Welcome

to today's episode:

CYBERTECHNOLOGIES CT300: THE SWISS ARMY KNIFE (SAK) OF OPTICAL METROLOGY

COVALENT ACADEMY

Industrial Applications of Advanced Metrology

Episode 36

Karl-Heinz Strass

Managing Director,
cyberTECHNOLOGIES USA

March 26, 2024 at 11 AM PT

COVALENT METROLOGY

cyber TECHNOLOGIES

COVALENT METROLOGY

Modern, digitally-empowered analytical services platform delivering quality data and expert analysis to accelerate advanced materials and device innovation.

Comprehensive Solutions Stack

50+ Cutting-edge instruments in-house, 150+ Techniques

Analytical Services

Advanced Modeling

Method Development

Custom Consulting Solutions

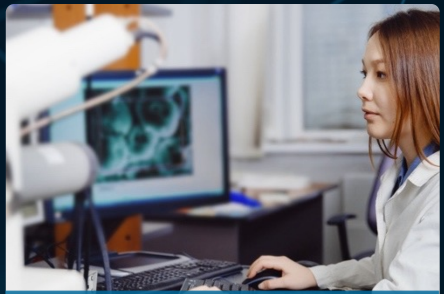
High-touch, High-Quality Services

Ionic Membership Program

Enterprise Metrology Solutions

Instant, Secure Access to Data and Reports

Expanding Toolkit in Custom Digital Platform



Flexible Business Models

LiveView™ (real-time collaboration)

Co-op and Tool-share Opportunities

Training and Certification on Instrumentation

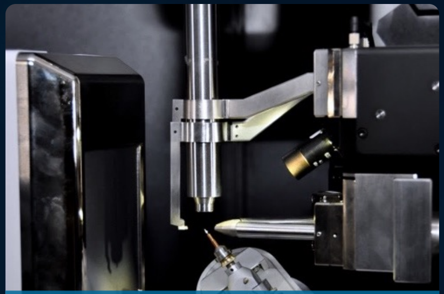
Laboratory Audits

Rich Network of Partnerships

Partner to World's Leading Instrument Manufacturers and Labs

Expanding access to Advanced Instruments and Analysis Tools

Lab Connections and Applications Learning



Who We Are, Who We Serve

50+ People, 14 PhDs

Comprehensive, Modern Analytical Capabilities

Headquarter Lab in Sunnyvale, CA

600+ Clients, 15-30 new clients / week

Covalent's Analytical Services & Technical Groups

COVALENT METROLOGY

Enterprise Metrology Solutions: Failure Analysis & EM

Electron Microscopy

- S/TEM
  with EDS; EELS; Electron Diffraction; SAED
- FIB-SEM & HR-SEM
  with EDS; EBSD; 3D Tomography
- Lamella Preparation
  incl. specialized lift-outs

Failure Analysis

- DPA / Mechanical X-section
- Dye & Pry Test
- EBIC / OBIC failure analysis
- Hot Spot Detection
- NIR / IR Imaging
- Emission Microscopy
- Root-Cause Failure Analysis

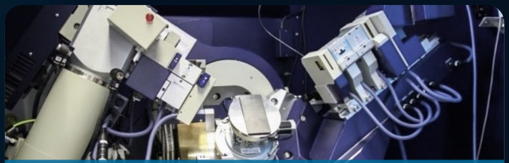
Materials, Chemicals, and Surfaces

Microscopy & Profilometry

- Chromatic Aberration
- Digital Optical Microscopy
- Laser Scanning Confocal Microscopy
- White Light Interferometry
- Scanning Acoustic Microscopy (SAM)

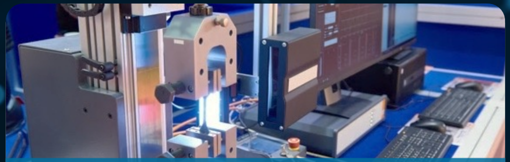
Analytical Chemistry

- Mass Spectroscopy: ICP-MS and LA-ICP-MS; GCMS
- ICP-OES / GDOES
- Raman
- NMR (solid / liquid + 1,2,3 nuclei)
- XPS, UPS, ISS
- SIMS, TOF-SIMS



X-ray Characterization

- X-Ray Diffraction (XRD)
- X-Ray Reflectometry (XRR)
- Micro-computed X-ray Tomography (Micro-CT)
- 2D / 2.5D / 3D X-ray Inspection & X-ray Radiography
- ED-XRF / WD-XRF

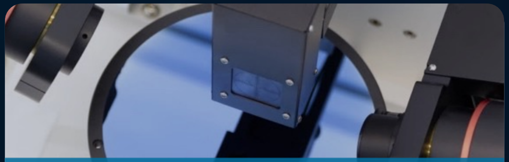


Mechanical Testing

- AFM & Advanced AFM Modes (EFM, KPFM, MFM, PFM, PiFM)
- Nano-indent / Nano-scratch
- Rheometry / Viscosity
- DMA / TMA (bend/stretch/compression)
- Tensile testing

Misc. Material Properties

- Thermal Analysis: DSC, TGA
- Surface Zeta Potential
- Porometry / Pycnometry
- Gas Adsorption / Chemisorption
- Foam Density / Skeletal Density / Tap Density
- Particle Analysis: DLS / ELS / size distribution / zeta potential



Optical Characterization

- Fourier Transformed Infrared Spectroscopy (FTIR and ATR-FTIR)
- Spectral Ellipsometry & Advanced Optical Modeling
- UV-Vis-NIR Spectroscopy

Covalent Partners & cyberTECHNOLOGIES

COVALENT METROLOGY

cyber TECHNOLOGIES

- Develop Optical Metrology Platforms with a modular architecture from the ground up:
  - Integrates a wide range of important measurements in a single package
  - Tools can be customized to clients' specific needs: up to 5 distinct sensors per machine
- cyberTECHNOLOGIES' non-contact 3D measurement systems are widely used in microelectronics and other precision industries – we'll see examples of these applications in the talk today!

Other Covalent Partners

Rigaku

JEOL Solutions for Innovation

J.A. Woollam

ThermoFisher SCIENTIFIC

Digital Surf

TA Instruments

Asylum Research an Oxford Instruments company

PVA TePla

KEYENCE

HORIBA Scientific

TELEDYNE CETAC TECHNOLOGIES Everywhereyoulook™

Introducing today's speaker…

COVALENT METROLOGY

Karl-Heinz Strass

Managing Director for the Americas, cyberTECHNOLOGIES

- Over 35 years of experience in thin film and surface metrology
  - Specialized in researching and developing metrology systems and applications
- Master's degree in Engineering from the University of Applied Sciences in Munich
- Joined Tencor Instruments (later KLA-Tencor) as an applications engineer
- Worked in various Sales and Marketing roles; now overseeing cyberTECHNOLOGIES' sales and marketing operations across the Americas

cyber TECHNOLOGIES

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(HiRes Topo & Film Thickness)
CFM

CONFOCAL WHITE LIGHT
(Topo & Film Thickness)
CHR

3D WHITE LIGHT INTER-FEROMETER
(HiRes Topo)
WLI

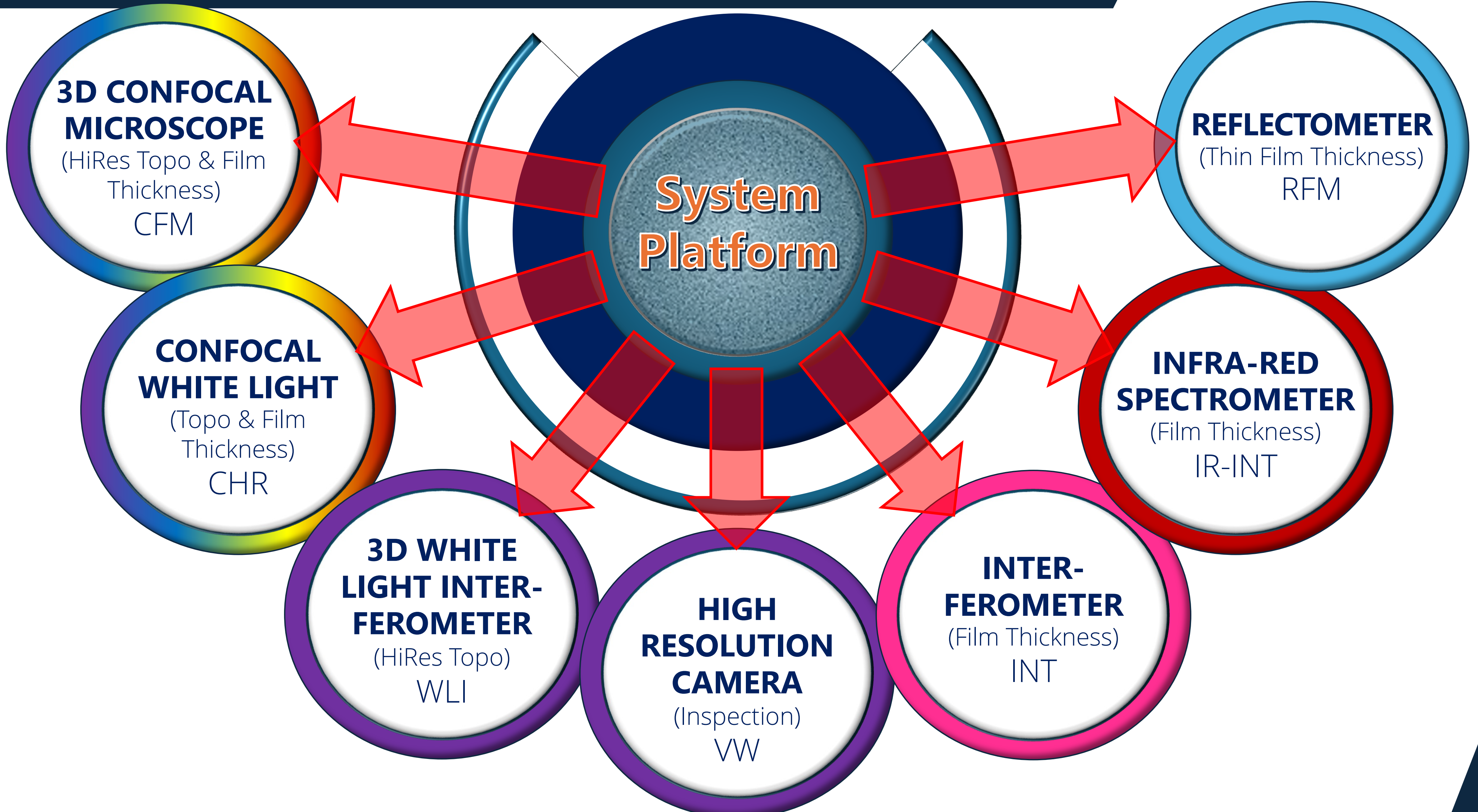
HIGH RESOLUTION CAMERA
(Inspection)
VW

INTER-FEROMETER
(Film Thickness)
INT

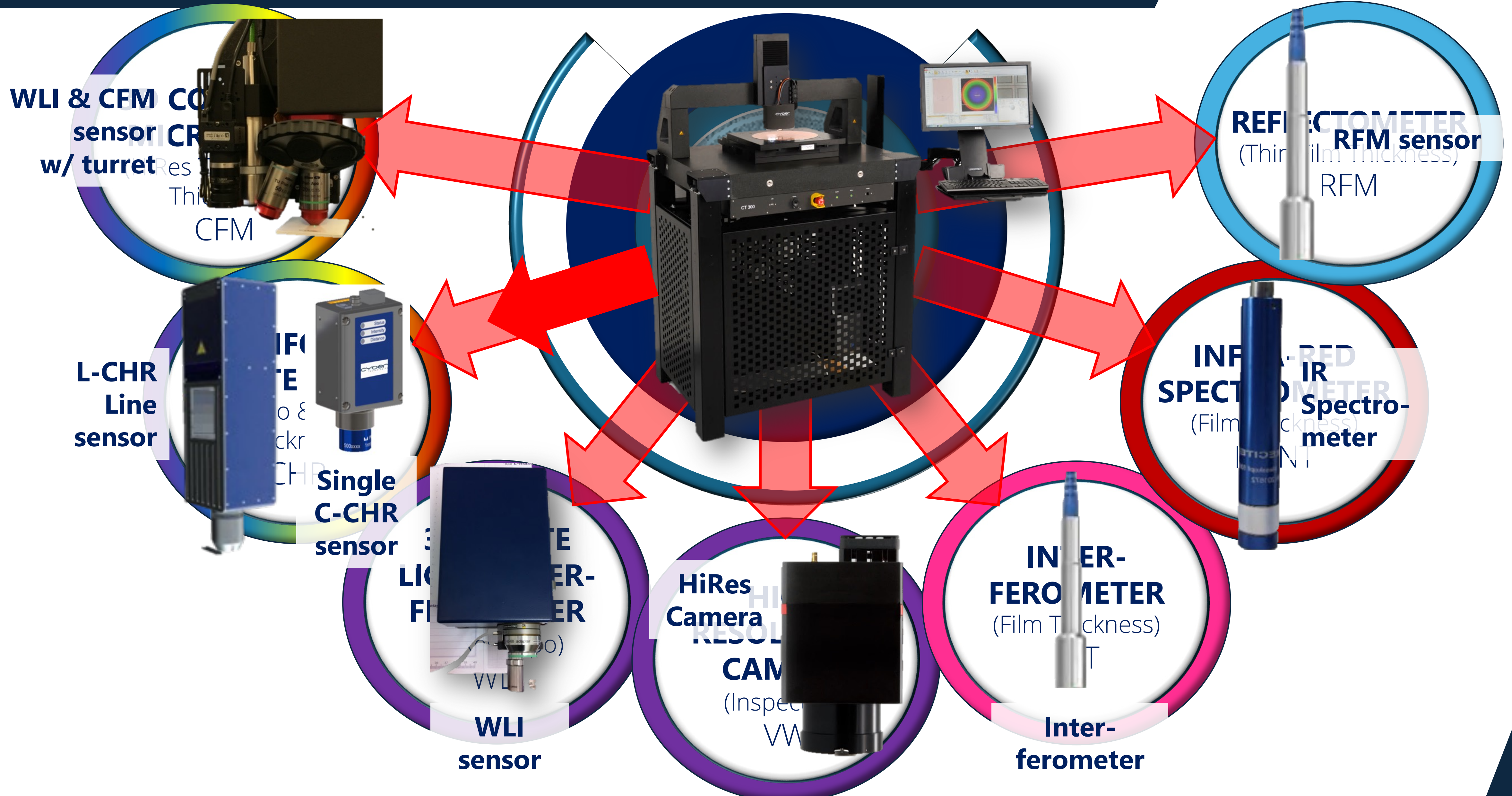
INFRA-RED SPECTROMETER
(Film Thickness)
IR-INT

REFLECTOMETER
(Thin Film Thickness)
RFM

MEASUREMENT TECHNOLOGIES

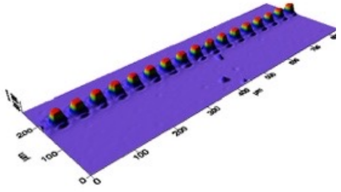
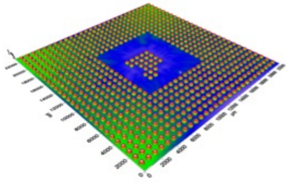
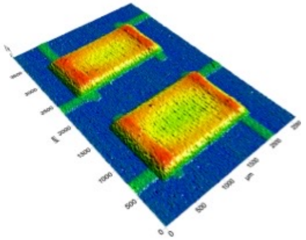
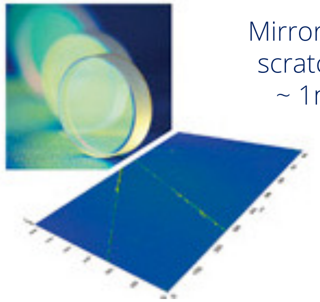
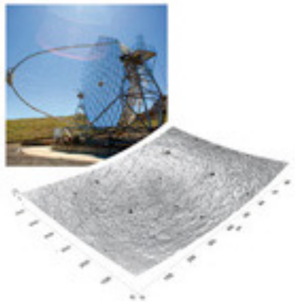
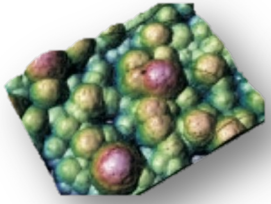
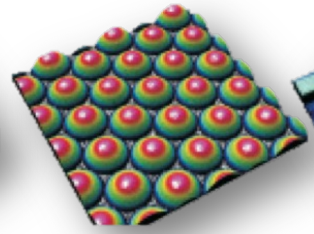


MEASUREMENT TECHNOLOGIES



Sensor Technologies & Use Cases
Topography Measurements

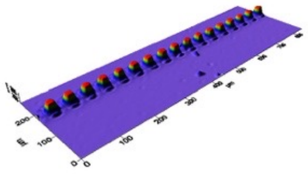
cyber TECHNOLOGIES

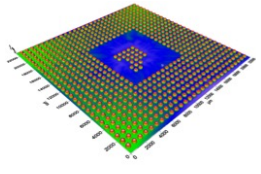
Sensor Technologies	Approx. z Resolution	Typical Use Cases	Examples
CONFOCAL WHITE LIGHT	P/L-CHR point sensor 70 nm ~ µm	General surface topography, roughness, step heights, BGA, flatness	 Dispensed dots  BGA, Micro-BGA, Solder Deposits  Printed Materials
3D WHITE LIGHT INTERFEROMETER	WLI 2D/3D sensor 0.1 nm ~ 1 nm	High resolution roughness measurements, ie. roughness of smooth or polished surfaces	 Mirror with scratches ~ 1nm 
3D CONFOCAL MICROSCOPE	CFM 2D/3D sensor 1 nm ~ 3 nm	High resolution topography measurements, ie. patterned wafers, etched micro-channels	 Metal surface 230µm x 300µm  Micro-lens array 125µm x 125µm  Opto-electronic device 40µm x 50µm

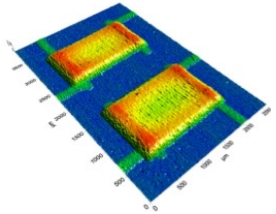
Sensor Technologies & Use Cases
Film Thickness Measurements

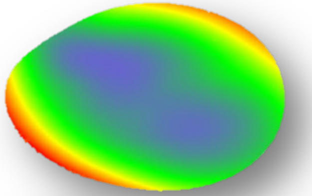
Sensor Technologies	Approx. z Resolution	Typical Use Cases
CONFOCAL WHITE LIGHT	P/L-CHR point sensor 70 nm ~ µm	General surface topography, roughness, step heights, BGA, flatness
REFLECTOMETER (Thin Film Thickness)	RFM point sensor 70 nm ~ 5 µm	Thin Film Thickness measurements (<5 um), measurements through transparent films, very high precision
3D CONFOCAL MICROSCOPE	CFM 2D/3D sensor 1 nm ~ 3 nm	High resolution topography measurements, ie. patterned wafers, etched micro-channels
INTERFEROMETER (Film Thickness)	INT point sensor µm	Film Thickness measurements, measurements through transparent films, conformal coating
INFRA-RED SPECTROMETER	IR-INT point sensor µm	Thickness measurements of Si (transparent for IR), air gap measurements under Si layers

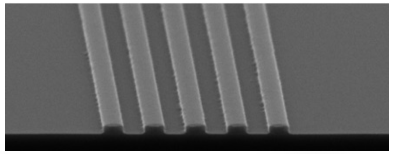
Examples

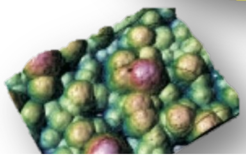

Dispensed dots

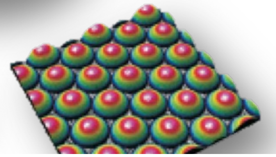

BGA, Micro-BGA, Solder Deposits


Printed Materials

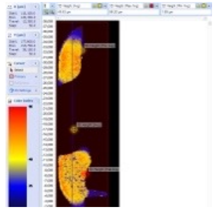




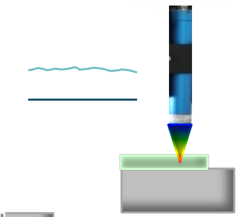

Metal surface 230µm x 300µm


Micro-lens array 125µm x 125µm

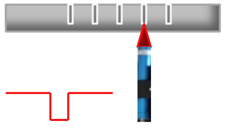

Opto-electronic device 40µm x 50µm



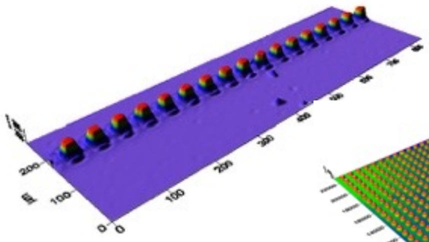
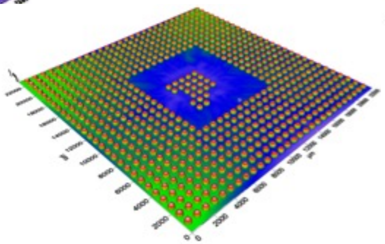
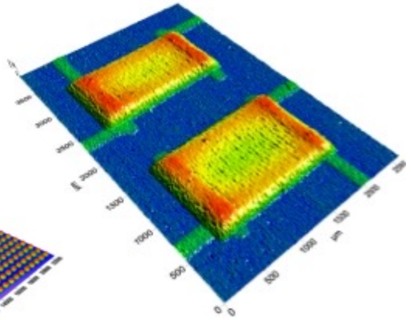
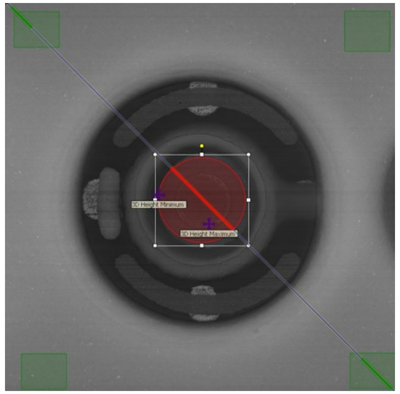
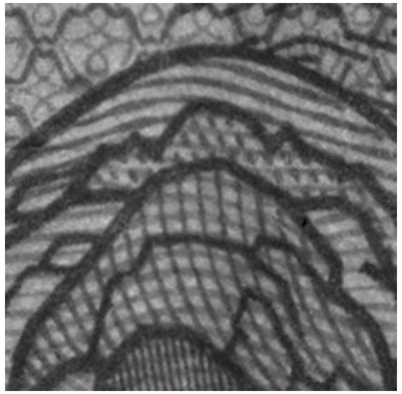
Conformal Coating



Wafer Thickness
Via Depth



Sensor Technologies & Use Cases
Visual / Defect Inspection

Sensor Technologies	Approx. z Resolution	Typical Use Cases	Examples
CONFOCAL WHITE LIGHT	P/L-CHR point sensor 70 nm ~ µm	General surface topography, roughness, step heights, BGA, flatness	 Dispensed dots  BGA, Micro-BGA, Solder Deposits  Printed Materials
High Resolution Camera	Dep on objective down to 2 um	Full field image capture with 220 MP Pixel-shifting camera Image analysis, defect detection, feature detection	 Bio-med sensor  Currency

