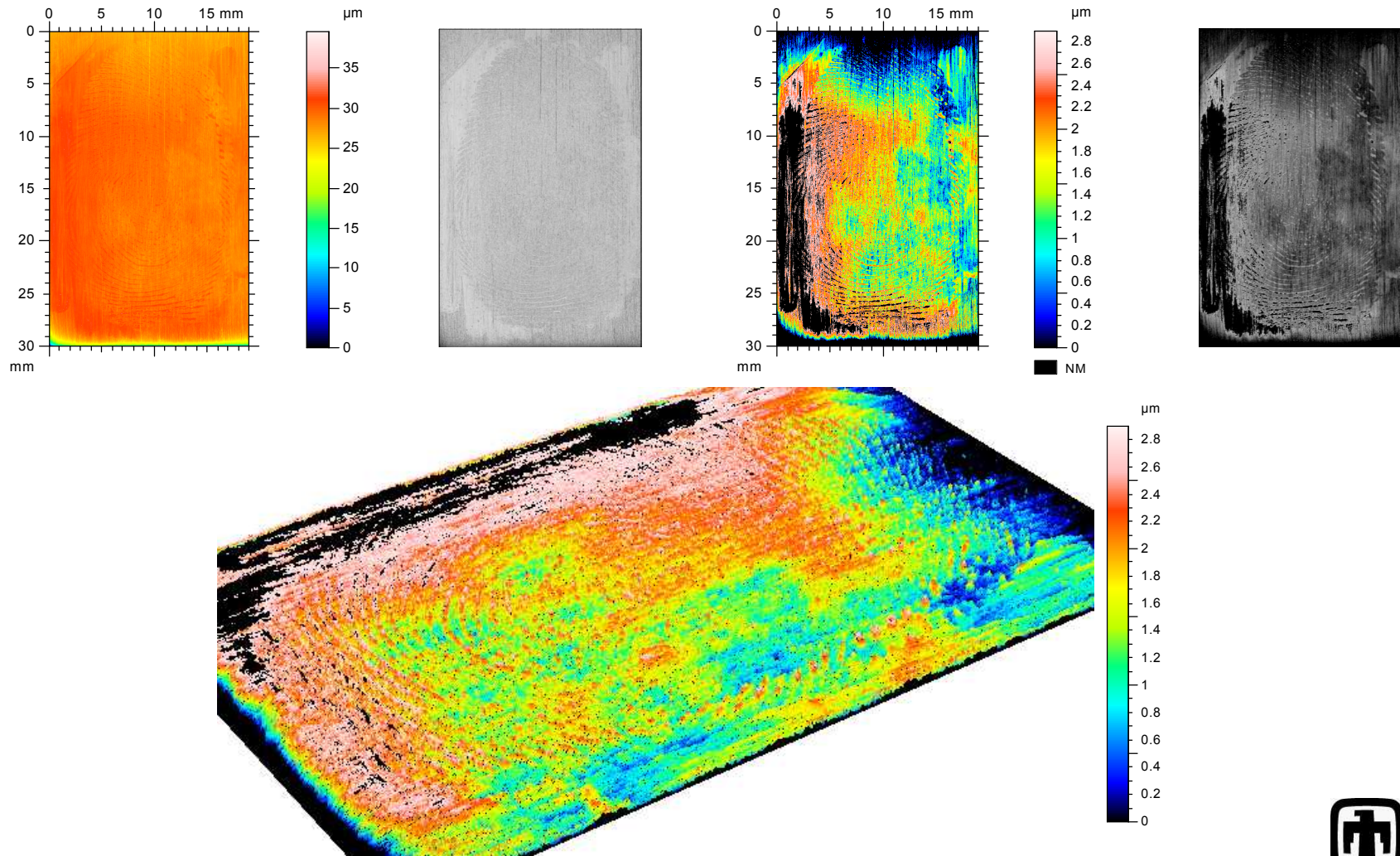
Area	=	0.379 mm ²	+/- 0.00 mm ²
Equivalent diameter	=	694 μm	+/- 0.00 μm
Roundness	=	0.988	+/- 0.00



