SensoMAP
Advanced Analysis software
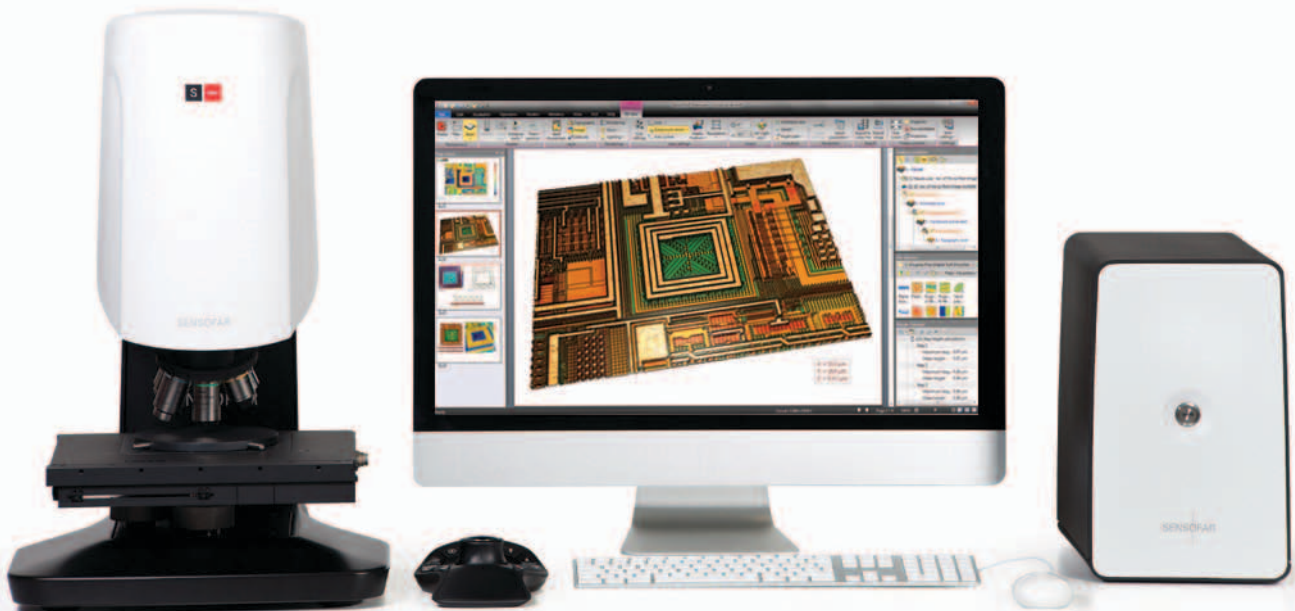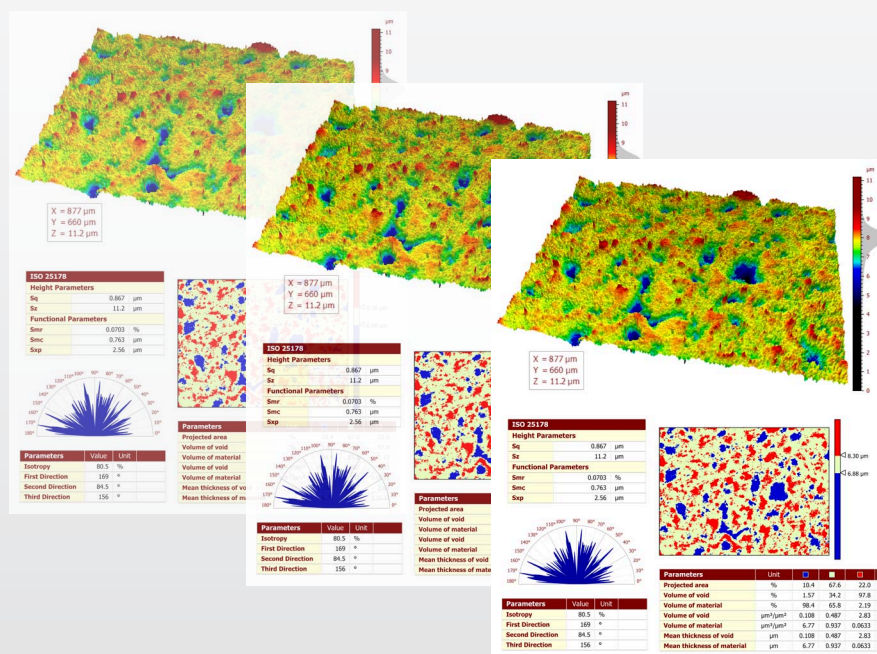
SensoMAP
Standard Features