The Swiss Army Knife of Metrology
Automatically switch amongst sensors

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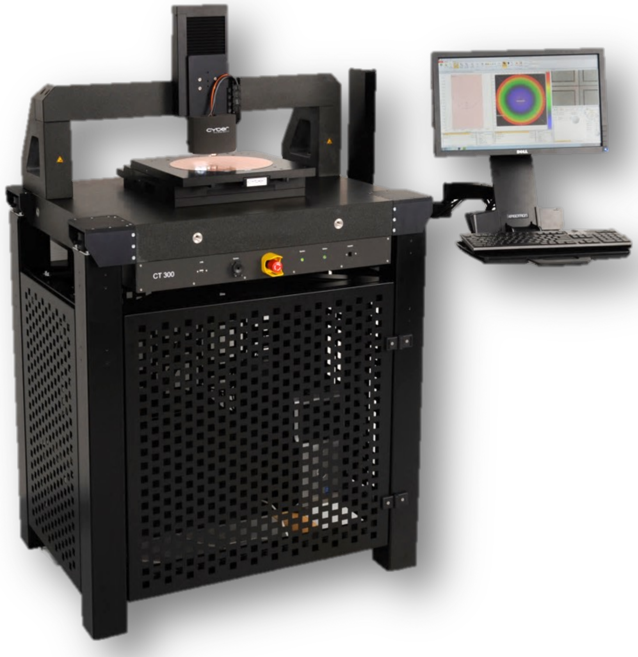
WLI & CFM sensor w/ turret

L-CHR Line sensor

Single C-CHR sensor

WLI sensor



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HiRes Camera

Inter-ferometer

RFM sensor

IR Spectro-meter

The Swiss Army Knife of Metrology
Automatically switch amongst sensors

cyber TECHNOLOGIES

WLI & CFM sensor w/ turret

RFM sensor

L-CHR Line sensor

Single C-CHR sensor

cyberscan CT 300

IR Spectro-meter

WLI sensor

HiRes Camera

Inter-ferometer

The Swiss Army Knife of Metrology
Automatically switch amongst sensors

WLI & CFM sensor w/ turret

RFM sensor

L-CHR Line sensor

Single C-CHR sensor

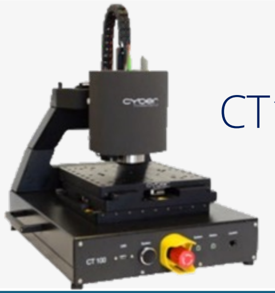
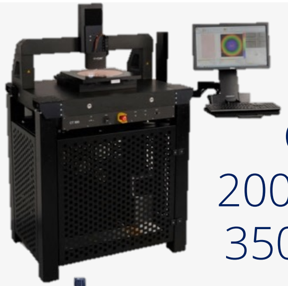
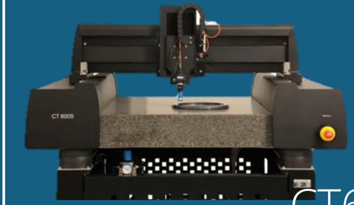
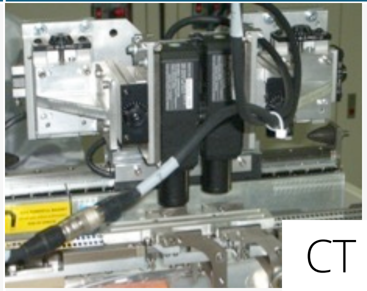
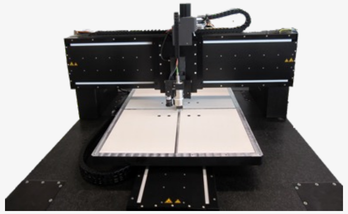
IR Spectro-meter

WLI sensor

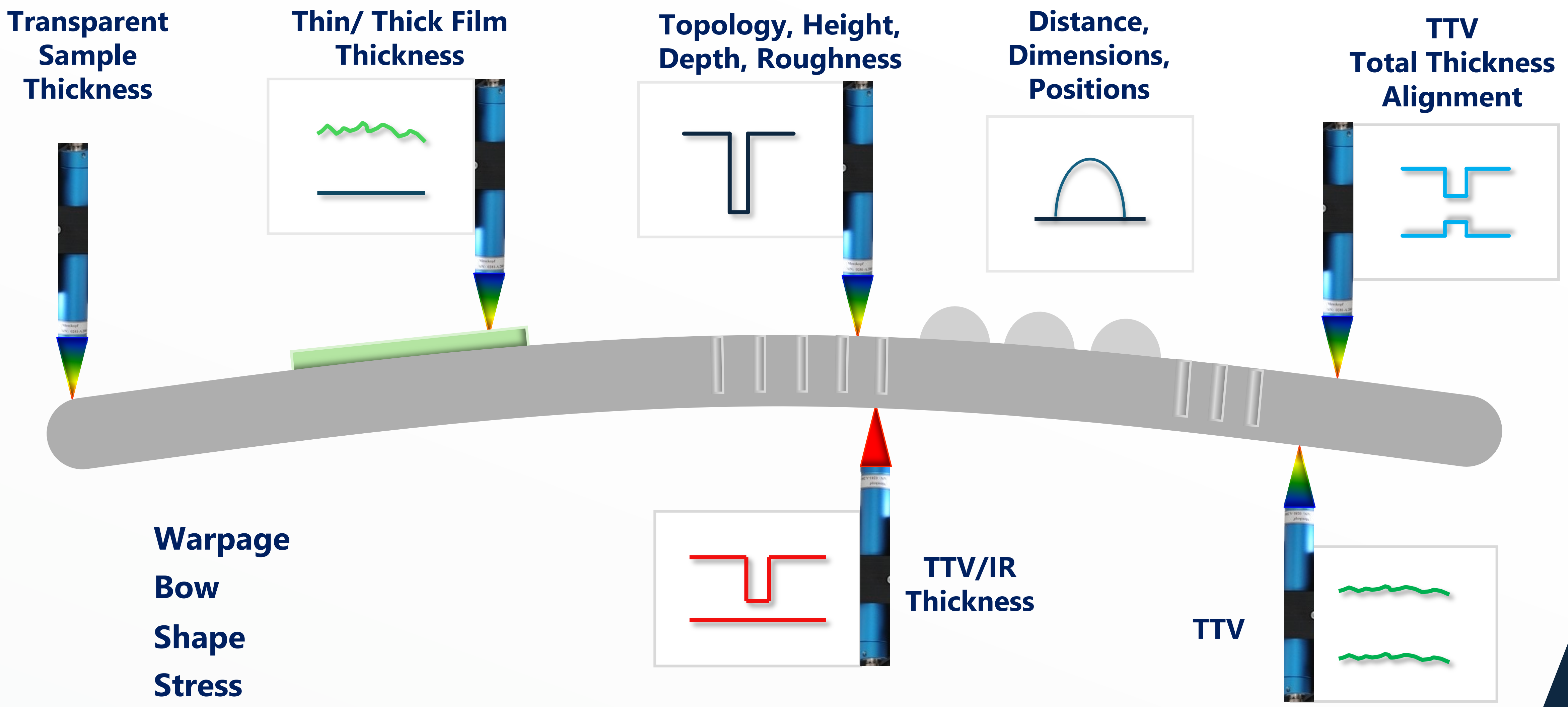
HiRes Camera

Inter-ferometer

SYSTEM PLATFORMS

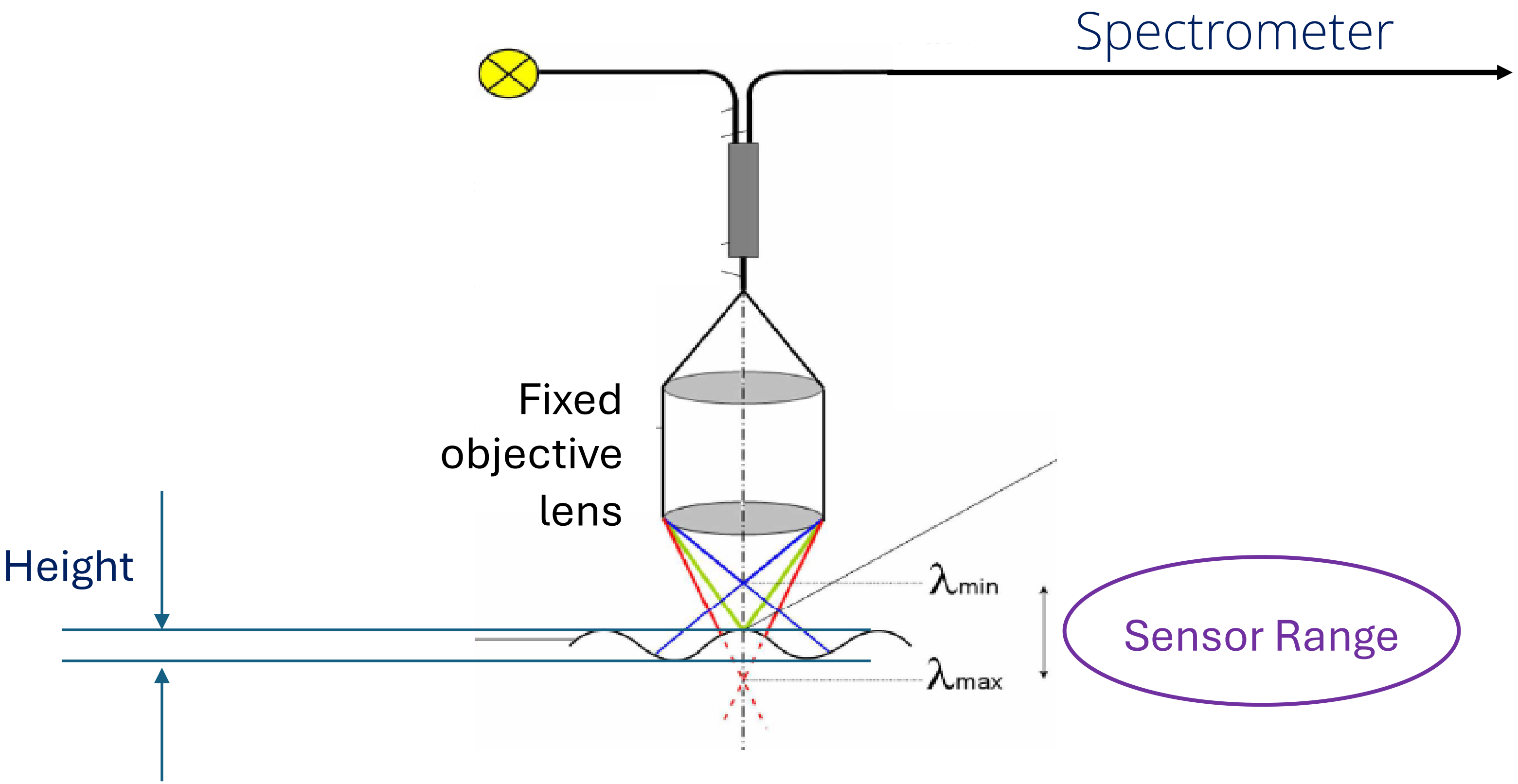
VANTAGE	 Vantage 1	 Vantage 2-C	 Vantage 2-P	
CT SERIES Surface & TTV	 CT100	 CT150	 CT 200/300/ 350/450	 CT250/ 350T/ 600T TTV
CTS SERIES & Automated Systems	 CT350S	 CT300	 CT600T	 CT600
CTX SERIES	 CT R200	 CT IL	 CT600L	 CT600S

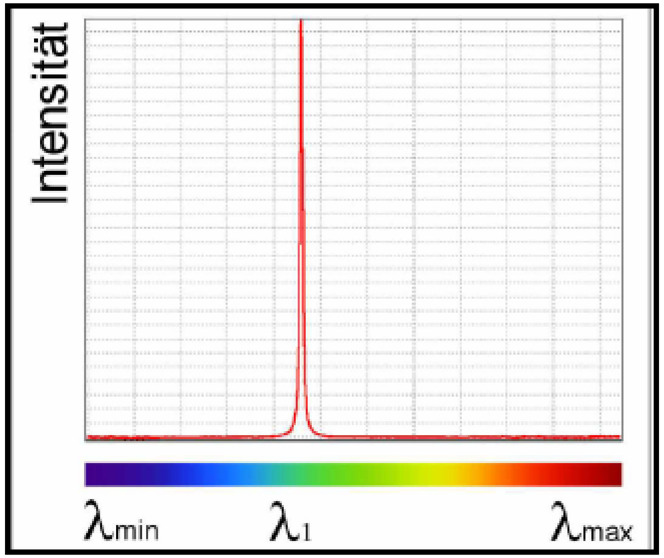
Use Cases for Chromatic Confocal Sensors

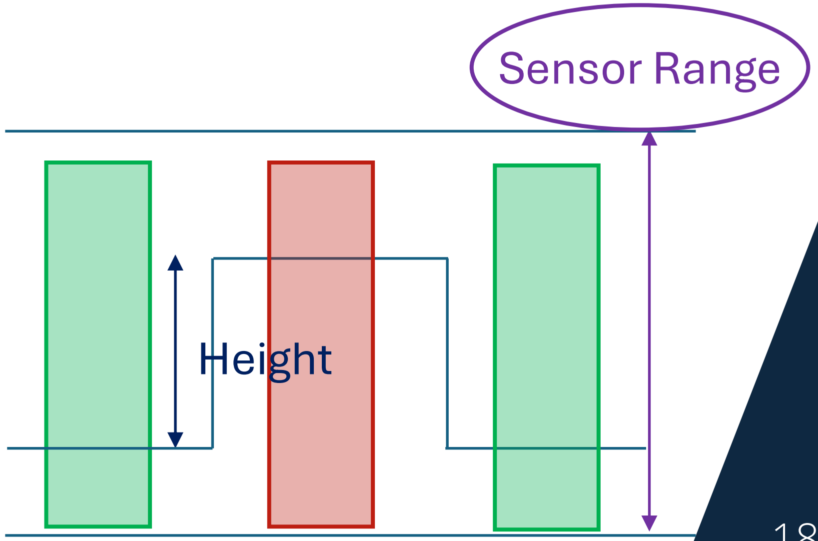


Confocal White Light Sensor

Chromatic confocal sensor







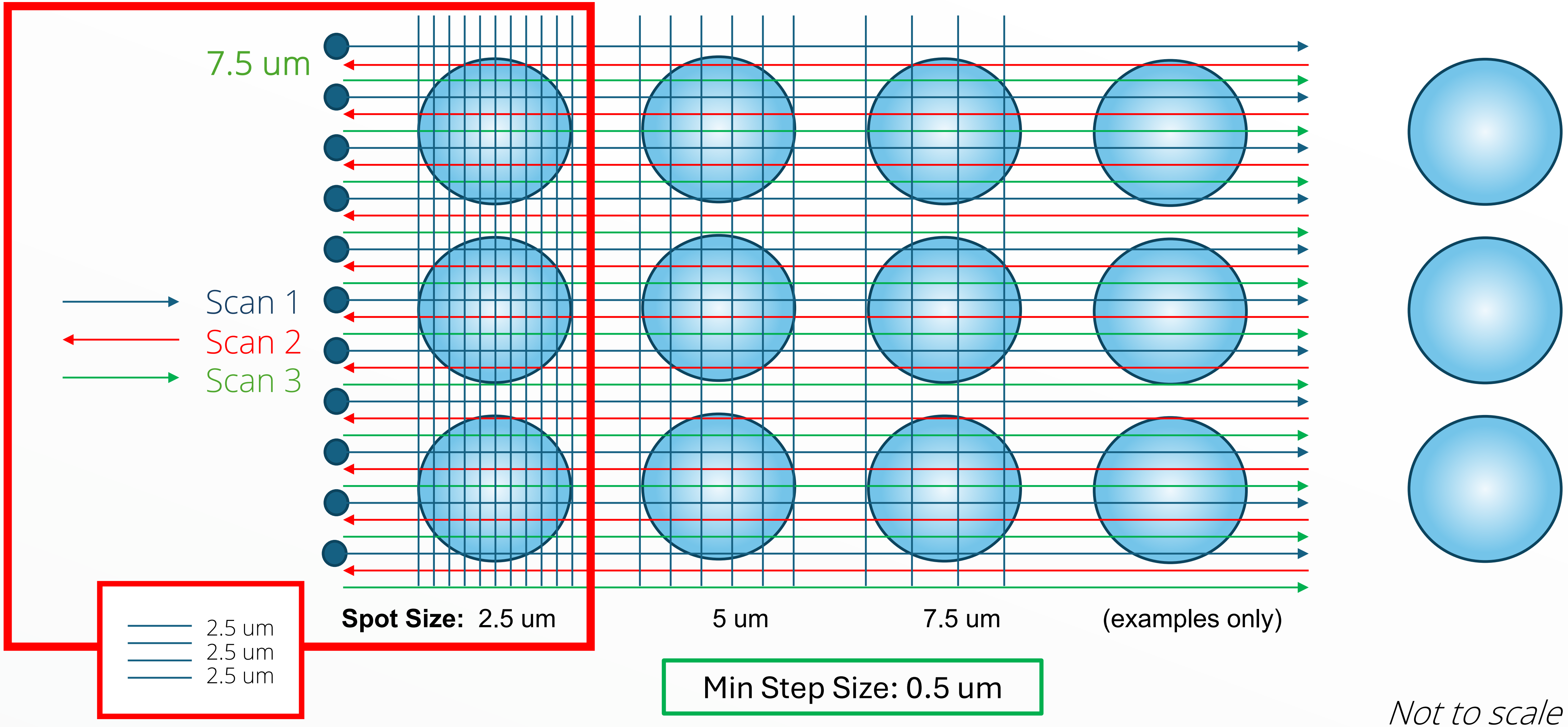
- Analysis: Relative Measurement within the sensor range
  - No physical movement of objective within the measurement range

Line Sensor– Point Pitch & Line Width

MODEL	POINT PITCH		LINE WIDTH		Numeric Aperture
L-CHR-200	5 µm	0.20 mils	0.96 mm	0.04 inch	0.7
L-CHR-500	7.5 µm	0.30 mils	1.43 mm	0.06 inch	0.61
L-CHR-1000	10 µm	0.39 mils	1.91 mm	0.08 inch	0.55
L-CHR-4000	25 µm	0.98 mils	4.78 mm	0.19 inch	0.33

Line Sensor– Point Pitch Interlaced Step Size Overview

Point Pitch: 7.5 um. interlaced (in this example 3 times for visual simplicity)



Min Step Size: 0.5 um

Not to scale

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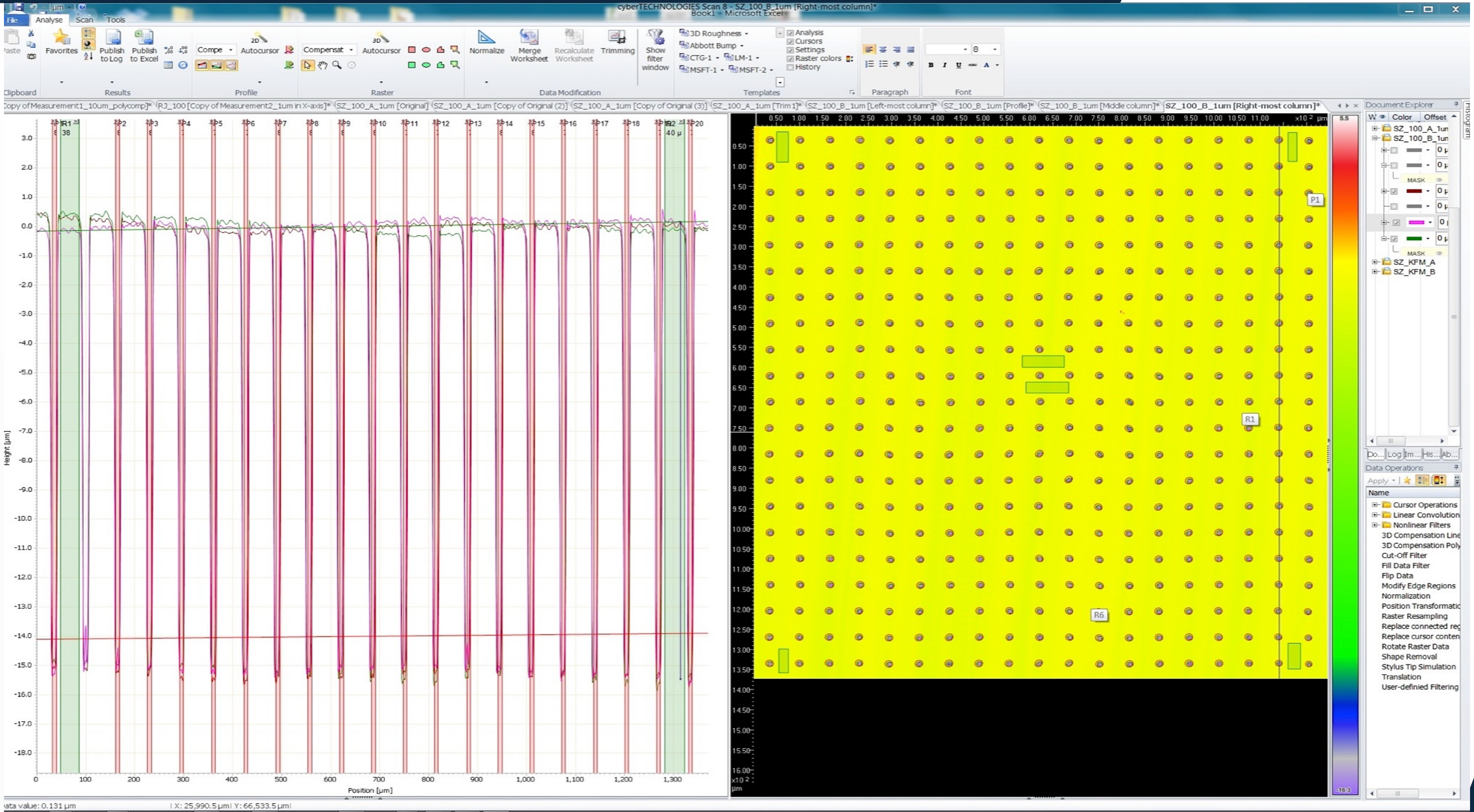
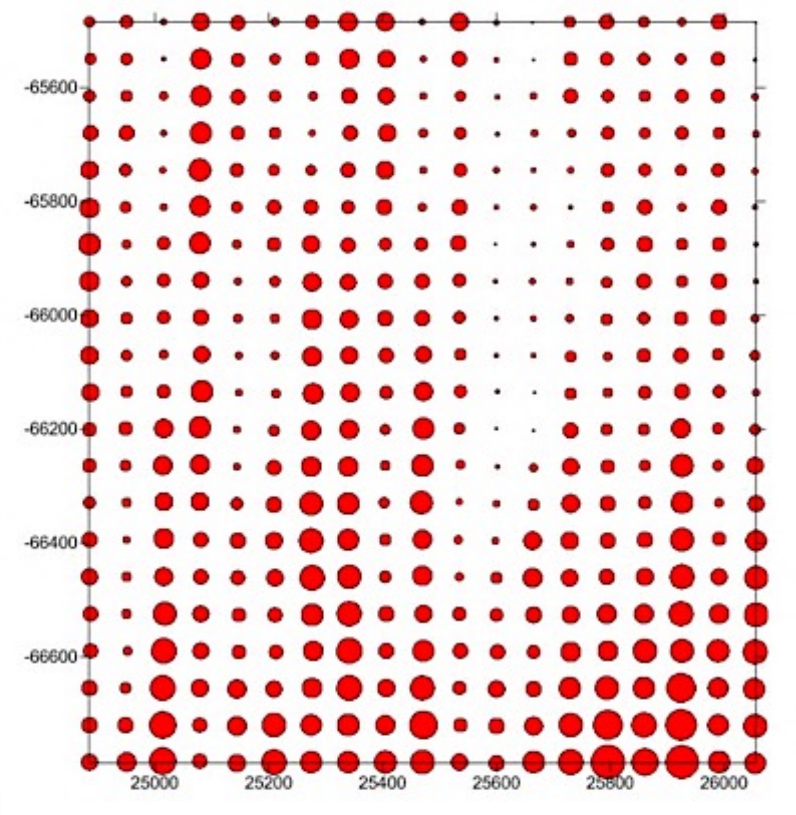
Monitoring Process Uniformities

Via sample: multiple profiles overlaid



Monitoring Process Uniformities

"Heat Map"



- Graphical display of feature height, depth, diameter, volume or roughness by location
- Nominal vs actual
- Dot size can represent any measured parameter, like
  - ball height, ~diameter, local roughness, feature height, volume etc.