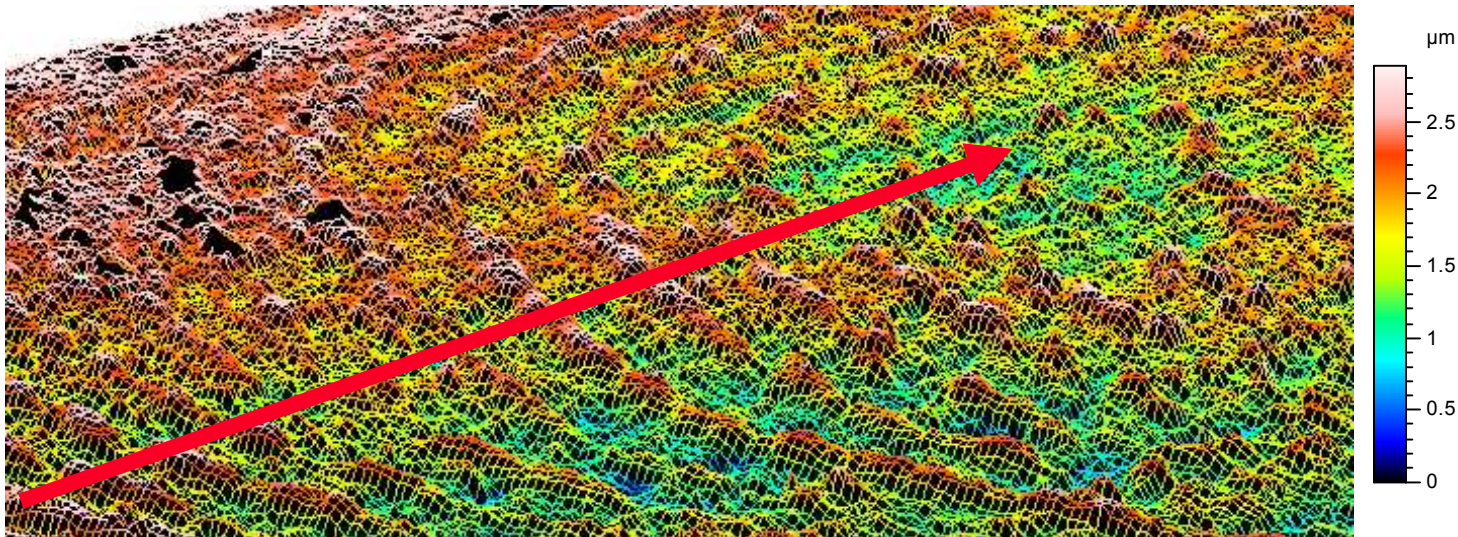
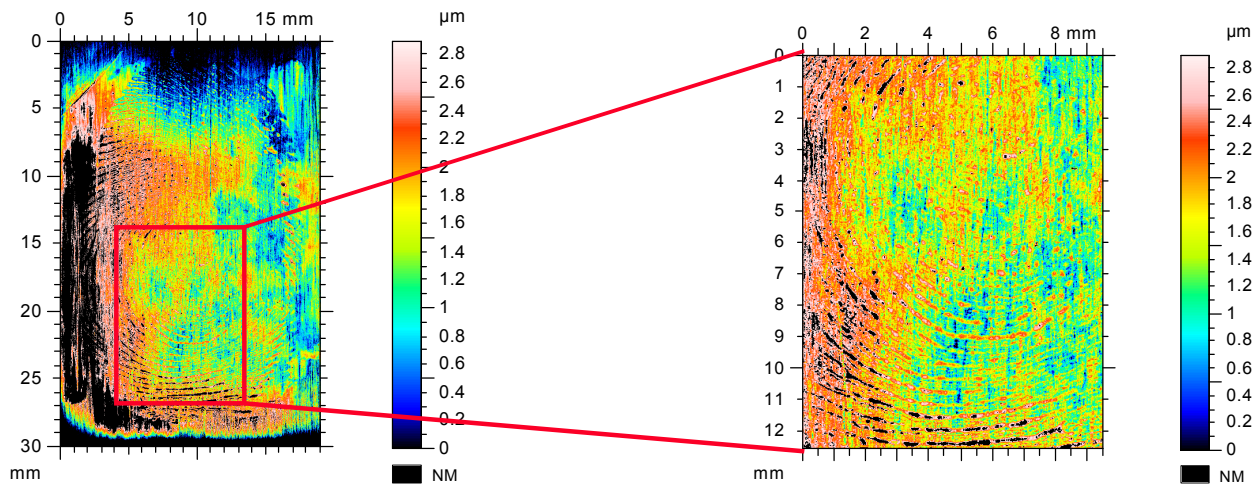
Detail Scanning (CLI + CCI)