Designed for use with the broadest range of research and industrial applications, SensoMAP software is the perfect surface imaging, analysis and metrology solution that is fully integrated with Sensofar 3D optical profilers. It includes:

■ Imaging – visualization of surface data using cutting-edge imaging technology and intelligent filters.

■ Metrology – analytical studies in accordance with the very latest standards and methods.

■ Report Creation – creation of detailed, accurate multi-page surface analysis reports in a smart desktop publishing environment with powerful automation features to speed up analysis.

SensoMAP is scalable software available on two product levels:

■ SensoMAP Standard provides the features required for standard surface imaging and analysis. It comes with numerous optional modules that can be added at any time for advanced and specialized applications.

■ SensoMAP Premium is a much more powerful solution that includes almost all of the modules, with the exception of a few highly specialized modules that can be added if required.

## Highly intuitive desktop publishing environment
Full metrological traceability, automation, fine-tuning on the fly

Visual analysis reports

In SensoMAP you can build a visual analysis report frame by frame, page by page, working in one of six European languages, Brazilian Portuguese, Japanese, Korean or Mandarin Chinese. Frames contain 3D and other views of surface data, the results of applying filters, analytical studies, ISO and national parameters, measurement identity cards, comments and illustrations. You can navigate to any frame in a report by selecting it in the page viewer.

Smart user environment

The smart user environment – with logical top-down organization of all functions, contextual object-oriented ribbons and expanded graphical tooltips – means that you can move from idea to action with minimum effort.
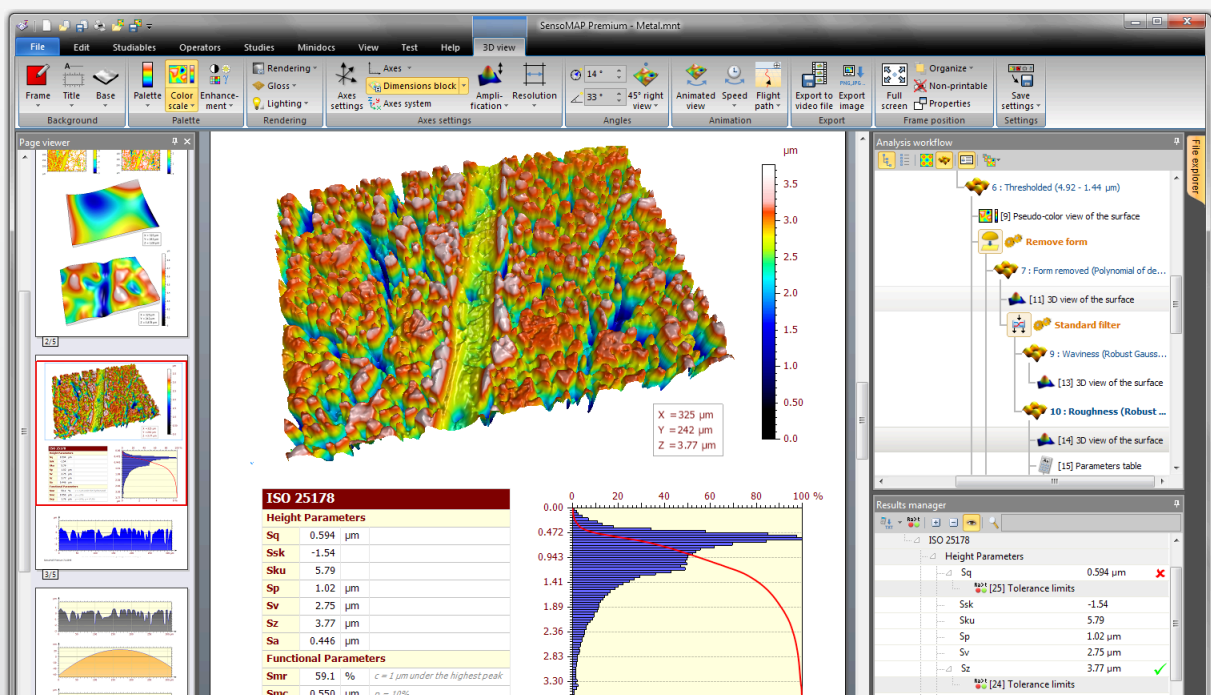
Full metrological traceability