Coplanarity

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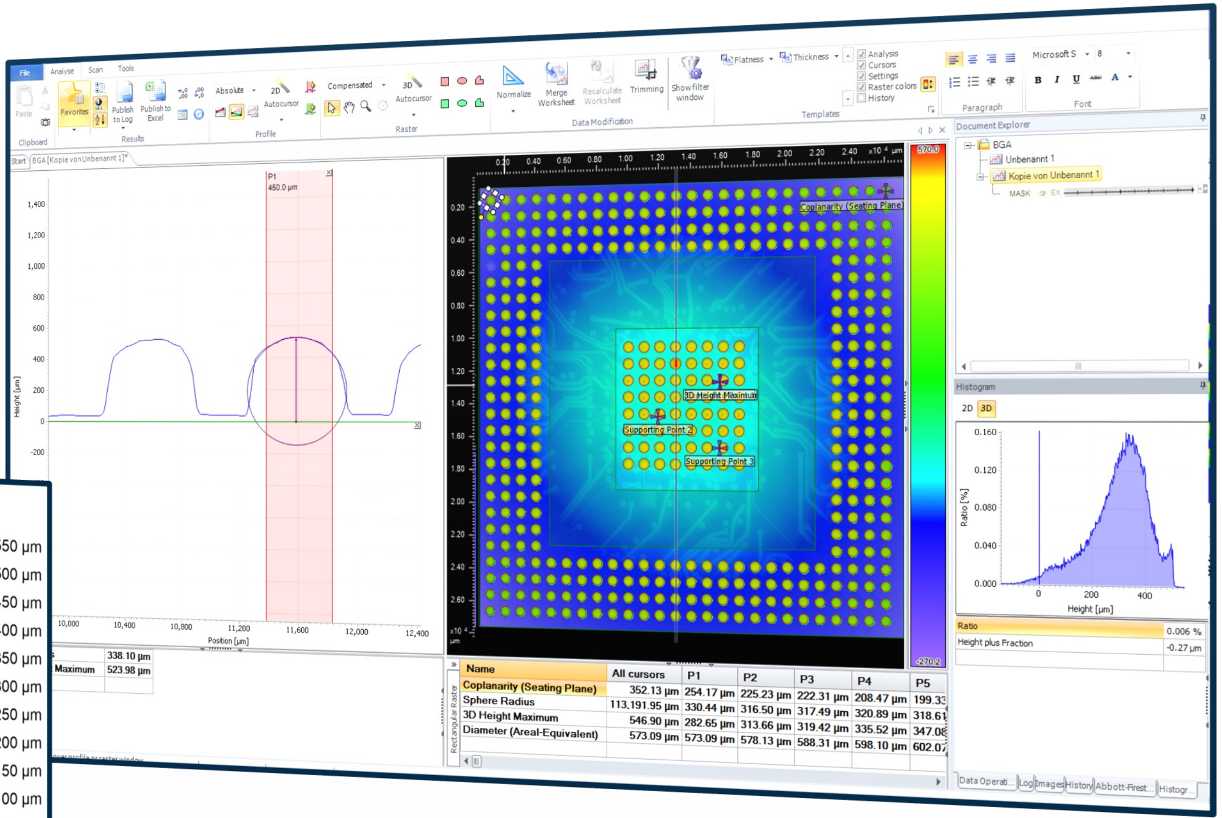
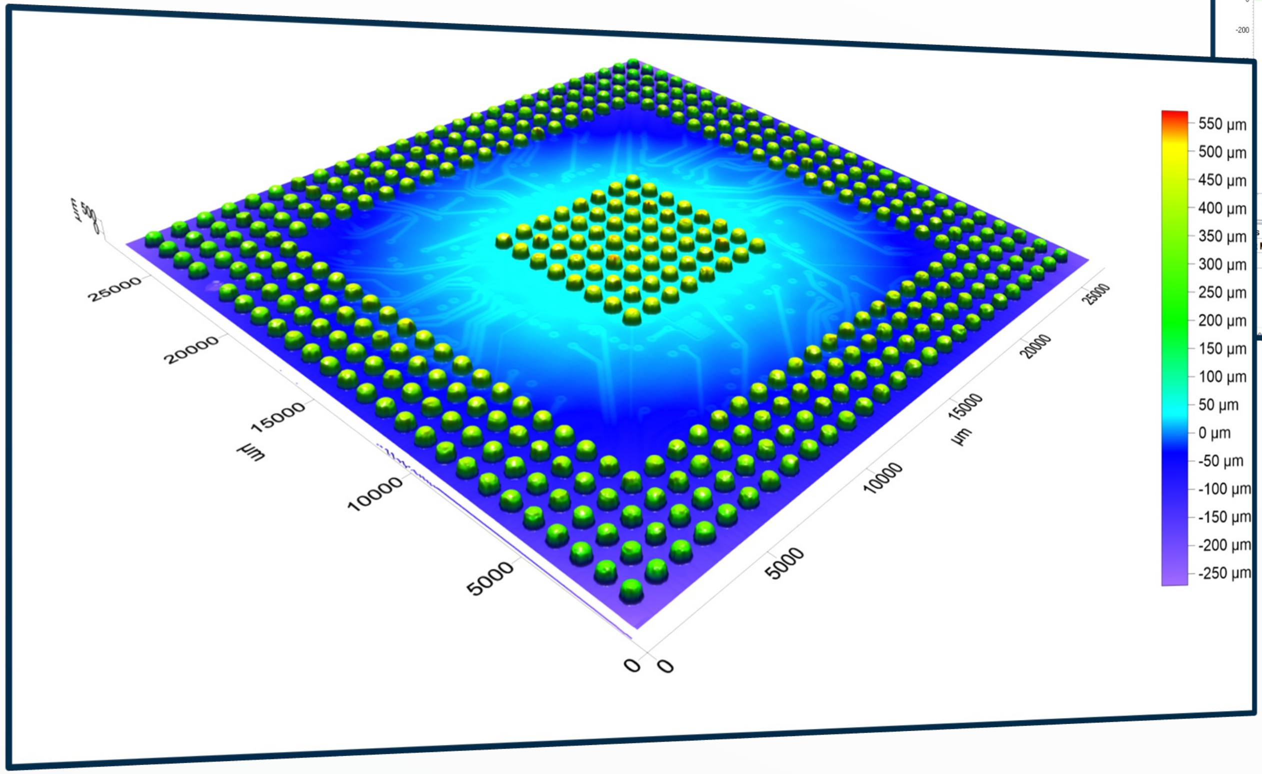
- Automatic Analysis
- Seating Plane
- Regression Plane
- Bump Height
- Bump Radius

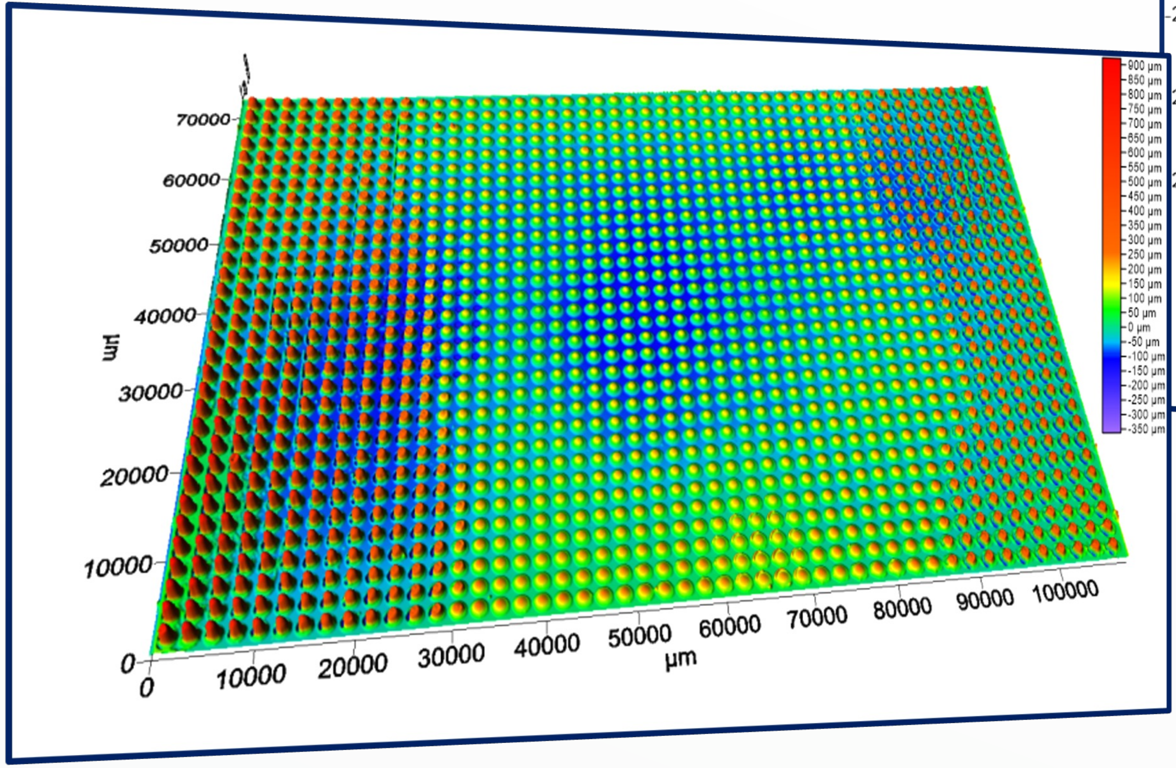


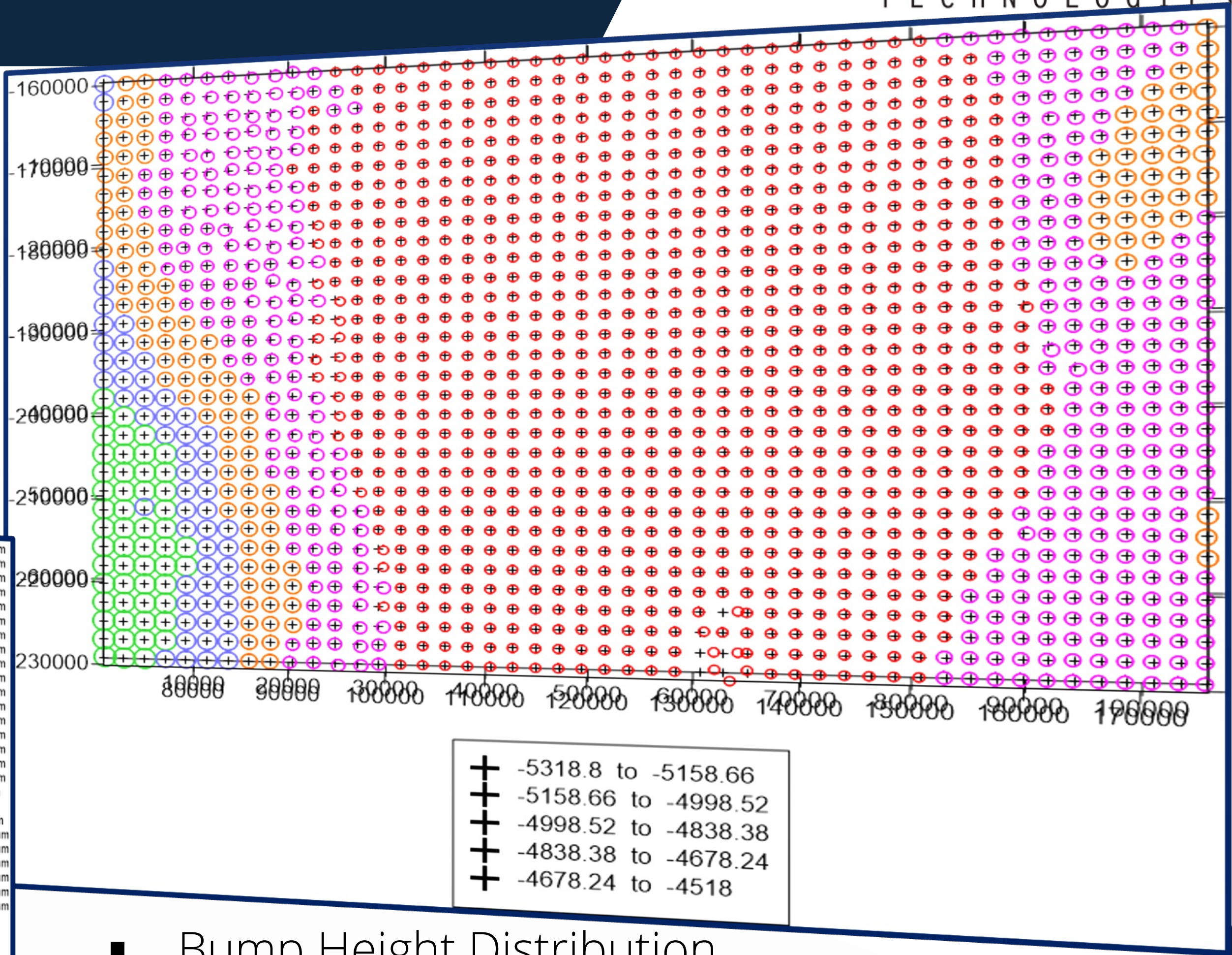


- Bump Location
- Bump Spacing
- Missing Bumps

Coplanarity

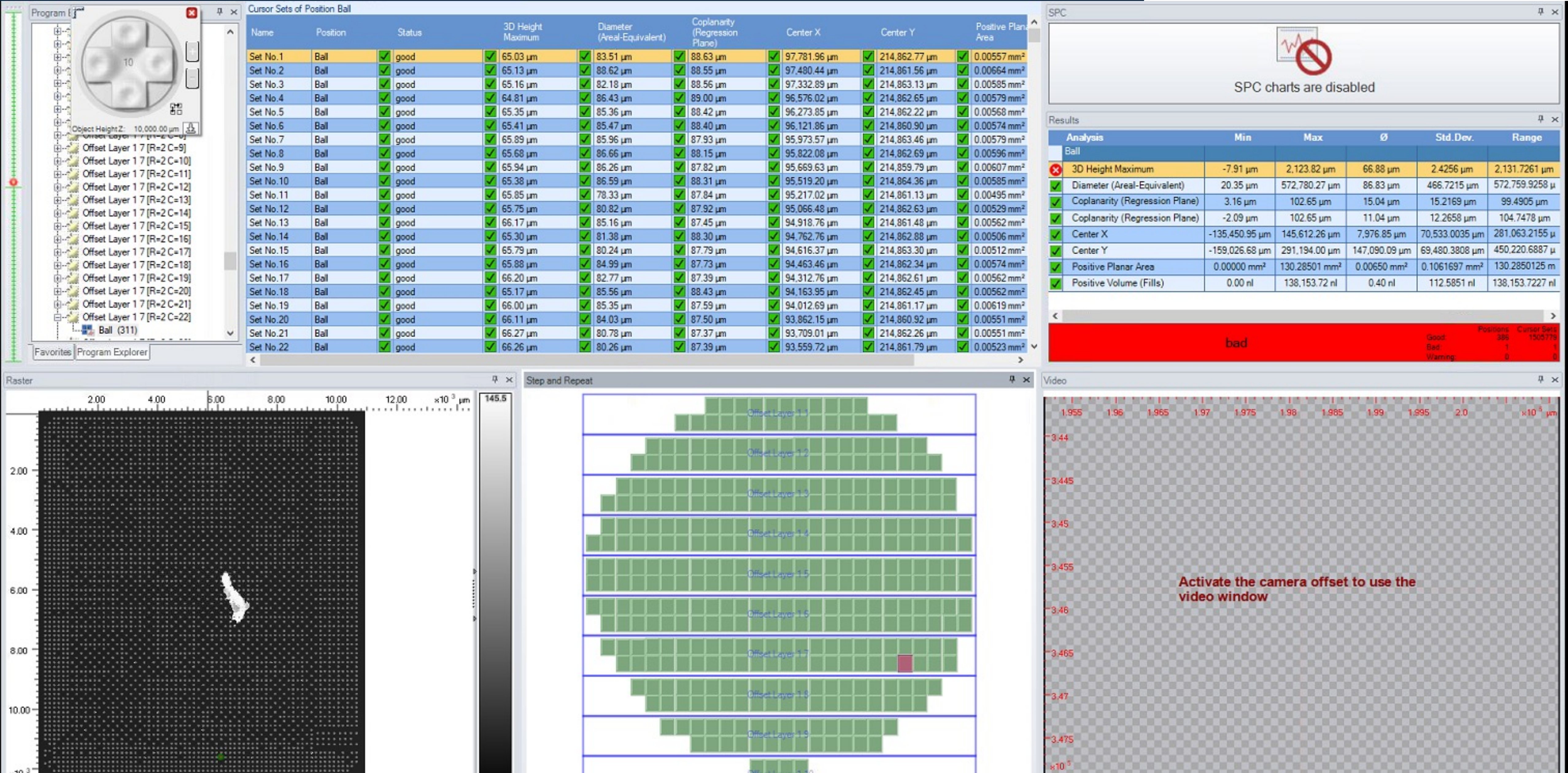
- Automatic Analysis
- Seating Plane
- Regression Plane
- Bump Height
- Bump Radius





- Bump Height Distribution
- Deviation from Nominal
- Missing Bumps

Sample Wafer



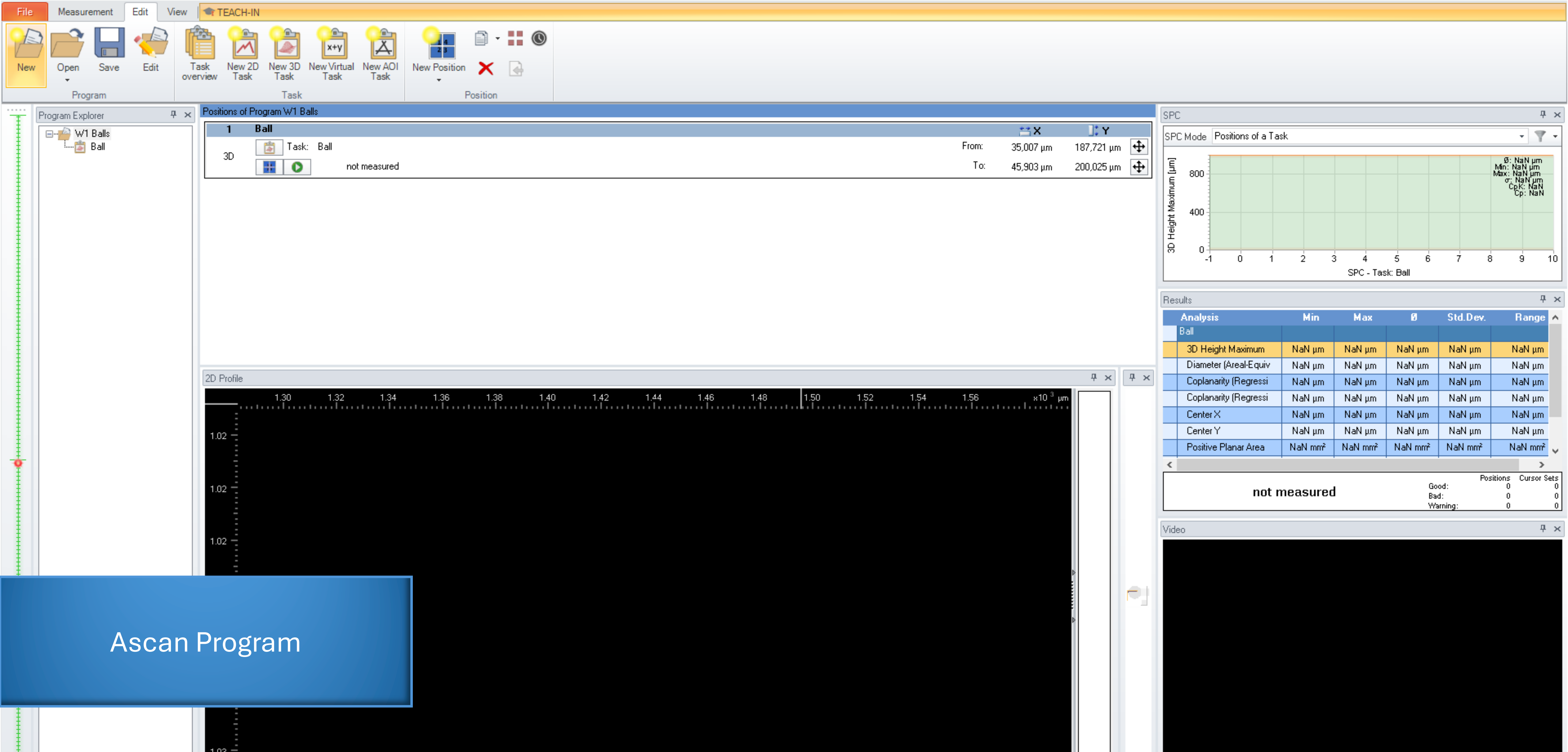
Cursor Sets of Position Ball

Name	Position	Status	3D Height Maximum	Diameter (Areal-Equivalent)	Coplanarity (Regression Plane)	Center X	Center Y	Positive Planar Area
Set No.1	Ball	good	65.03 µm	83.51 µm	88.63 µm	97,781.96 µm	214,862.77 µm	0.00557 mm²
Set No.2	Ball	good	65.13 µm	88.62 µm	88.55 µm	97,480.44 µm	214,861.56 µm	0.00664 mm²
Set No.3	Ball	good	65.16 µm	82.18 µm	88.56 µm	97,332.89 µm	214,863.13 µm	0.00585 mm²
Set No.4	Ball	good	64.81 µm	86.43 µm	89.00 µm	96,576.02 µm	214,862.65 µm	0.00579 mm²
Set No.5	Ball	good	65.35 µm	85.36 µm	88.42 µm	96,273.85 µm	214,862.22 µm	0.00568 mm²
Set No.6	Ball	good	65.41 µm	85.47 µm	88.40 µm	96,121.86 µm	214,860.90 µm	0.00574 mm²
Set No.7	Ball	good	65.89 µm	85.96 µm	87.93 µm	95,973.57 µm	214,863.46 µm	0.00579 mm²
Set No.8	Ball	good	65.68 µm	86.66 µm	88.15 µm	95,822.08 µm	214,862.69 µm	0.00596 mm²
Set No.9	Ball	good	65.94 µm	86.26 µm	87.82 µm	95,669.63 µm	214,859.79 µm	0.00607 mm²
Set No.10	Ball	good	65.38 µm	86.59 µm	88.31 µm	95,519.20 µm	214,864.36 µm	0.00585 mm²
Set No.11	Ball	good	65.85 µm	78.33 µm	87.84 µm	95,217.02 µm	214,861.13 µm	0.00495 mm²
Set No.12	Ball	good	65.75 µm	80.82 µm	87.92 µm	95,066.48 µm	214,862.63 µm	0.00529 mm²
Set No.13	Ball	good	66.17 µm	85.16 µm	87.45 µm	94,918.76 µm	214,861.48 µm	0.00562 mm²
Set No.14	Ball	good	65.30 µm	81.38 µm	88.30 µm	94,762.76 µm	214,862.88 µm	0.00506 mm²
Set No.15	Ball	good	65.79 µm	80.24 µm	87.79 µm	94,616.37 µm	214,863.30 µm	0.00512 mm²
Set No.16	Ball	good	65.88 µm	84.99 µm	87.73 µm	94,463.46 µm	214,862.34 µm	0.00574 mm²
Set No.17	Ball	good	66.20 µm	82.77 µm	87.39 µm	94,312.76 µm	214,862.61 µm	0.00562 mm²
Set No.18	Ball	good	65.17 µm	85.56 µm	88.43 µm	94,163.95 µm	214,862.45 µm	0.00562 mm²
Set No.19	Ball	good	66.00 µm	85.35 µm	87.59 µm	94,012.69 µm	214,861.17 µm	0.00619 mm²
Set No.20	Ball	good	66.11 µm	84.03 µm	87.50 µm	93,862.15 µm	214,860.92 µm	0.00551 mm²
Set No.21	Ball	good	66.27 µm	80.78 µm	87.37 µm	93,709.01 µm	214,862.26 µm	0.00551 mm²
Set No.22	Ball	good	66.26 µm	80.26 µm	87.39 µm	93,559.72 µm	214,861.79 µm	0.00523 mm²