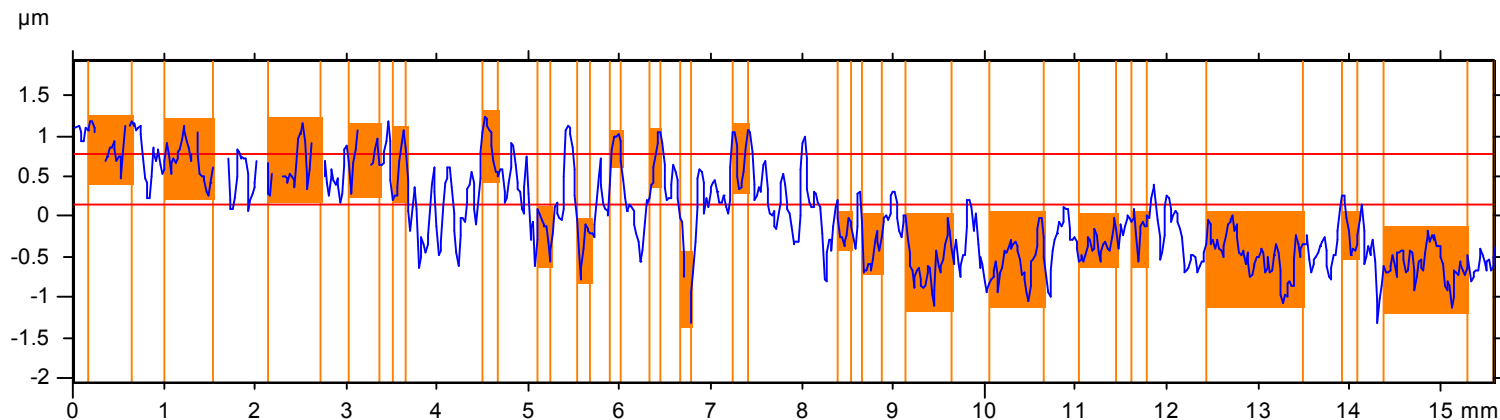
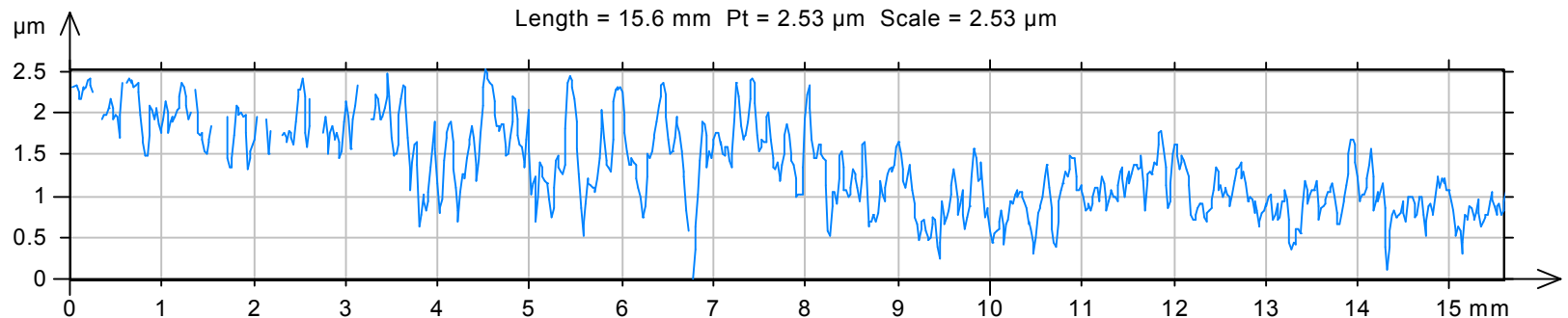
Detail Isolation



Detail Isolation



Detail Isolation for Analysis



Mean values on 12 steps.

Maximum depth	2.07 μm
Mean depth	1.17 μm
Width	0.38 mm



Questions ?