Every analysis step is recorded in a hierarchical analysis workflow to assure full metrological traceability. Analysis steps in the workflow can be fine-tuned at any time. All dependent steps are recalculated automatically.

Powerful automation features

Once an analysis report has been completed it can be applied as a template to automate the analysis of multiple measurement data files. In addition, common sequences of analysis steps can be saved in a library for insertion into future analysis reports to save time.

SensoMAP
Standard Features

Pass/fail with tolerancing

Pass/fail criteria with tolerances can be defined for any parameter. Green (pass) and red (fail) traffic lights are displayed automatically and the parameter value and tolerance limits are shown graphically.

Data export

Frames and pages can be exported as bitmaps up to 1200 dpi for poster sessions. Finished reports can be exported in PDF and RTF formats for easy circulation. All numerical results are accessible in the Results Manager panel and can be exported in Excel-compatible text files for interfacing with 3rd party software, including quality management software.

See everything that you measure
### Real-time visualization of 3D surface topography with overlays

Real-time 3D imaging

In SensoMAP, you can zoom in on a 3D surface and rotate it in real time. To achieve the best image quality, you can apply image enhancement tools, choose the best lighting conditions, select renderings, set surface height amplification, and use an optimized color palette for the vertical scale. In addition, you can display contour diagrams and photo simulations and you can extract 2D profiles from a 3D surface for visualization and analysis.
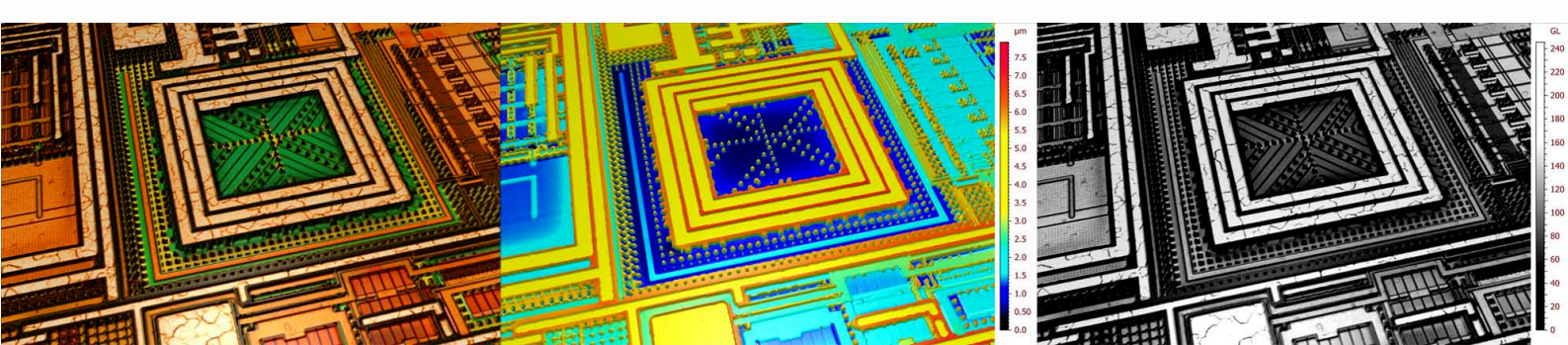
3D views of electronic circuit with 2% height amplification: (a) Color image overlay on 3D topography, (b) 3D surface topography, (c) Intensity image overlay on 3D topography.