Results

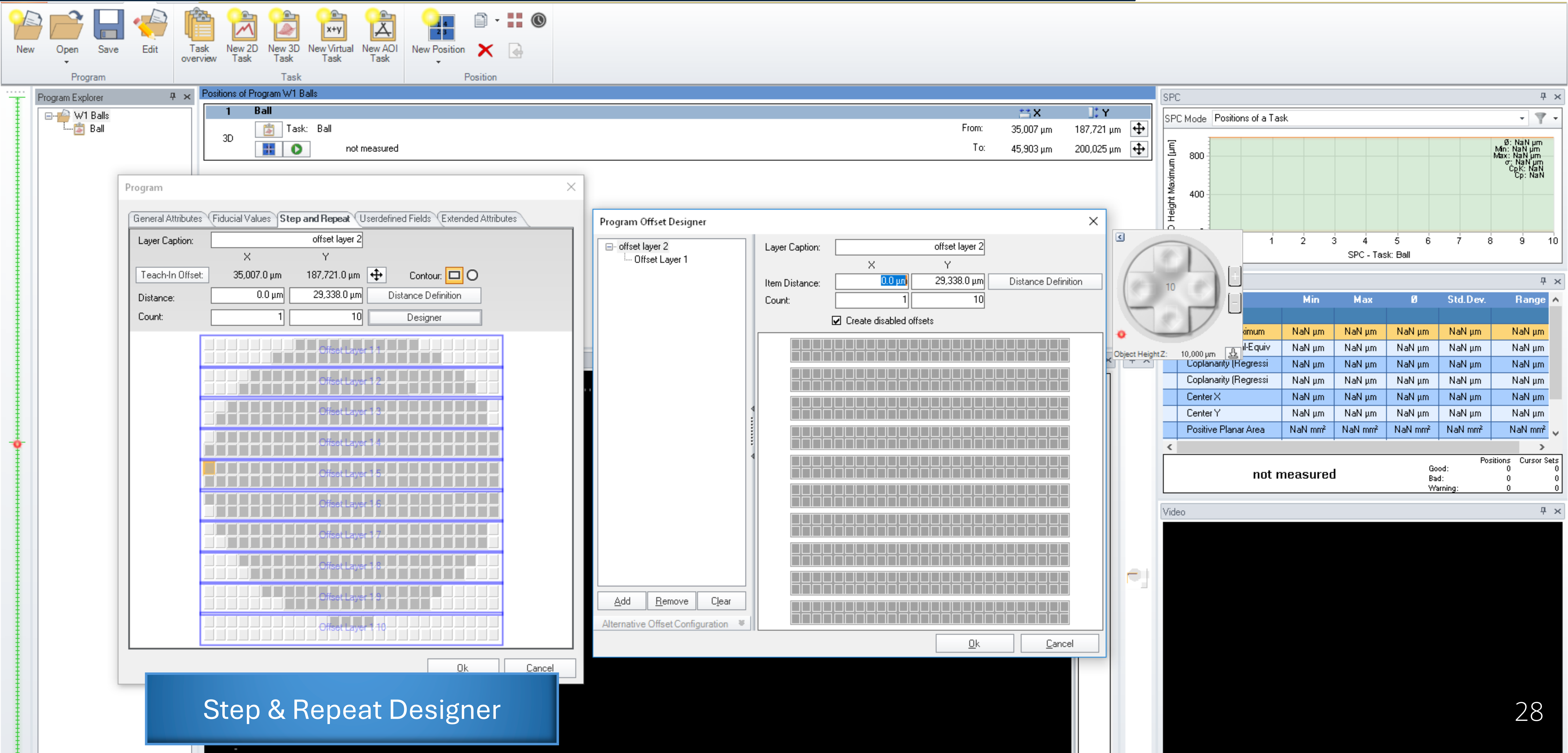
Analysis	Min	Max	Ø	Std.Dev.	Range
Ball					
3D Height Maximum	-7.91 µm	2,123.82 µm	66.88 µm	2.4256 µm	2,131.7261 µm
Diameter (Areal-Equivalent)	20.35 µm	572,780.27 µm	86.83 µm	466.7215 µm	572,759.9258 µ
Coplanarity (Regression Plane)	3.16 µm	102.65 µm	15.04 µm	15.2169 µm	99.4905 µm
Coplanarity (Regression Plane)	-2.09 µm	102.65 µm	11.04 µm	12.2658 µm	104.7478 µm
Center X	-135,450.95 µm	145,612.26 µm	7,976.85 µm	70,533.0035 µm	281,063.2155 µ
Center Y	-159,026.68 µm	291,194.00 µm	147,090.09 µm	69,480.3808 µm	450,220.6887 µ
Positive Planar Area	0.00000 mm²	130.28501 mm²	0.00650 mm²	0.1061697 mm²	130.2850125 m
Positive Volume (Fills)	0.00 nl	138,153.72 nl	0.40 nl	112.5851 nl	138,153.7227 nl