Overlay color and intensity images on 3D surface topography

Multi-channel topography, color and intensity image layers can be manipulated simultaneously. With a single click, you can overlay the color or intensity image on the 3D surface topography to speed up the detection of surface features. You can adjust the transparency of the overlay to achieve optimal rendering.

Extract a sub-surface and analyze it just like a full surface

With SensoMAP, you can not only visualize and analyze a full surface image or measurement, but also extract a region of interest or sub-surface and analyze it in exactly the same way as a full surface.

There are several methods for extracting sub-surfaces:

>> Extract a rectangular or non-rectangular zone.

>> Remove the upper or lower slice of a surface by thresholding.

>> Apply a binary mask.

>> Automatically partition a surface into motifs (texture cells), then use the Partition and Level operator to extract a sub-surface and level it so that it is ready for independent study.

Once a sub-surface or region of interest has been extracted it can be analyzed in exactly the same way as a full surface; the parameters are calculated for the sub-surface only. For example, you can study the roughness, flatness and coplanarity of planes on MEMS and mechanical and electronic components.

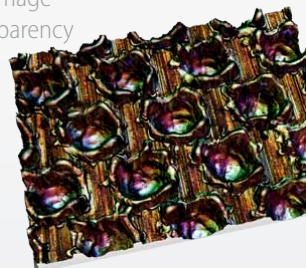Color image
0% transparency
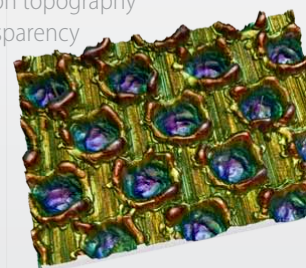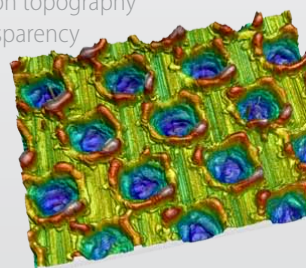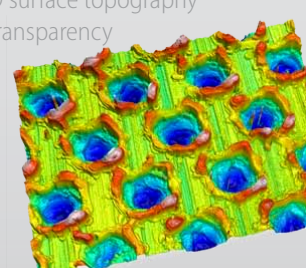

Image overlay on topography
30% transparency

Image overlay on topography
60% transparency

Pseudo-color 3D surface topography
100% transparency

Optimal rendering can be achieved by adjusting the transparency of the color image overlay on the 3D surface topography.

SensoMAP
Standard Features

## Use powerful tools to prepare surface data for analysis
Data normalization and correction

Visual analysis reports

SensoMAP includes a full set of intelligent operators and filters for normalizing 3D surface data and removing measurement artifacts prior to analysis. They include:

>> Leveling.
>> Flipping in the horizontal or vertical axis.
>> Rotation.
>> Thresholding.
>> Outlier removal.
>> Filling in missing data points.
>> Spatial filtering and surface smoothing.
>> Retouching of isolated artifacts.
>> Resampling to improve image resolution.

The threshold operator has pairs of interactive cursors for delimiting the height and material ratio on a material distribution plot.
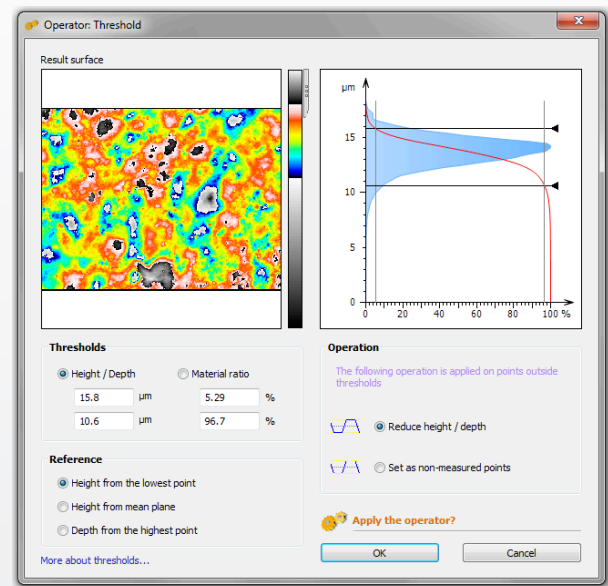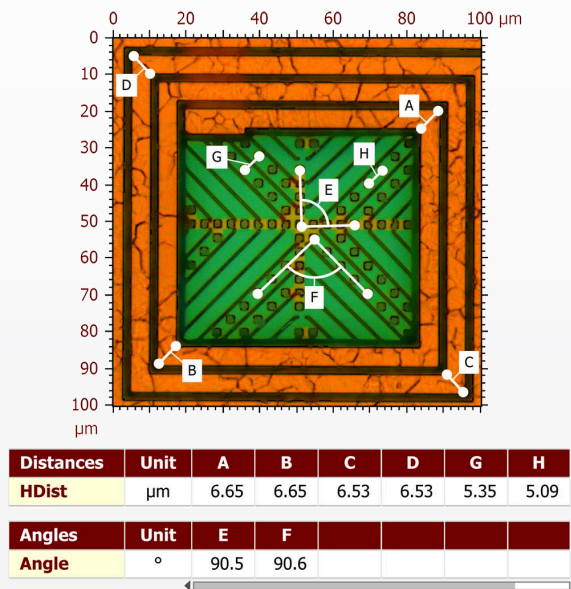

Increase field of view virtually

In some cases, the field of view is too limited to measure the whole surface under study. SensoMAP overcomes this limitation by stitching multiple measurements together to form a single surface that is ready for analysis.
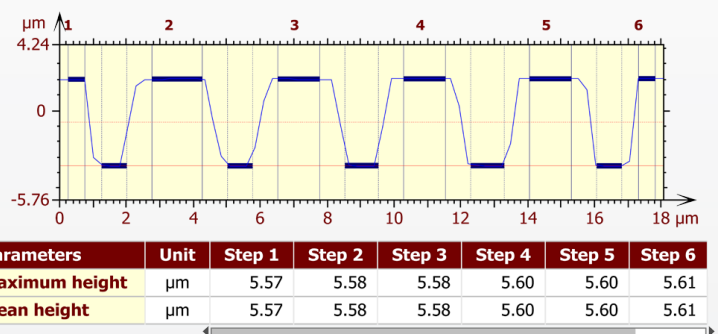
Analyze surface geometry
Calculate distances, areas, volumes and step heights