Simple Program Setup

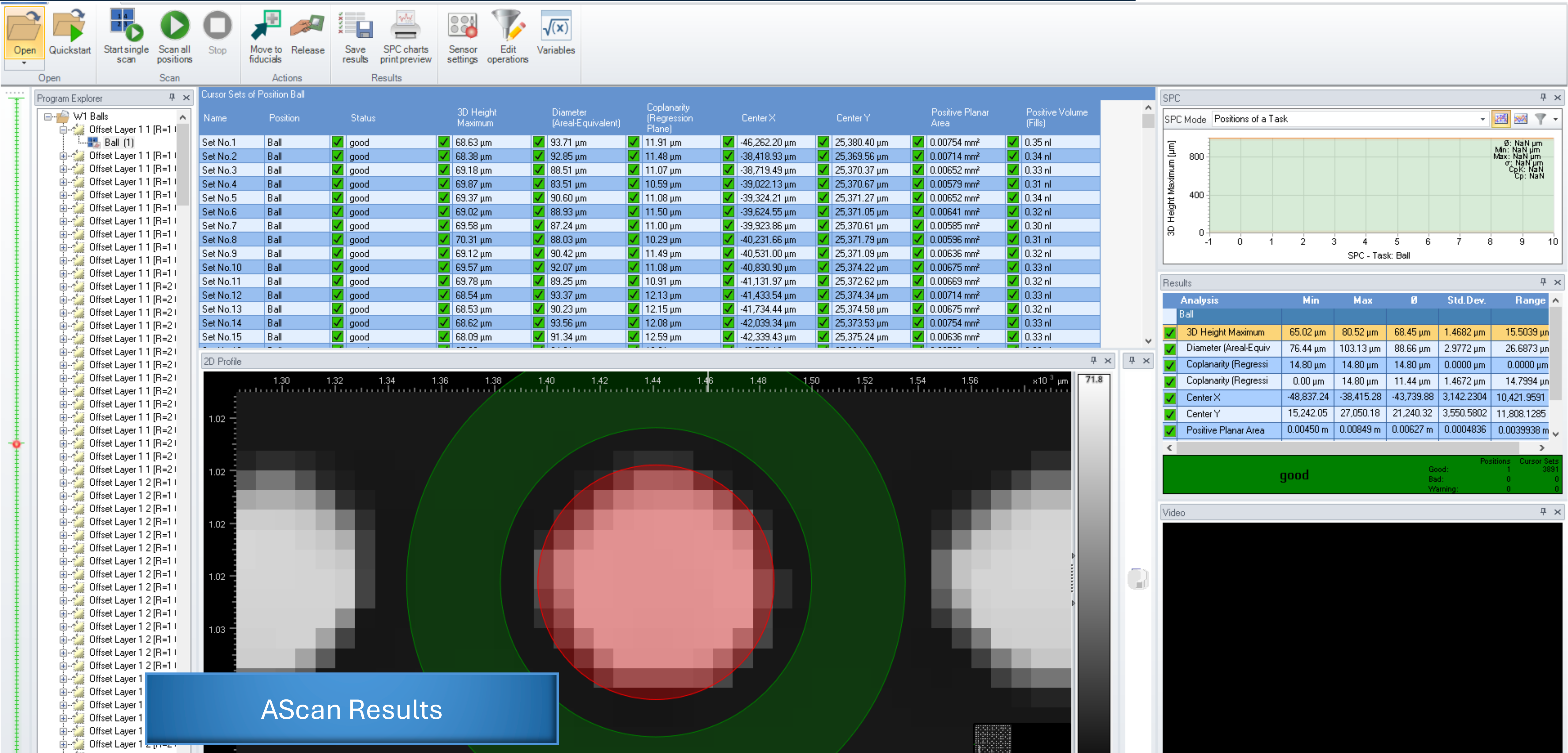


Ascan Program

Wafer Die Grid

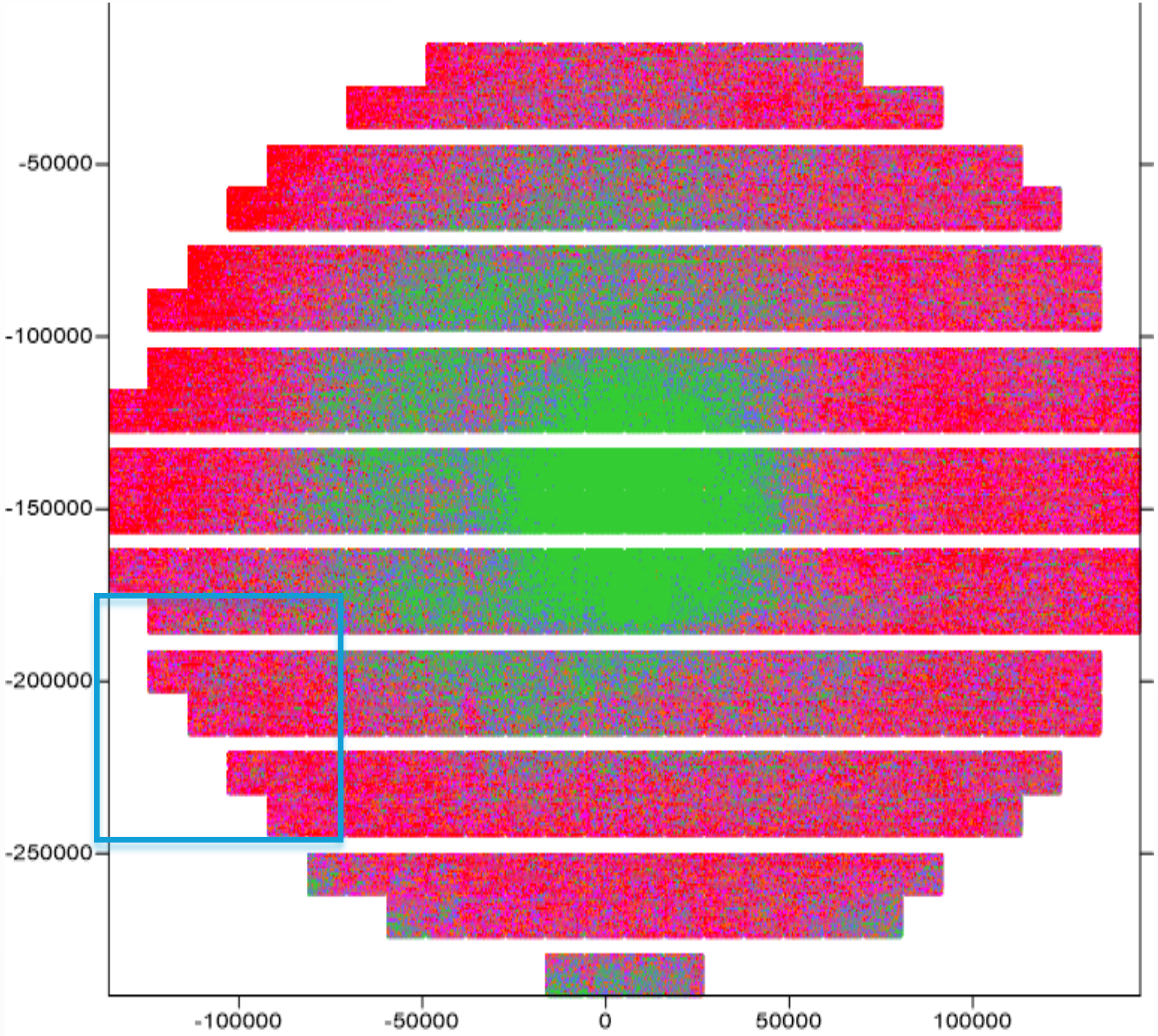


Sample Wafer

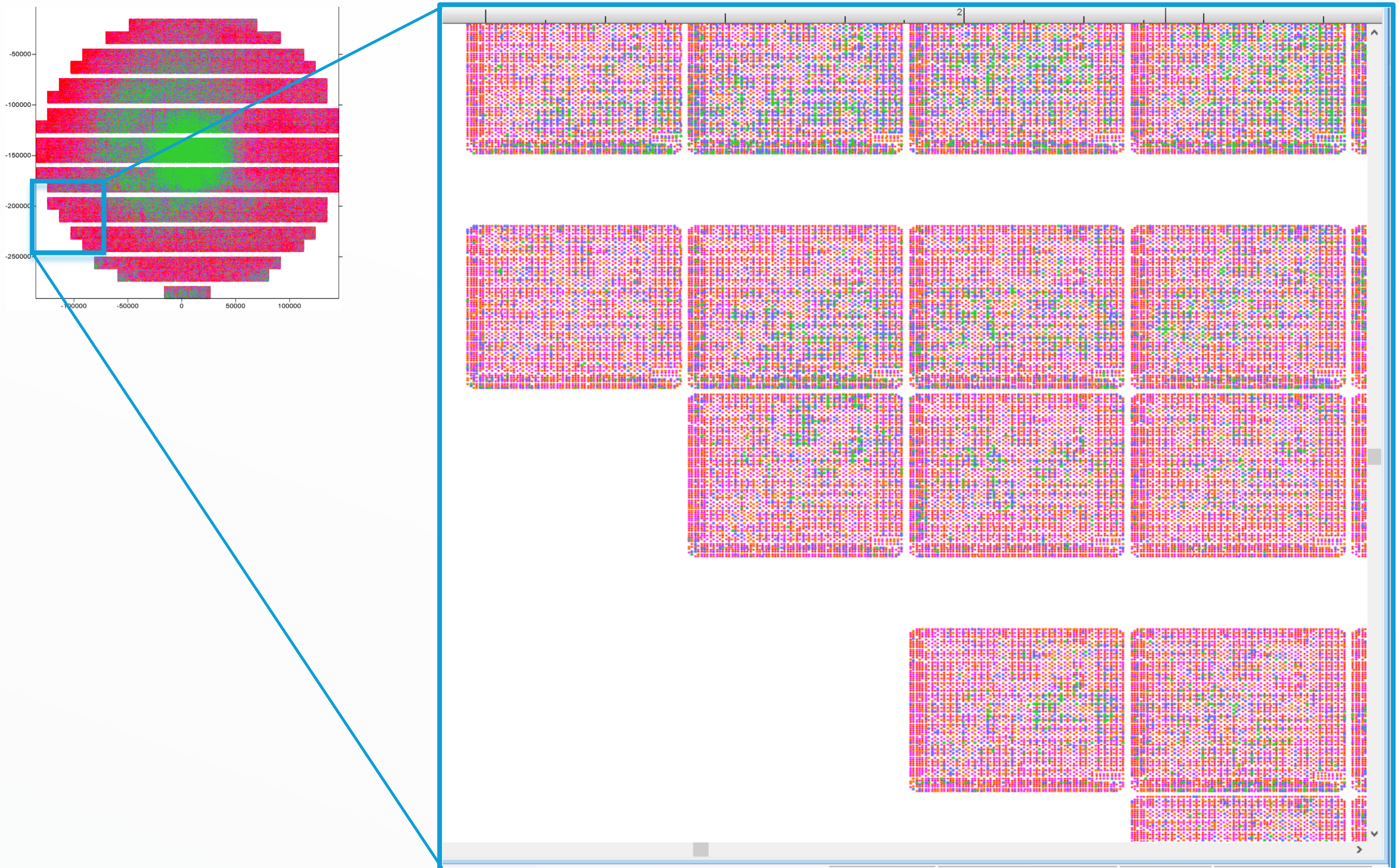


AScan Results

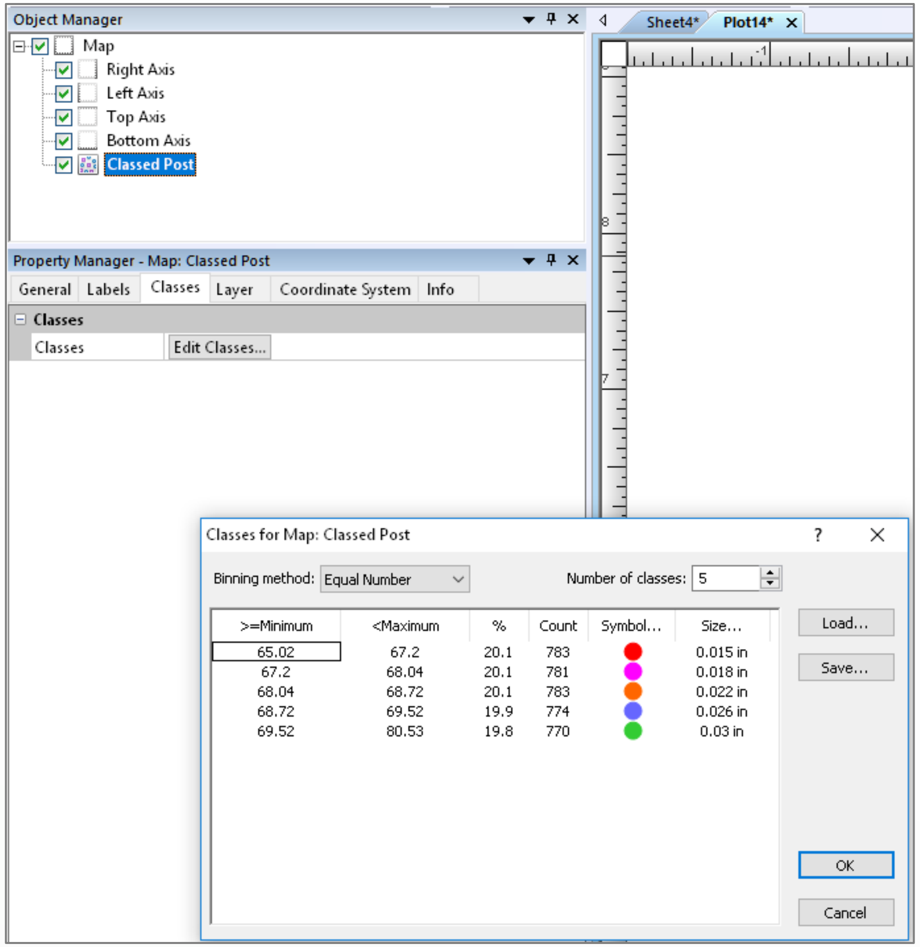
Full Wafer Bump Height Distribution

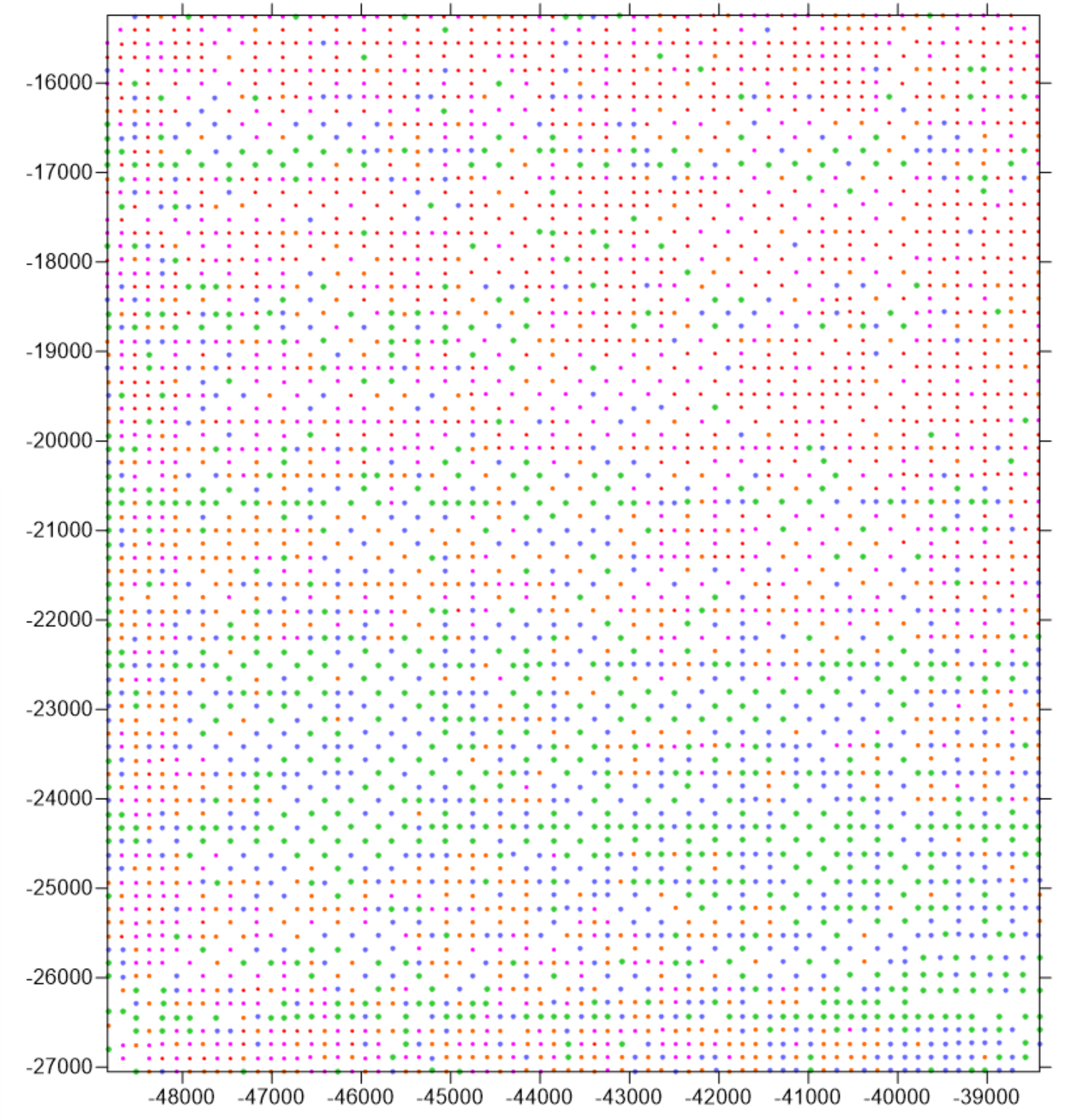


Sample Wafer – Wafer May by Die



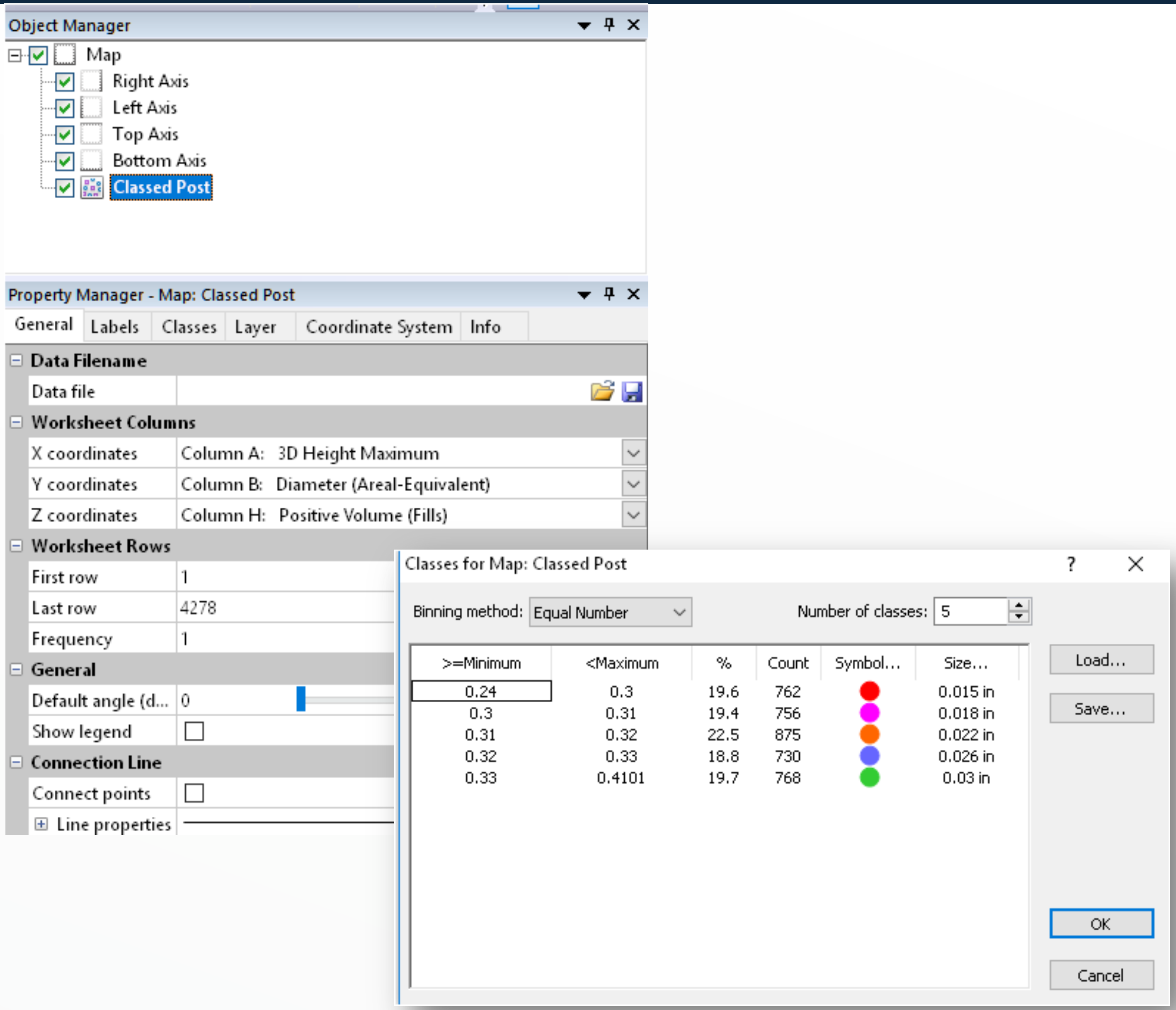
Sample Wafer – Height



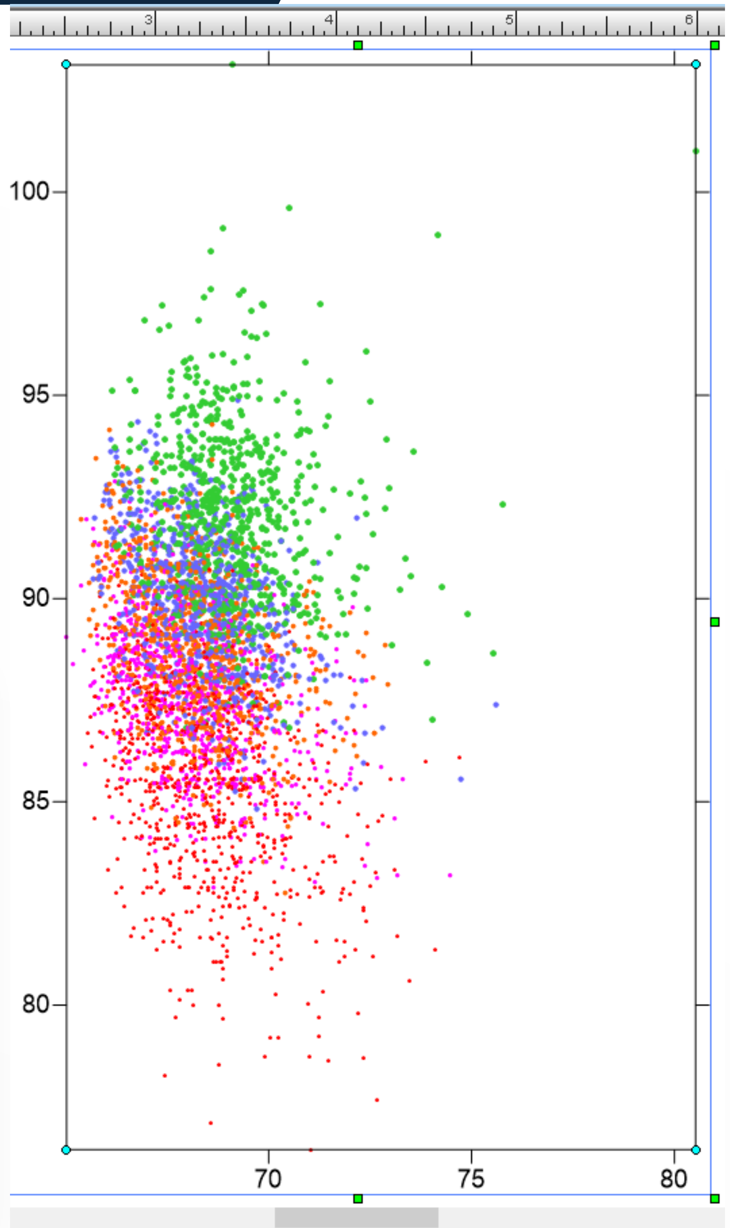


Height – equal Numbers

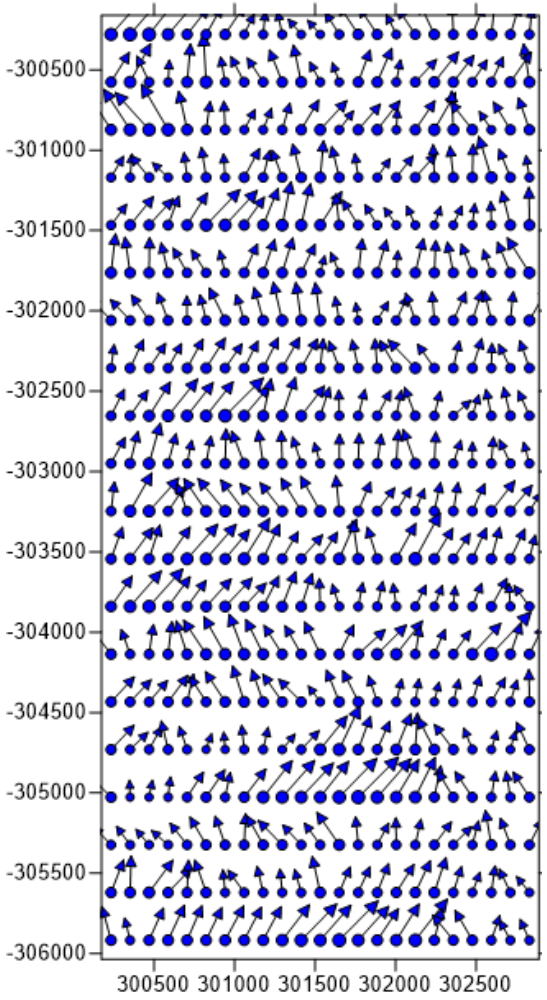
Sample Wafer – Height vs Diameter vs Volume Distribution

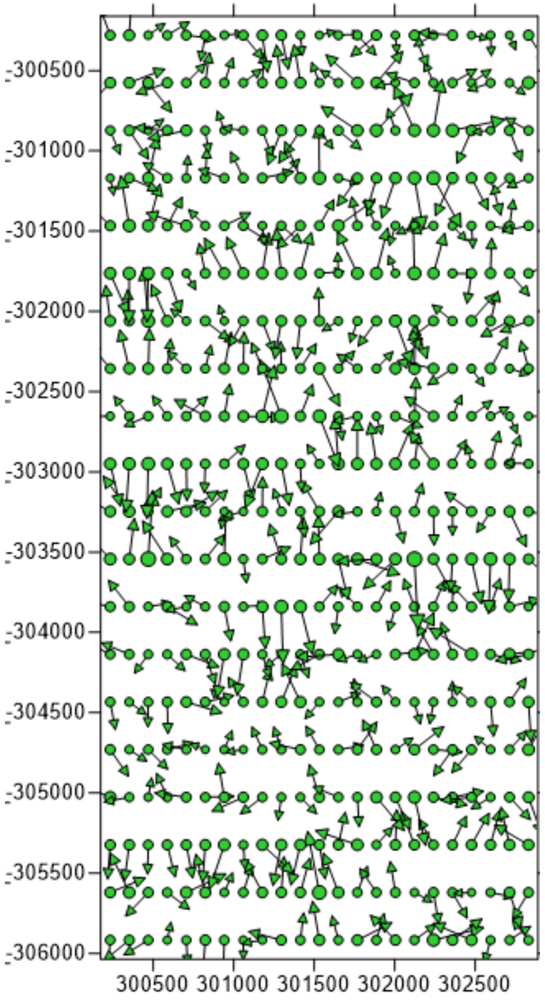


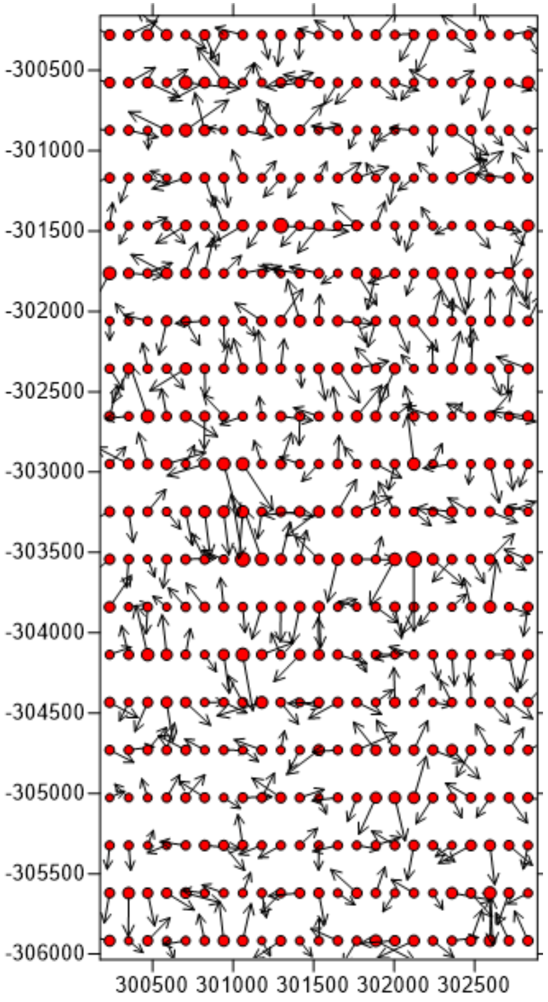
>=Minimum	<Maximum	%	Count	Symbol...	Size...
0.24	0.3	19.6	762		0.015 in
0.3	0.31	19.4	756		0.018 in
0.31	0.32	22.5	875		0.022 in
0.32	0.33	18.8	730		0.026 in
0.33	0.4101	19.7	768		0.03 in



Fully automated analysis of x/y deviation across the entire sample





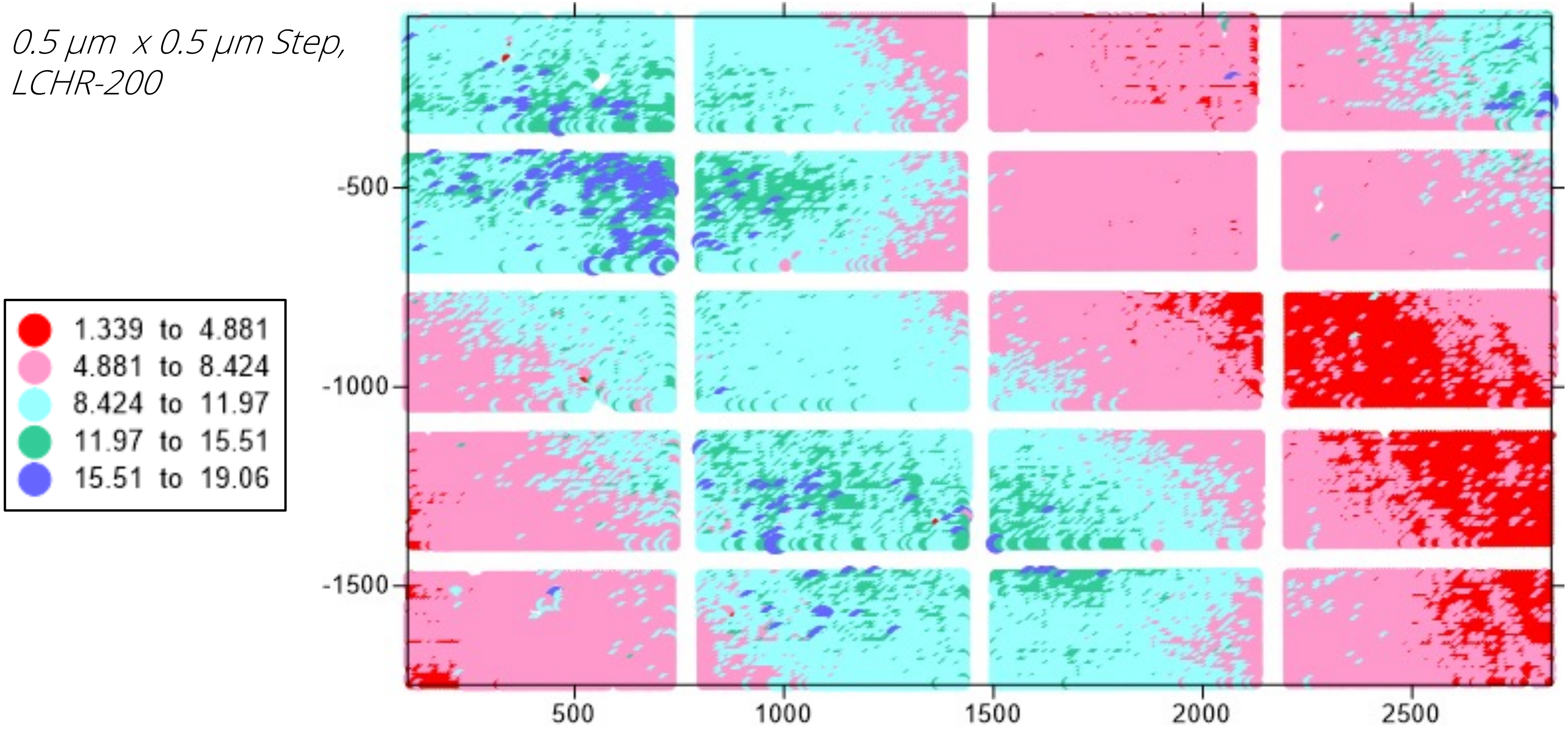


Each individual feature or other specified measurement location is automatically analyzed for nominal vs actual position

Bump Defect Inspection:
Bump Height Uniformity across sample

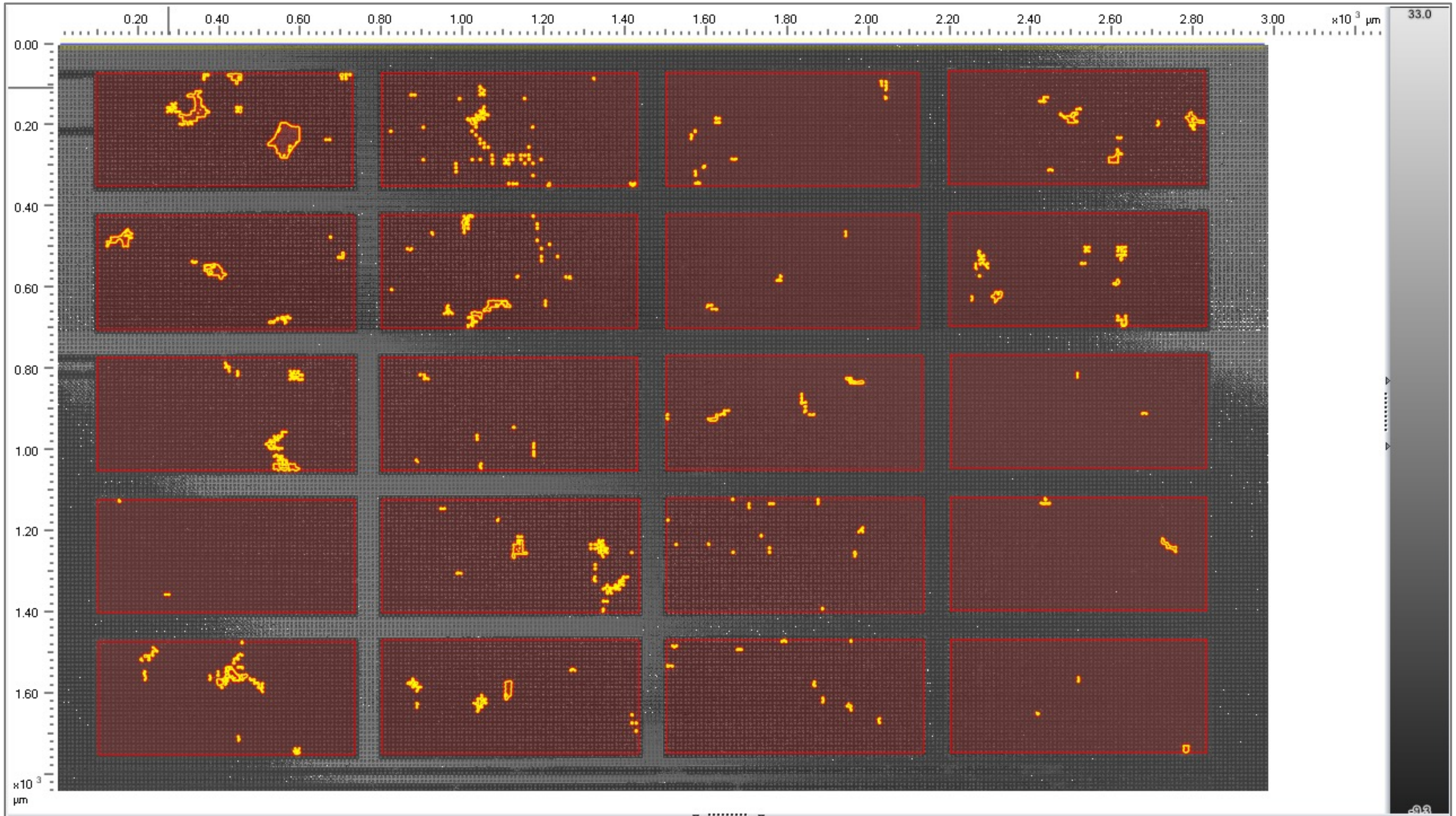
0.5 µm x 0.5 µm Step,
LCHR-200

Max Bump Height



Bump Defect Inspection

0.5 µm x 0.5 µm Step, LCHR-200



Rectangular Raster

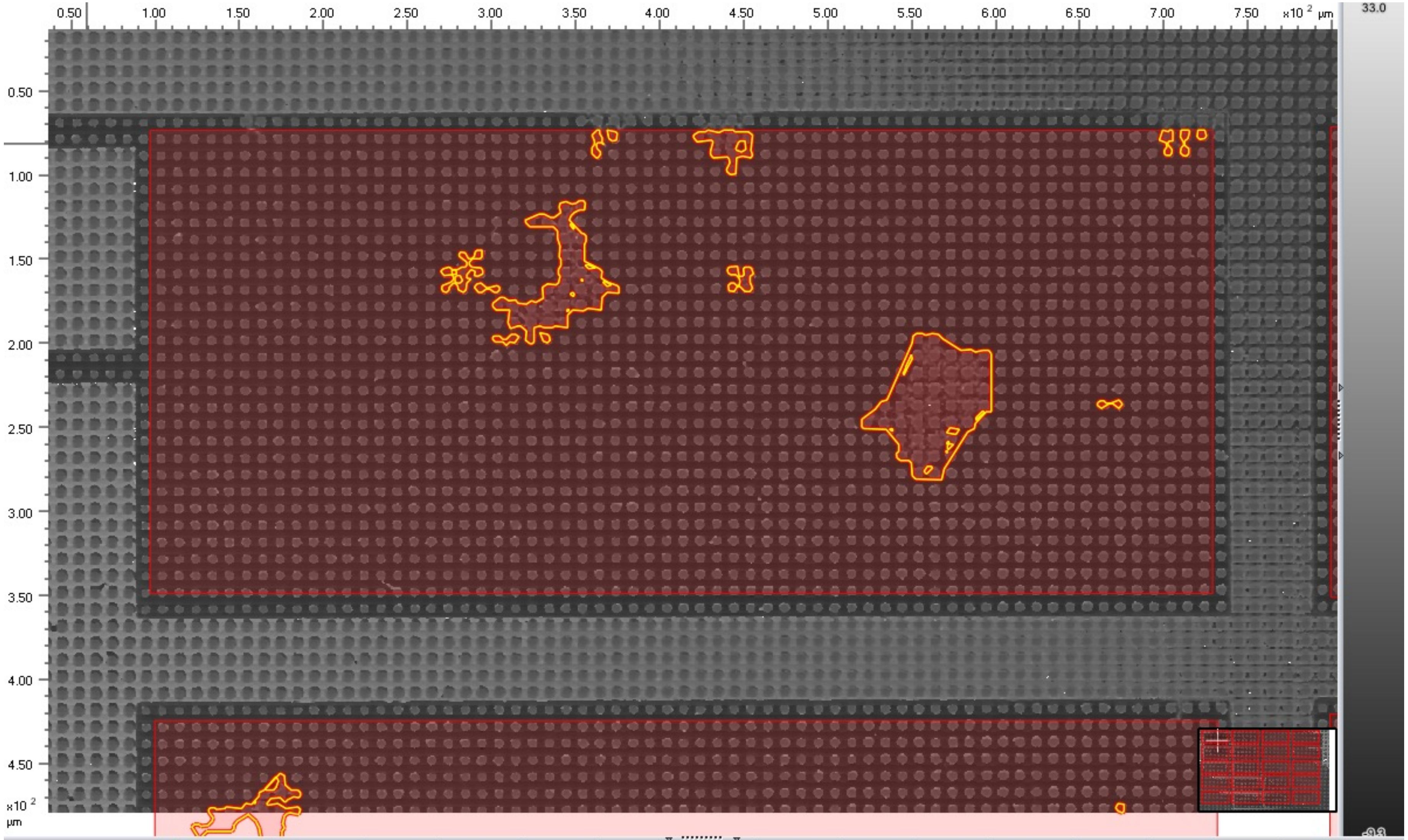
	X	Y
	128,667 µm	85,194 µm
	131,650 µm	87,058 µm
	2,983 µm	1,864 µm
	0.500 µm	0.500 µm
Z	12,378 µm	

Name	All cursors	P1	P2	P3	P4	P5	P6	P7	P8
Area	29,452.00 µm²	7,356.00 µm²	1,876.75 µm²	425.37 µm²	1,862.62 µm²	2,788.25 µm²	2,319.00 µm²	170.62 µm²	1,352.75 µm²

Name	P9	P10	P11	P12	P13	P14	P15
Area	2,078.37 µm²	312.38 µm²	823.13 µm²	56.88 µm²	46.12 µm²	2,308.38 µm²	410.87 µm²