SensoMAP assures fast and accurate analysis of surface geometry with tools for measuring distances, angles, areas of peaks and valleys, volumes of bumps and holes, step heights on surfaces and profiles, and coplanarity.
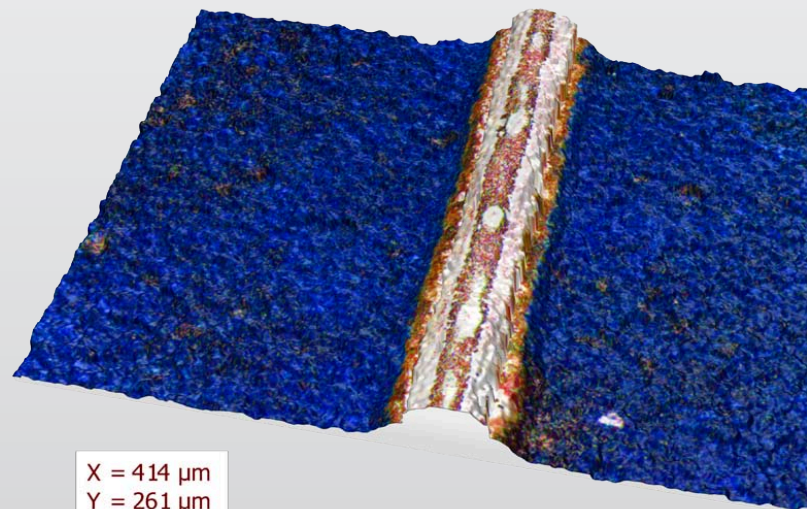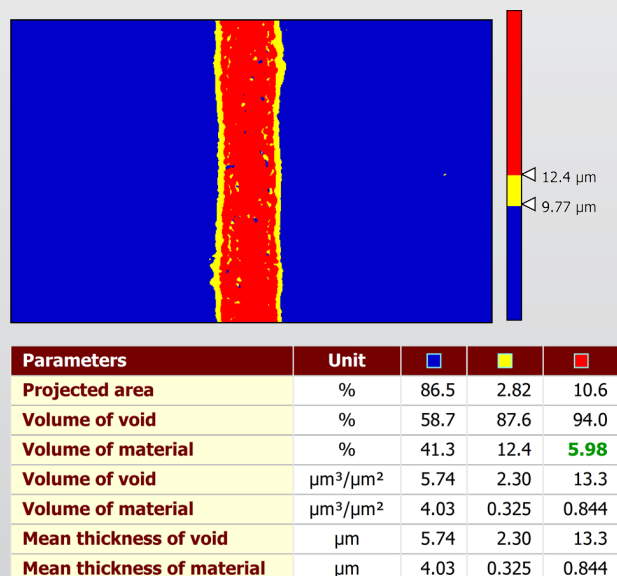
Distances	Unit	A	B	C	D	G	H
HDist	µm	6.65	6.65	6.53	6.53	5.35	5.09

Angles	Unit	E	F				
Angle	°	90.5	90.6				

Parameters	Unit	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Maximum height	µm	5.57	5.58	5.58	5.60	5.60	5.61
Mean height	µm	5.57	5.58	5.58	5.60	5.60	5.61

(a) Multiple distances and angles can be measured in the same frame and (b) step height measurements on a profile.

Standard functional analysis
Bearing ratio, depth distribution, volume and thickness of slices, subtraction

SensoMAP provides standard functional analysis, including the Abbott-Firestone bearing ratio curve and depth distribution histogram, the material/void volume and thickness of up to three vertical surface slices, and surface subtraction for wear analysis.

12.4 µm
9.77 µm

Parameters	Unit	■	■	■
Projected area	%	86.5	2.82	10.6
Volume of void	%	58.7	87.6	94.0
Volume of material	%	41.3	12.4	5.98
Volume of void	µm³/µm²	5.74	2.30	13.3
Volume of material	µm³/µm²	4.03	0.325	0.844
Mean thickness of void	µm	5.74	2.30	13.3
Mean thickness of material	µm	4.03	0.325	0.844

X = 414 µm
Y = 261 µm
Z = 26.5 µm

Solar cell: calculation of the volume of a drain

SensoMAP
Standard Features

Surface texture characterization in accordance with international standards
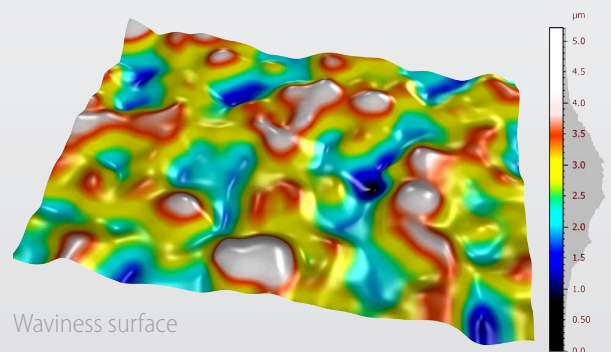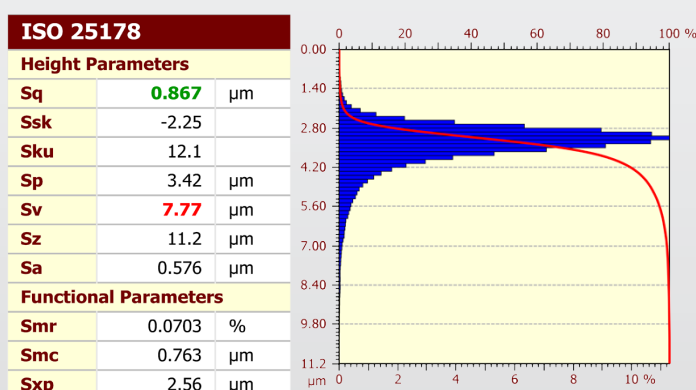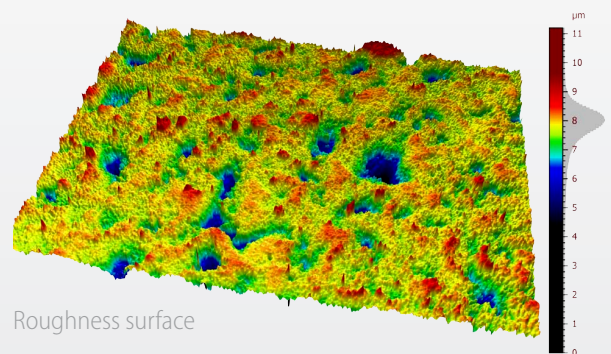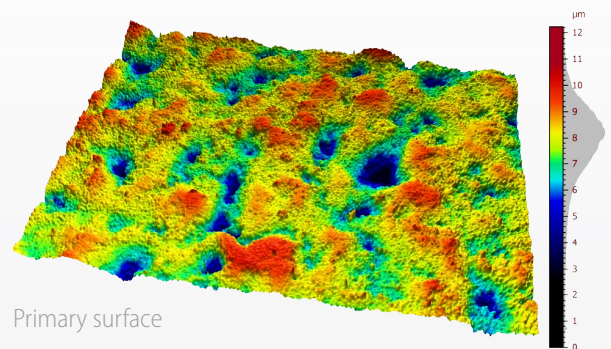ISO filtering techniques and parameters

From Gaussian to advanced ISO 16610 filtering techniques

The roughness and waviness components of surfaces are separated using the latest ISO 16610 advanced filtering techniques, including robust Gaussian and spline filters. Previous filtering techniques are also supported.

Primary surface

The most popular surface texture parameters from Ra to ISO 25178

The following parameters are available in all SensoMAP products:

>> ISO 25178 height (including Sa, Sq, Ssk, Sku and Sz) and bearing ratio (Smr, Sdc and Sxp) parameters

>> ISO 4287 amplitude, spacing, material ratio and peak parameters for primary, waviness and roughness profiles (for example Ra, Rq, Rsk, Rmr, Rdc, Rdq and RPc)

Roughness surface

ISO 25178		
Height Parameters		
Sq	**0.867**	µm
Ssk	-2.25	
Sku	12.1	
Sp	3.42	µm
Sv	**7.77**	µm
Sz	11.2	µm
Sa	0.576	µm
Functional Parameters		
Smr	0.0703	%
Smc	0.763	µm
Sxp	2.56	µm

Waviness surface

The right standards wherever you are

Wherever you are, with SensoMAP you can work with national and international standards. The software not only calculates ISO parameters, it also calculates ASME B46.1 2D and 3D parameters (USA), displays GB/T (China), DIN (Germany), JIS (Japan), NF (France), BSI (UK), UNE (Spain) and UNI (Italy) equivalents of ISO parameters when they are available, and calculates the older EUR 15178 3D parameters.