Bump Defect Inspection

0.5 µm x 0.5 µm Step,
LCHR-200



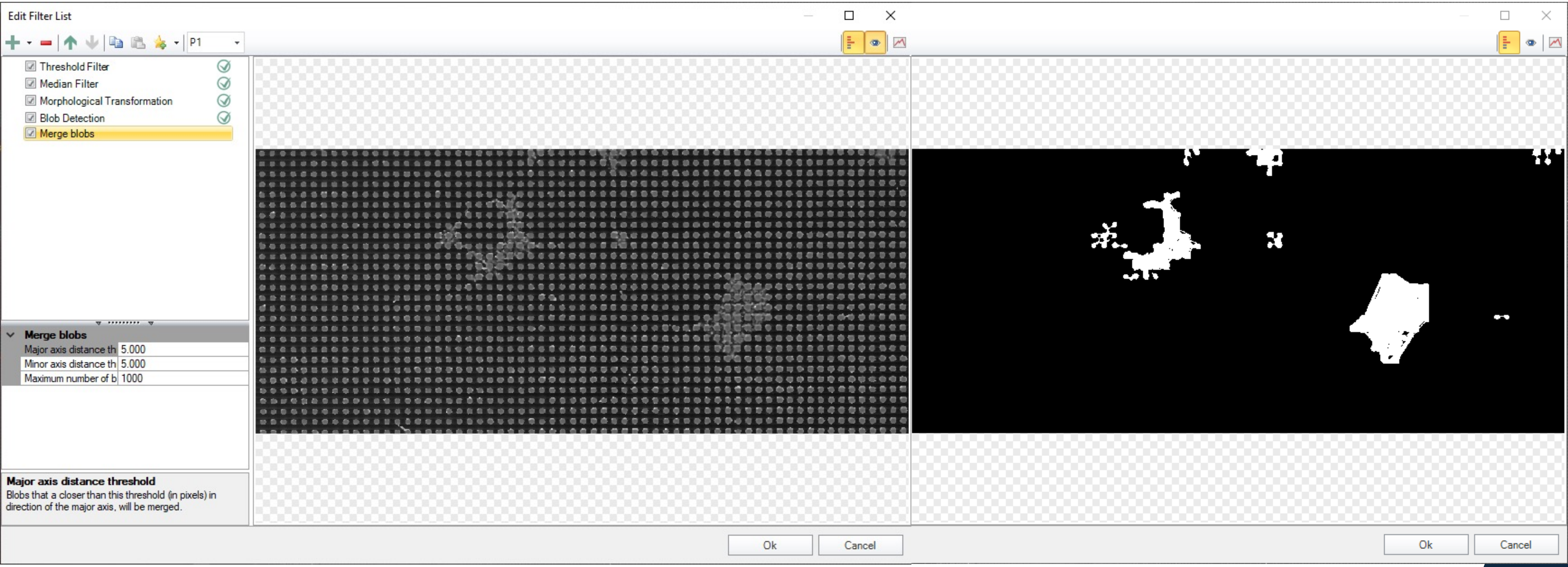
Rectangular Raster

	X	Y
	128,667 µm	85,194 µm
	131,650 µm	87,058 µm
	2,983 µm	1,864 µm

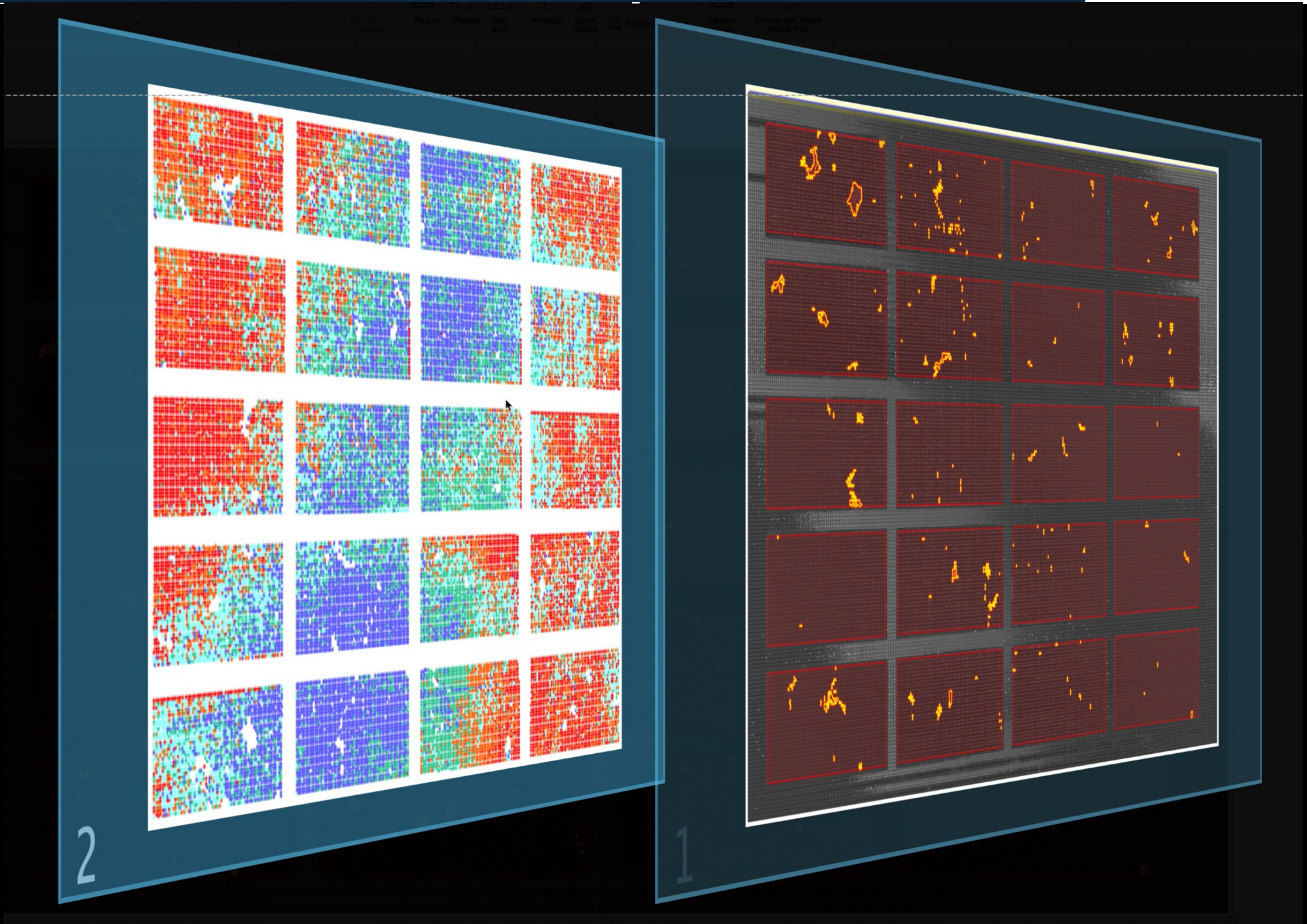
Name	All cursors	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
Area	29,452.00 µm²	7,356.00 µm²	1,876.75 µm²	425.37 µm²	1,862.62 µm²	2,788.25 µm²	2,319.00 µm²	170.62 µm²	1,352.75 µm²	2,078.37 µm²	312.38 µm²	823.13 µm²	56.88 µm²	46.12 µm²	2,308.38

Bump Defect Inspection

0.5 µm x 0.5 µm Step, LCHR-200



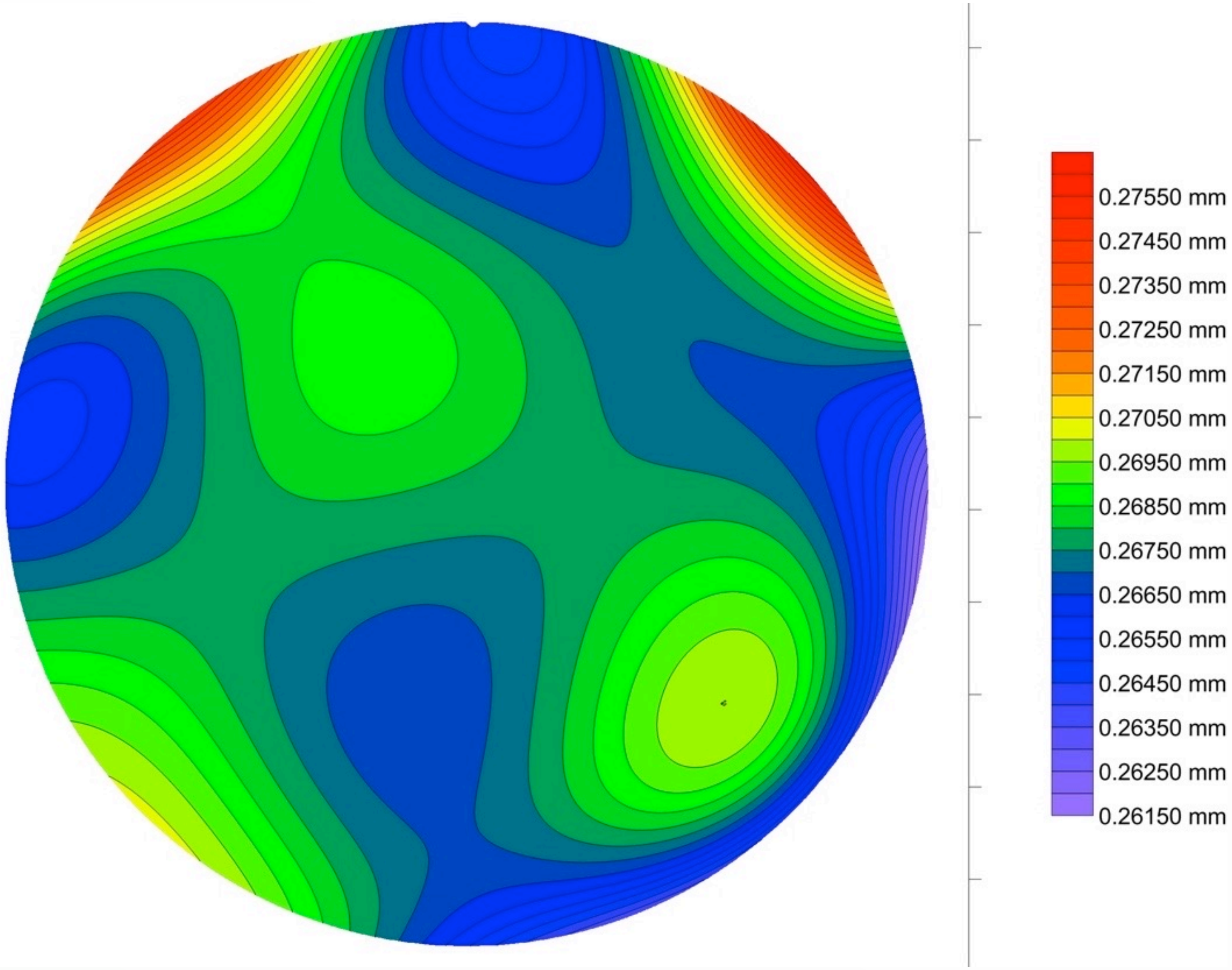
Bump Defect Inspection



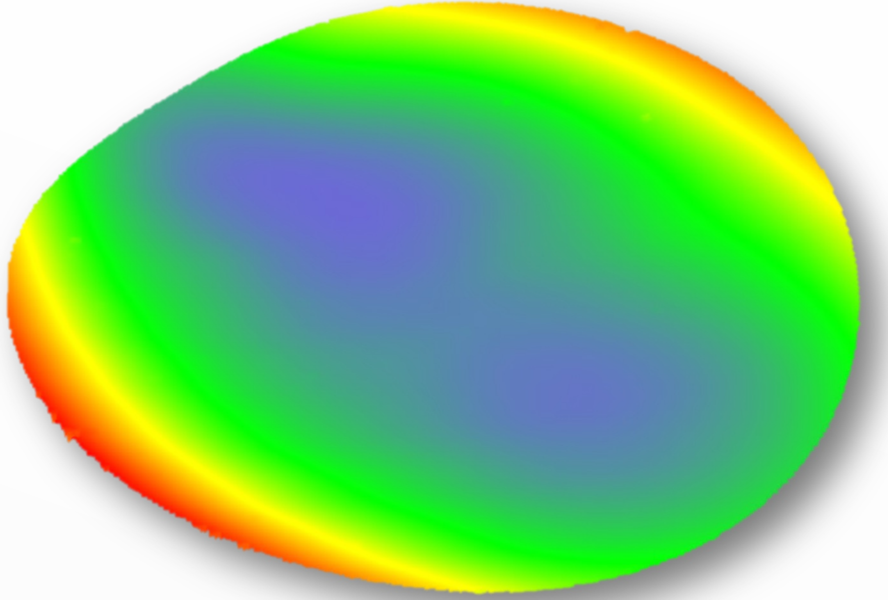
Thickness– Thinned Silicon Wafer
Dual-sided CTx50T Systems

- Fast and accurate thickness measurement over large areas
- Total Thickness, Total Thickness Variation, Warpage, Bow, Stress

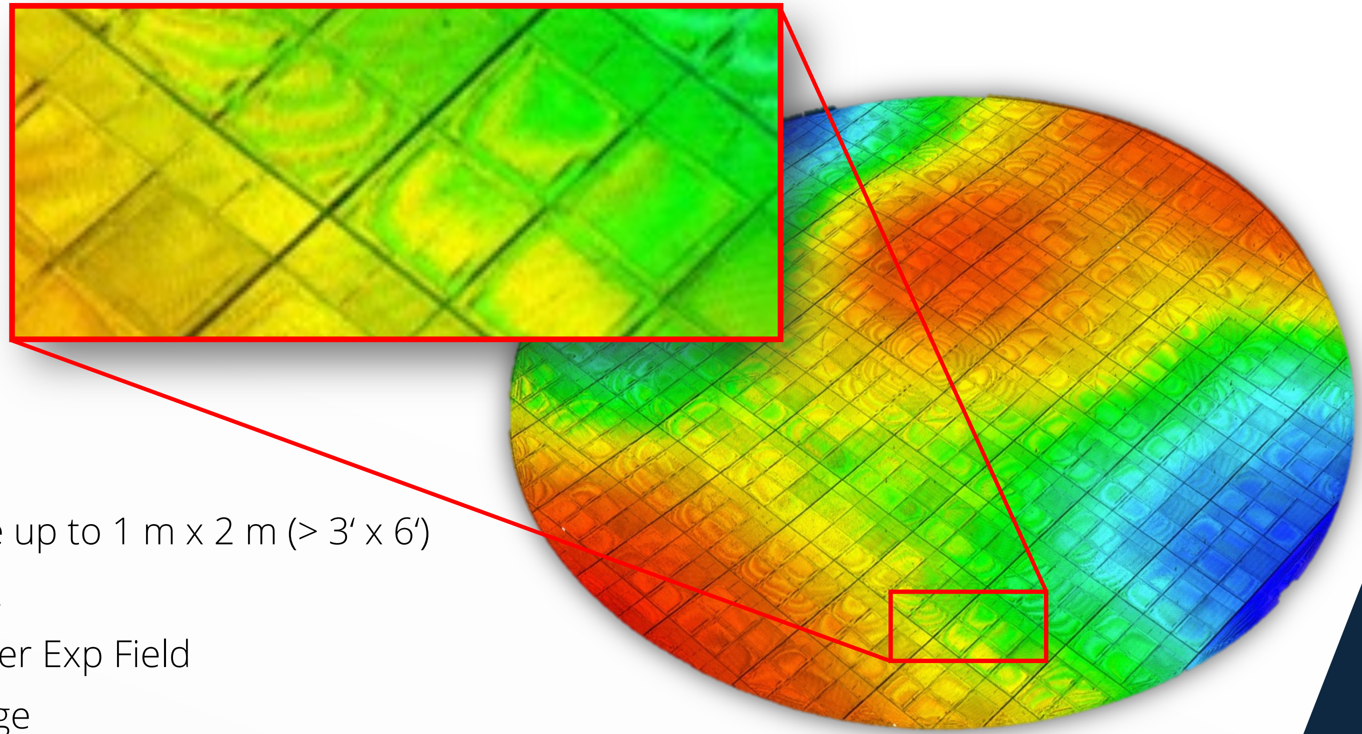
3D Thickness Map of a Silicon Wafer



Wafer Mapping



Blank or patterned wafers

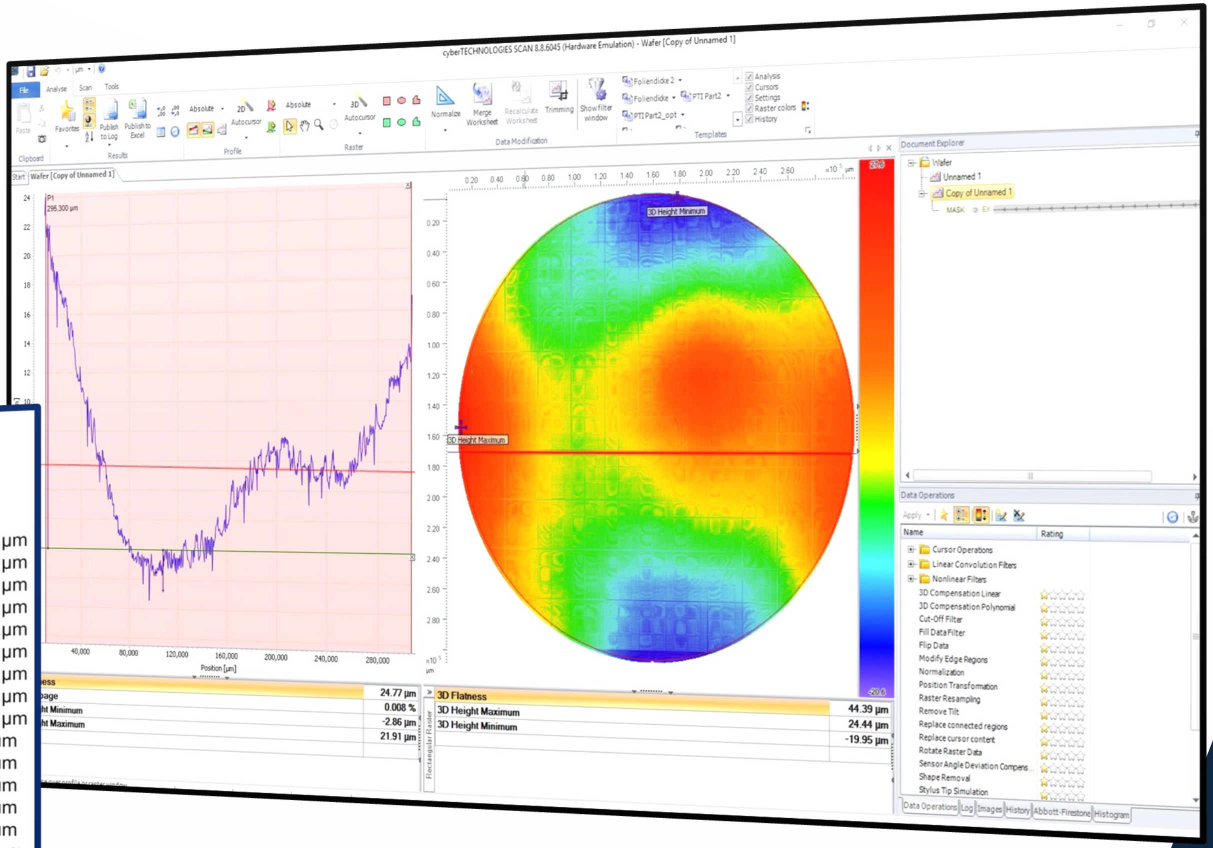


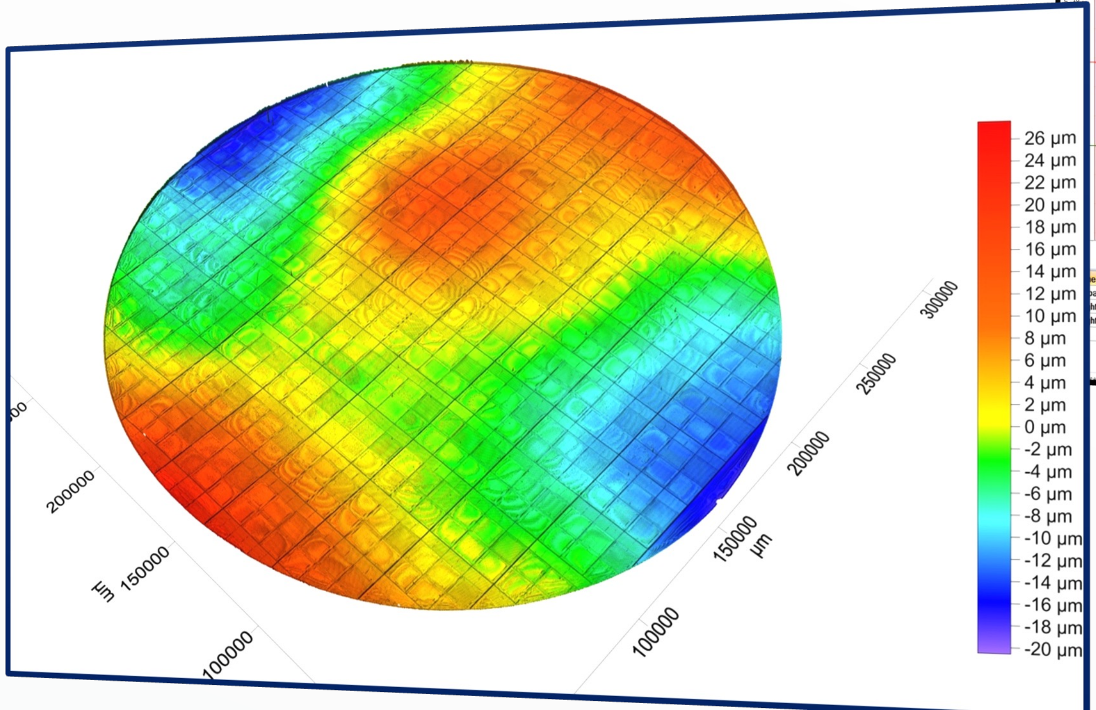
Flatness
Warpage
Thickness

- Flatness across entire sample up to 1 m x 2 m (> 3' x 6')
- Macro & Micro Measurement
  - Full Wafer & w/in Stepper Exp Field
- Detection of Bow and Warpage
- Gravity Compensation
- Stress Measurement
- Film Thickness Variation

Flatness

- Flatness across entire sample up to 1 m x 2 m (> 3‘ x 6‘)
- Macro & Micro Measurement
  - Full Wafer & w/in Stepper Exp Field
- Detection of Bow and Warpage
- Gravity Compensation
- Stress Measurement
- Film Thickness Variation

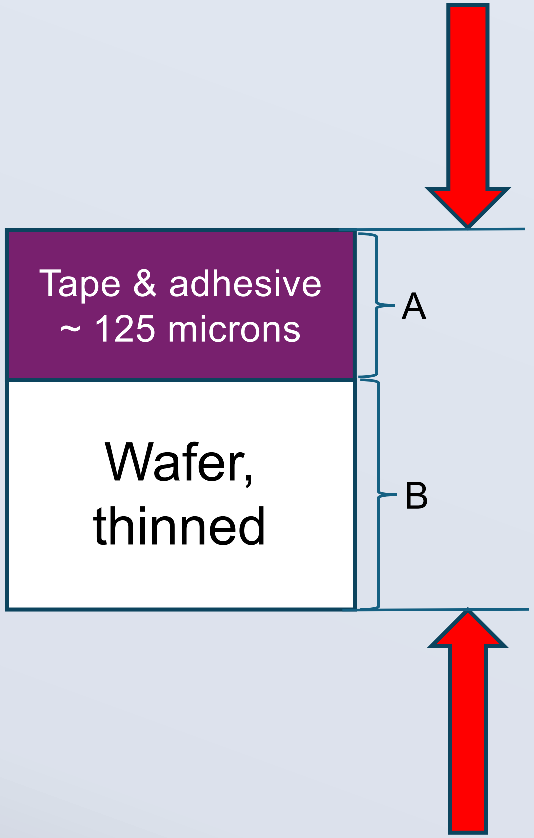




Wafer & Tape Thickness

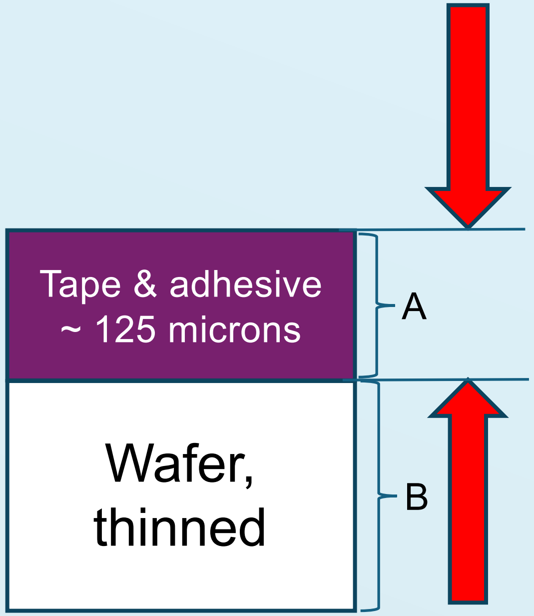
1. Total Thickness

A + B



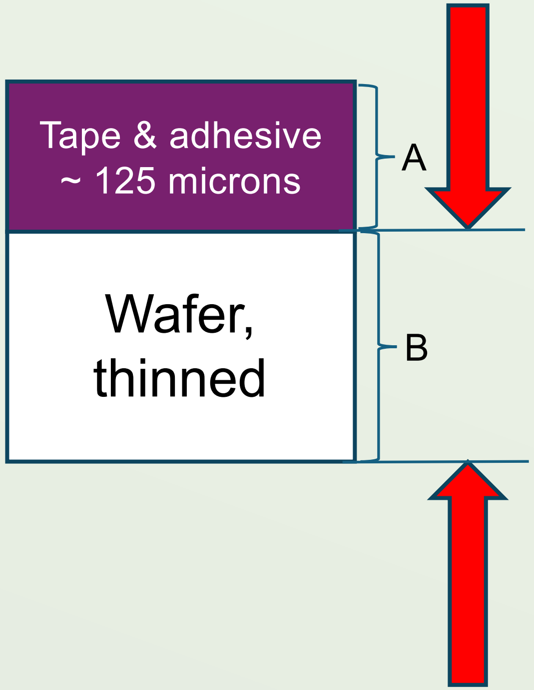
2. Tape Thickness

A



3. Wafer Thickness

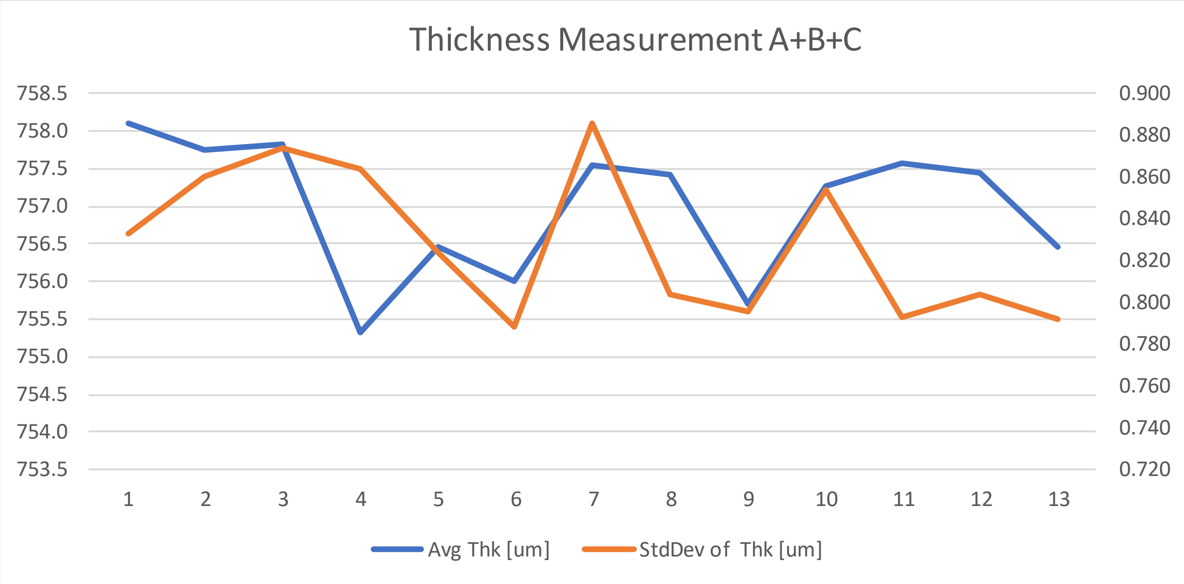
B

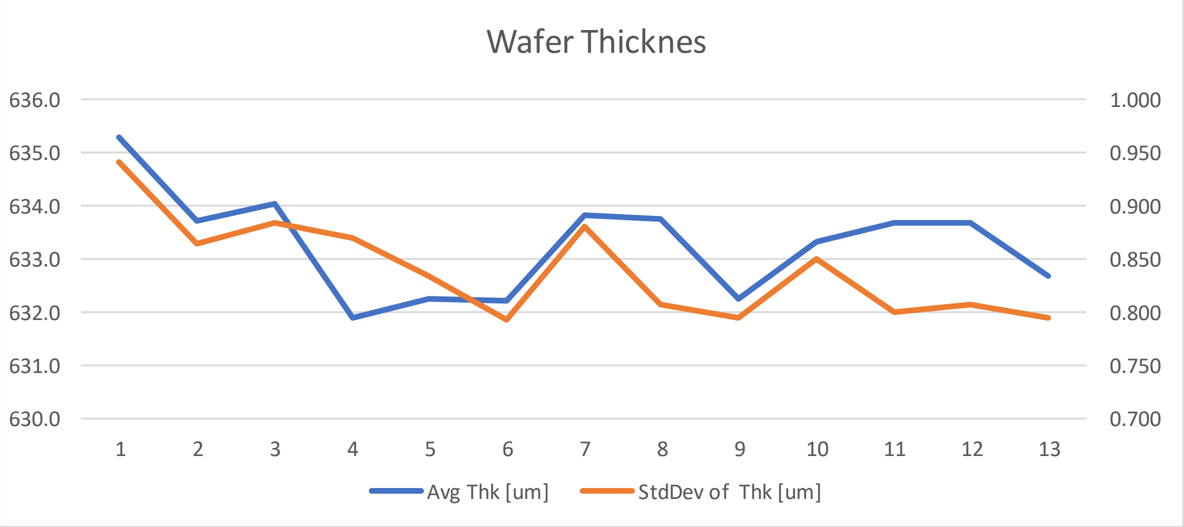


Wafer & Tape Thickness

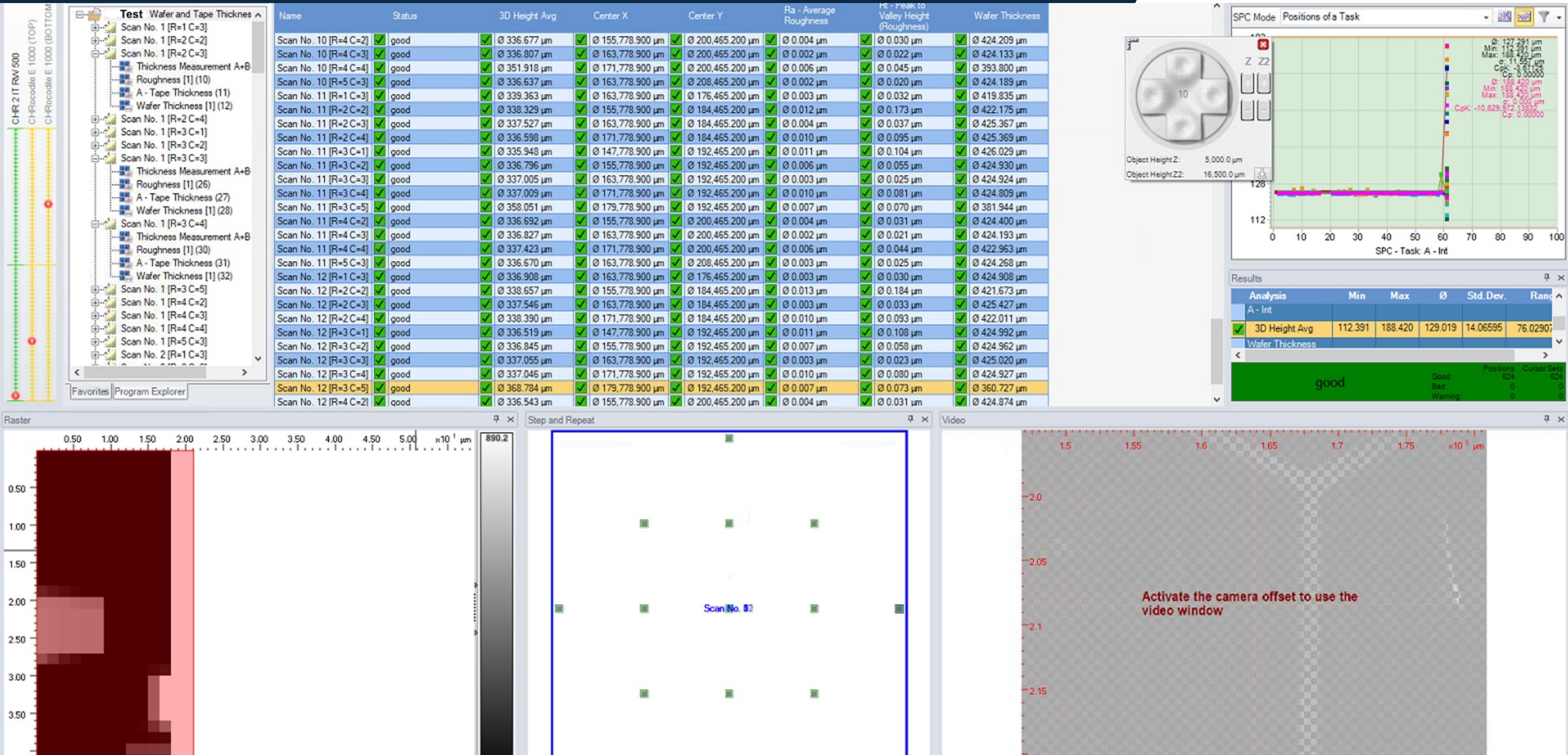
Thickness Measurement A+B+C	Avg Thk [um]	StdDev of Thk [um]	Stdev [%]
[R=1 C=3]	758.1	0.833	0.11%
[R=2 C=2]	757.8	0.860	0.11%
[R=2 C=3]	757.8	0.874	0.12%
[R=2 C=4]	755.3	0.864	0.11%
[R=3 C=1]	756.5	0.824	0.11%
[R=3 C=2]	756.0	0.788	0.10%
[R=3 C=3]	757.6	0.886	0.12%
[R=3 C=4]	757.4	0.804	0.11%
[R=3 C=5]	755.7	0.796	0.11%
[R=4 C=2]	757.3	0.854	0.11%
[R=4 C=3]	757.6	0.793	0.10%
[R=4 C=4]	757.4	0.804	0.11%
[R=5 C=3]	756.5	0.792	0.10%

Wafer Thickness [1]	Avg Thk [um]	StdDev of Thk [um]	Stdev [%]
[R=1 C=3]	635.3	0.942	0.15%
[R=2 C=2]	633.7	0.865	0.14%
[R=2 C=3]	634.0	0.884	0.14%
[R=2 C=4]	631.9	0.871	0.14%
[R=3 C=1]	632.2	0.835	0.13%
[R=3 C=2]	632.2	0.794	0.13%
[R=3 C=3]	633.8	0.881	0.14%
[R=3 C=4]	633.8	0.808	0.13%
[R=3 C=5]	632.2	0.795	0.13%
[R=4 C=2]	633.3	0.850	0.13%
[R=4 C=3]	633.7	0.801	0.13%
[R=4 C=4]	633.7	0.808	0.13%
[R=5 C=3]	632.7	0.795	0.13%



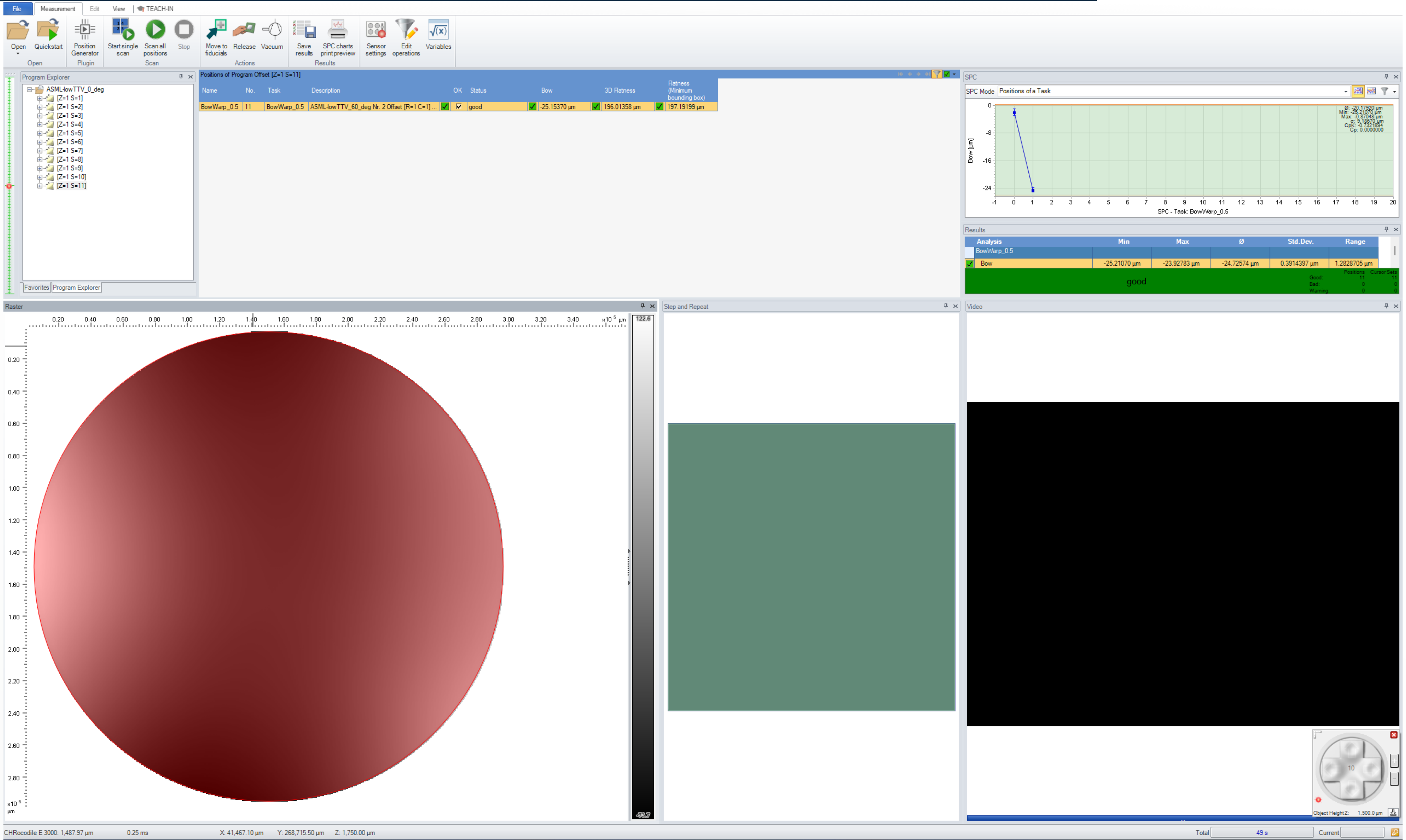


Wafer & Tape Thickness



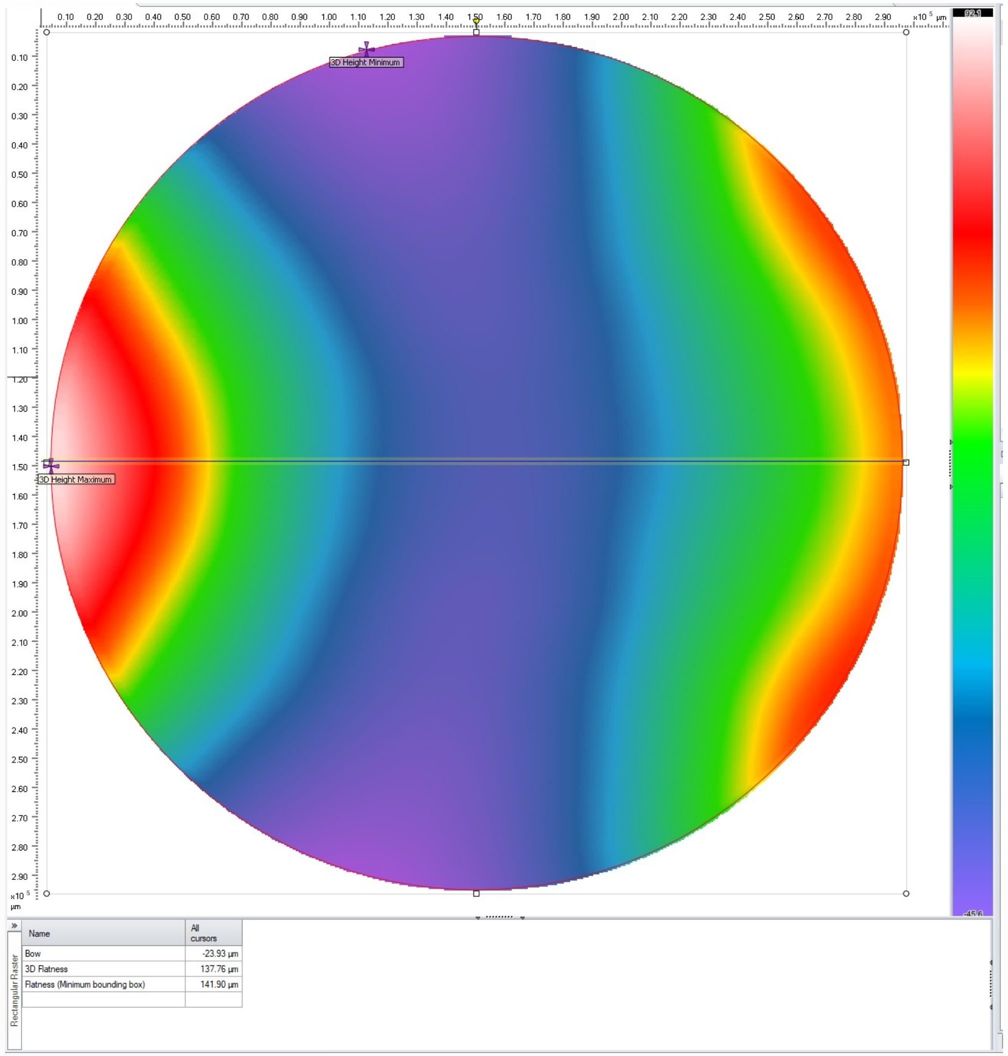
Name	Status	3D Height Avg	Center X	Center Y	Ra - Average Roughness	Rt - Peak to Valley Height (Roughness)	Wafer Thickness
Scan No. 10 [R=4 C=2]	good	Ø 336.677 µm	Ø 155,778.900 µm	Ø 200,465.200 µm	Ø 0.004 µm	Ø 0.030 µm	Ø 424.209 µm
Scan No. 10 [R=4 C=3]	good	Ø 336.807 µm	Ø 163,778.900 µm	Ø 200,465.200 µm	Ø 0.002 µm	Ø 0.022 µm	Ø 424.133 µm
Scan No. 10 [R=4 C=4]	good	Ø 351.918 µm	Ø 171,778.900 µm	Ø 200,465.200 µm	Ø 0.006 µm	Ø 0.045 µm	Ø 393.800 µm
Scan No. 10 [R=5 C=3]	good	Ø 336.637 µm	Ø 163,778.900 µm	Ø 208,465.200 µm	Ø 0.002 µm	Ø 0.020 µm	Ø 424.189 µm
Scan No. 11 [R=1 C=3]	good	Ø 339.363 µm	Ø 163,778.900 µm	Ø 176,465.200 µm	Ø 0.003 µm	Ø 0.032 µm	Ø 419.835 µm
Scan No. 11 [R=2 C=2]	good	Ø 338.329 µm	Ø 155,778.900 µm	Ø 184,465.200 µm	Ø 0.012 µm	Ø 0.173 µm	Ø 422.175 µm
Scan No. 11 [R=2 C=3]	good	Ø 337.527 µm	Ø 163,778.900 µm	Ø 184,465.200 µm	Ø 0.004 µm	Ø 0.037 µm	Ø 425.367 µm
Scan No. 11 [R=2 C=4]	good	Ø 336.598 µm	Ø 171,778.900 µm	Ø 184,465.200 µm	Ø 0.010 µm	Ø 0.095 µm	Ø 425.369 µm
Scan No. 11 [R=3 C=1]	good	Ø 335.948 µm	Ø 147,778.900 µm	Ø 192,465.200 µm	Ø 0.011 µm	Ø 0.104 µm	Ø 426.029 µm
Scan No. 11 [R=3 C=2]	good	Ø 336.796 µm	Ø 155,778.900 µm	Ø 192,465.200 µm	Ø 0.006 µm	Ø 0.055 µm	Ø 424.930 µm
Scan No. 11 [R=3 C=3]	good	Ø 337.005 µm	Ø 163,778.900 µm	Ø 192,465.200 µm	Ø 0.003 µm	Ø 0.025 µm	Ø 424.924 µm
Scan No. 11 [R=3 C=4]	good	Ø 337.009 µm	Ø 171,778.900 µm	Ø 192,465.200 µm	Ø 0.010 µm	Ø 0.081 µm	Ø 424.809 µm
Scan No. 11 [R=3 C=5]	good	Ø 358.051 µm	Ø 179,778.900 µm	Ø 192,465.200 µm	Ø 0.007 µm	Ø 0.070 µm	Ø 381.944 µm
Scan No. 11 [R=4 C=2]	good	Ø 336.692 µm	Ø 155,778.900 µm	Ø 200,465.200 µm	Ø 0.004 µm	Ø 0.031 µm	Ø 424.400 µm
Scan No. 11 [R=4 C=3]	good	Ø 336.827 µm	Ø 163,778.900 µm	Ø 200,465.200 µm	Ø 0.002 µm	Ø 0.021 µm	Ø 424.193 µm
Scan No. 11 [R=4 C=4]	good	Ø 337.423 µm	Ø 171,778.900 µm	Ø 200,465.200 µm	Ø 0.006 µm	Ø 0.044 µm	Ø 422.963 µm
Scan No. 11 [R=5 C=3]	good	Ø 336.670 µm	Ø 163,778.900 µm	Ø 208,465.200 µm	Ø 0.003 µm	Ø 0.025 µm	Ø 424.268 µm
Scan No. 12 [R=1 C=3]	good	Ø 336.908 µm	Ø 163,778.900 µm	Ø 176,465.200 µm	Ø 0.003 µm	Ø 0.030 µm	Ø 424.908 µm
Scan No. 12 [R=2 C=2]	good	Ø 338.657 µm	Ø 155,778.900 µm	Ø 184,465.200 µm	Ø 0.013 µm	Ø 0.184 µm	Ø 421.673 µm
Scan No. 12 [R=2 C=3]	good	Ø 337.546 µm	Ø 163,778.900 µm	Ø 184,465.200 µm	Ø 0.003 µm	Ø 0.033 µm	Ø 425.427 µm
Scan No. 12 [R=2 C=4]	good	Ø 338.390 µm	Ø 171,778.900 µm	Ø 184,465.200 µm	Ø 0.010 µm	Ø 0.093 µm	Ø 422.011 µm
Scan No. 12 [R=3 C=1]	good	Ø 336.519 µm	Ø 147,778.900 µm	Ø 192,465.200 µm	Ø 0.011 µm	Ø 0.108 µm	Ø 424.992 µm
Scan No. 12 [R=3 C=2]	good	Ø 336.845 µm	Ø 155,778.900 µm	Ø 192,465.200 µm	Ø 0.007 µm	Ø 0.058 µm	Ø 424.962 µm
Scan No. 12 [R=3 C=3]	good	Ø 337.055 µm	Ø 163,778.900 µm	Ø 192,465.200 µm	Ø 0.003 µm	Ø 0.023 µm	Ø 425.020 µm
Scan No. 12 [R=3 C=4]	good	Ø 337.046 µm	Ø 171,778.900 µm	Ø 192,465.200 µm	Ø 0.010 µm	Ø 0.080 µm	Ø 424.927 µm
Scan No. 12 [R=3 C=5]	good	Ø 368.784 µm	Ø 179,778.900 µm	Ø 192,465.200 µm	Ø 0.007 µm	Ø 0.073 µm	Ø 360.727 µm
Scan No. 12 [R=4 C=2]	good	Ø 336.543 µm	Ø 155,778.900 µm	Ø 200,465.200 µm	Ø 0.004 µm	Ø 0.031 µm	Ø 424.874 µm

Stress Measurement

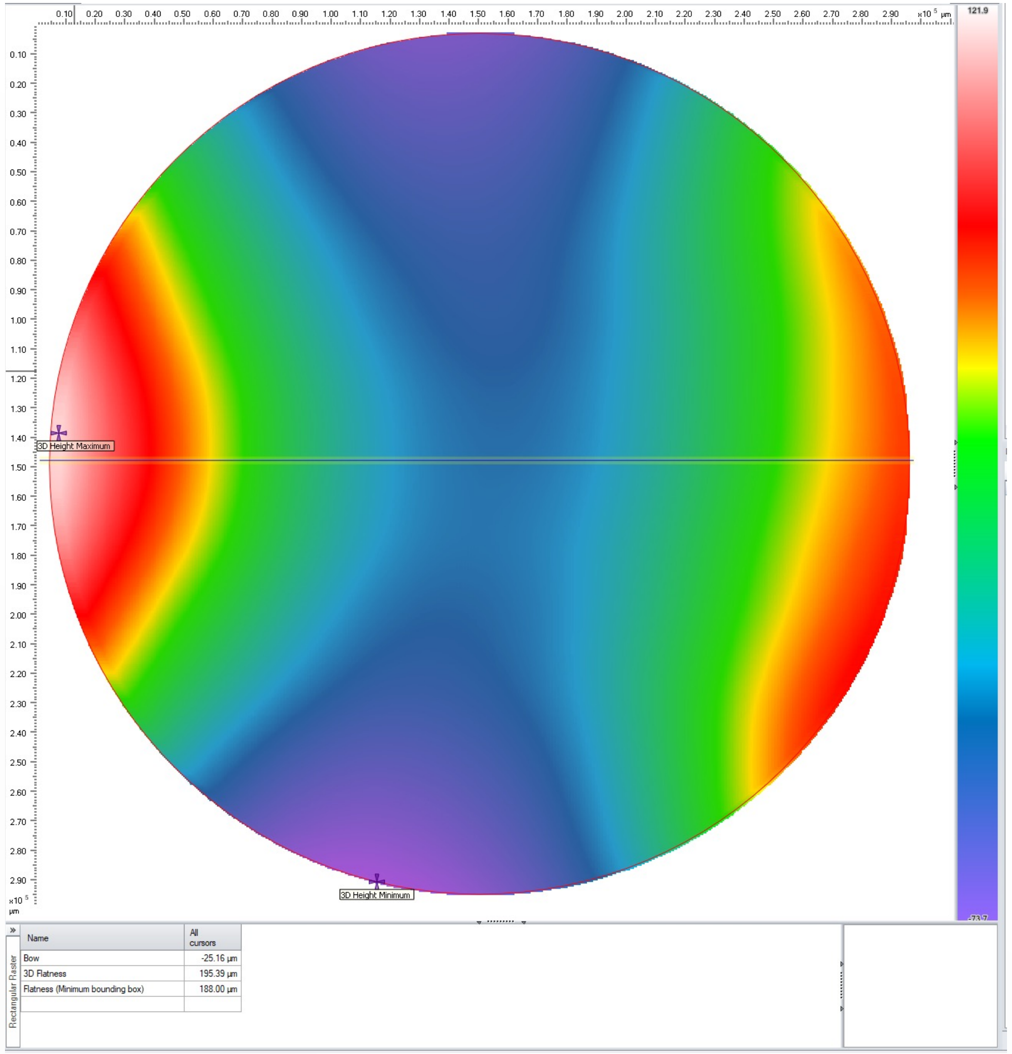


Flatness & Stress Measurement

Gravity Compensation

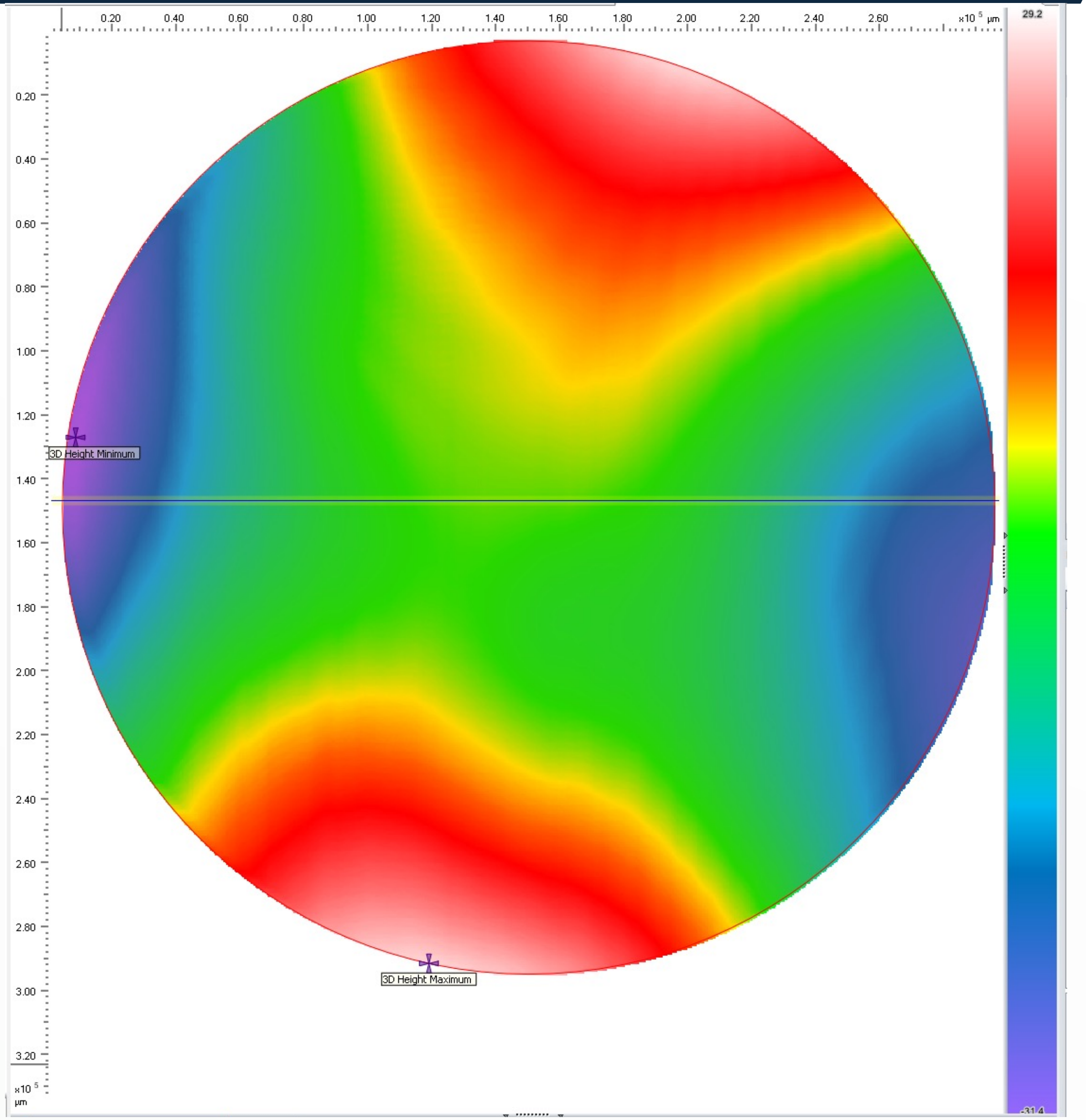


Without Compensation



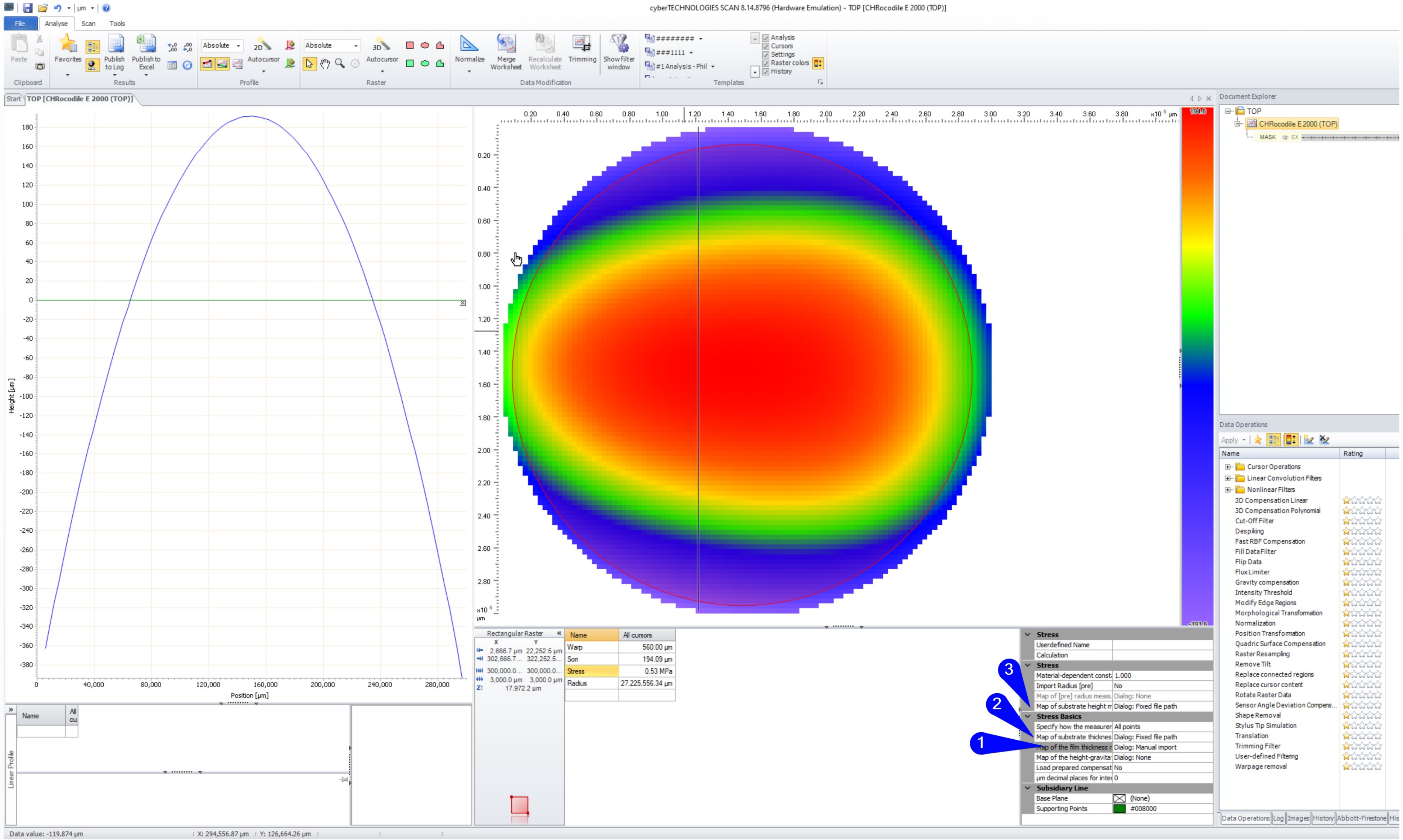
With Compensation

Stress Measurement



Gravity Compensation

Stress Measurement



1: Film-Thickness Map

2: Substrate Thickness Map

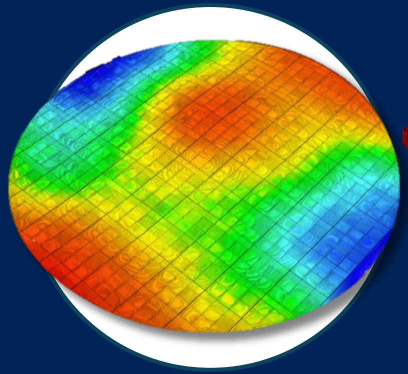
3: Substrate Height

Surface Metrology Systems

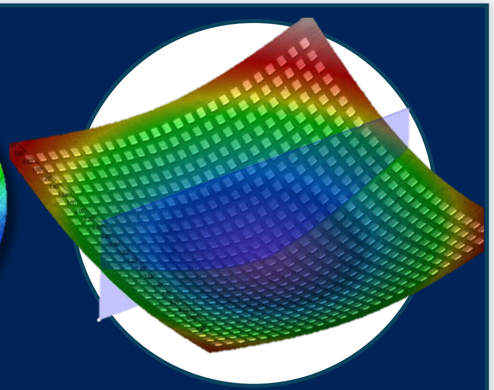
cyber TECHNOLOGIES

FOR PRODUCTION

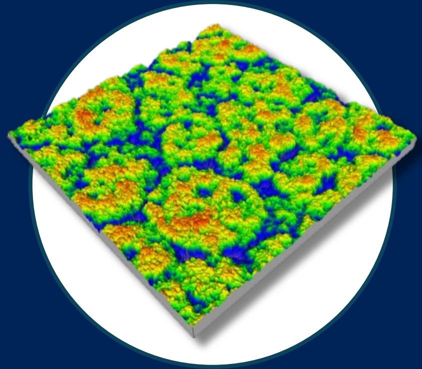
Fully automated measurement systems
with integrated handling even on large areas



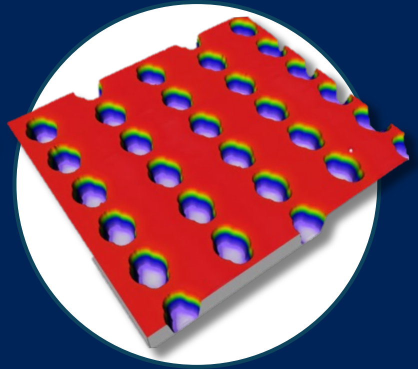
Warpage & TTV



Chiplet Position, Rot & Tilt



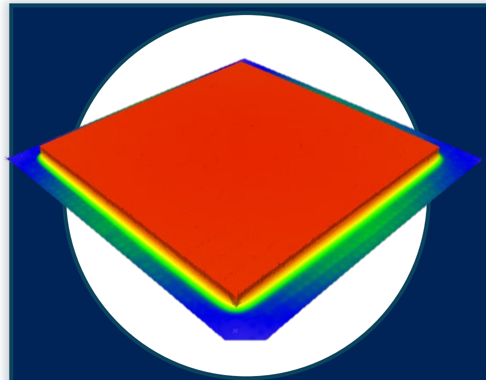
Surface Roughness



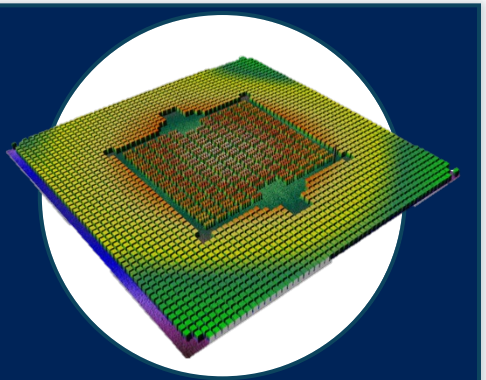
Via Diameter & Depth

FOR RESEARCH & DEVELOPMENT

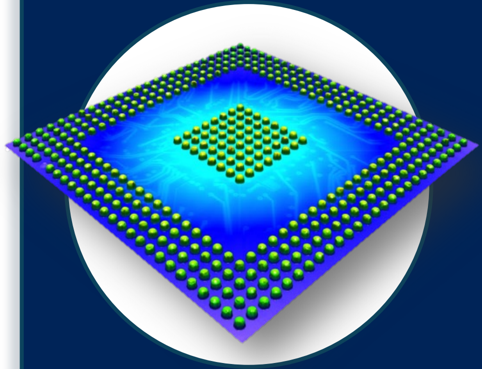
Compact and flexible
surface measurement systems



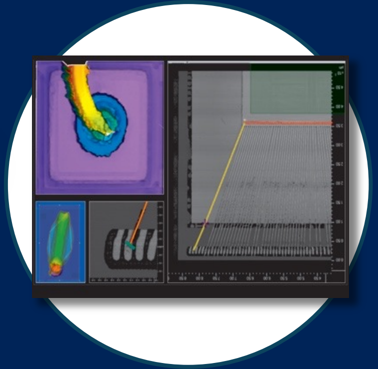
Fillet Height & Width, RBO



Probe Card Metrology



Bump Inspection



Wirebond

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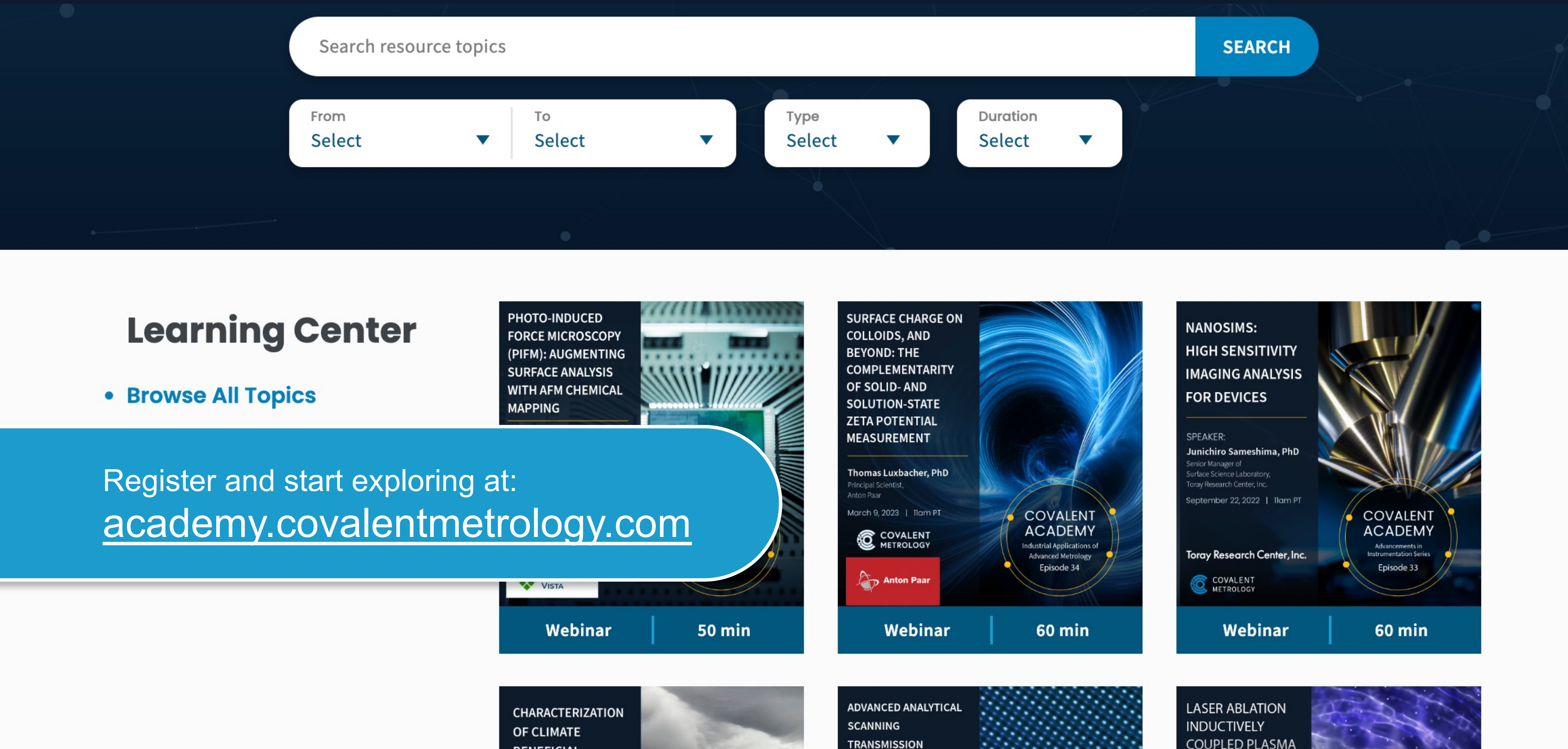

Register and start exploring at:
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Q & A Session

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Thank you.

Application Examples

- Full 2D/3D scans across small or large areas at predetermined locations
- Full 3D area measurements over the entire sample area
- Fully automatic determination of:
  - Height
  - Depth
  - Location
  - Flatness
  - Warpage
  - Roughness
  - Film Thickness
  - Thin Film Thickness
  - Bump Height, Vias, Diameter, Volume
  - Rotation vs custom reference/datum
  - Tilt, Angle
  - Distance, Width
  - Bump Height, Vias, Diameter, Volume
  - Coplanarity (Seating & Regression plane)
  - Defects (as in missing features, spikes, scratches, bridges, indentations etc...)
  - Bar-Code depth, roughness
  - Edge chipping, edge quality, distance

CONFOCAL WHITE LIGHT SENSOR



	Single C-CHR sensor	Single P-CHR sensor	Dual P-CHR sensors	L-CHR Line Sensor
Profiles	1	1	1	192
Sampling Rate	4 kHz	4kHz -66 kHz	4kHz -66 kHz	up to 6 kHz
Data Points/s	4,000	up to 66,000	up to 66,000	up to 1,152,000
3D Scans	Raster	Raster	Raster	Single Scan 3D

LINE SENSOR – CONFOCAL WHITE LIGHT

Sensor	L-CHR-200	L-CHR-500	L-CHR-1000	L-CHR-2300	L-CHR-4000
Measurement Range (vertical)	200 µm	500 µm	950 µm	2300 µm	3900 µm
Line Length	0.96 mm	1.43 mm	1.91 mm	1.53 mm	4.78 mm
Pitch	5 µm	7.5 µm	10 µm	8 µm	25 µm
Working distance (WD)	5.3 mm	12mm	18.5 mm	15.6 mm	36.4 mm
Individual spot diameter	2 µm	3 µm	4 µm	3.2 µm	10 µm
Lateral resolution	1 µm	1.5 µm	2 µm	1.6 µm	5 µm
Axial (vertical) resolution	20 nm	50 nm	80 nm	200 nm	320 nm
NA	0.7	0.61	0.55	0.55	0.33
Angle to surface	90 +/- 44	90 +/- 38	90 +/- 33	90 +/- 33	90 +/- 20
Transparent Thickness measurement range	20 µm – 280 µm	40 µm – 700 µm	75 µm – 1.35 mm	200 µm – 3.1 mm	300 µm – 5.5 mm
Characterization	Very high resolution, steeper side-wall, short range	Sufficient range for many typical topographies, steep sidewall	Versatile all-around sensor with large WD	Large mst range, relatively high lateral resolution	Large mst range, narrow NA
Applications	Roughness, laser mark, micro-bumps, vias, pillars	Roughness, wire bond, laser mark, bumps, Cu pillars, RF antennae	Bumps, warpage, waviness, prints, vias	Surface shape, injection molded precision parts, channel depth	Mechanical components, larger topographies, shapes

CONFOCAL WHITE LIGHT SENSOR