In addition to the SensoMAP standard features, there are twelve SensoMAP modules for advanced and specialized applications. Ten of these modules can be added to SensoMAP Standard and most of them, with the exception of highly specialized applications, are included in SensoMAP Premium.
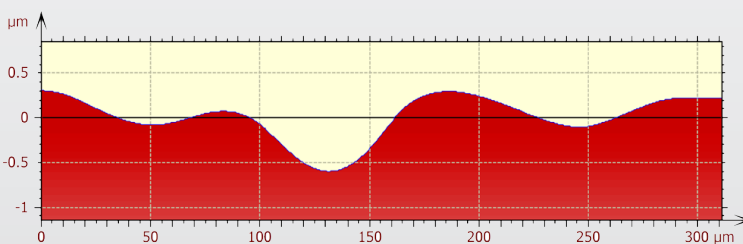
Advanced 2D surface texture

Studies, parameters and filters for advanced 2D profile analysis
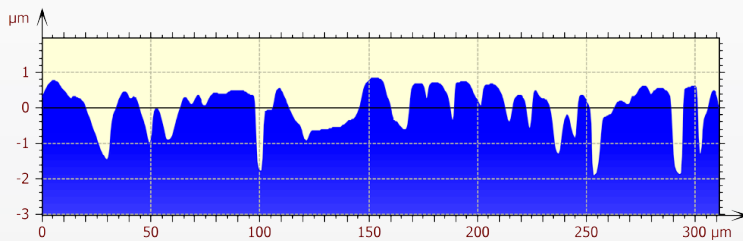
Primary profile
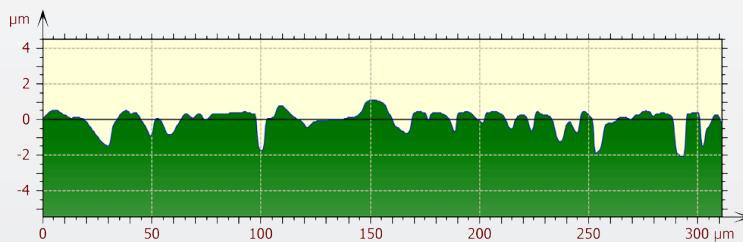
Roughness profile

Waviness profile

Apply advanced 2D filtering techniques

Remove form and apply roughness/waviness filters from Gaussian to ISO 16610 – apply morphological filters – denoise profiles using the FFT plot editor.

Correct measurement anomalies

Use data correction tools (thresholding, retouching and resampling) to eliminate anomalies and improve resolution prior to analysis.

Study functional characteristics

Study the bearing ratio curve and depth distribution histogram – subtract profiles to assess wear.

Analyze fractal dimensions of profiles

Using the enclosing boxes and morphological envelopes methods.

Overcome measurement limits virtually

Join overlapping profiles.

Generate statistics on series of profiles

The profiles in the series can be extracted from a series of surfaces or from the same surface.

MATLABTM compatibility

Use MATLABTM scripts to define custom filters for 2D profiles – execute the scripts in SensoMAP. (Note: MATLABTM and SensoMAP must be installed on the same PC.)

ISO 16610 filtering techniques for 2D profiles with end-effect management.

SensoMAP
Modules

Advanced 3D surface texture
Studies, parameters and filters for advanced 3D surface analysis

Analyze sub-surfaces
Extract and level planes on MEMS and mechanical, electronic and other components. Analyze the planes in exactly the same way as full surface measurements.

### Calculate more 3D surface texture and form parameters
ISO 25178 functional volume (Vmp, Vmc, Vvc and Vvv), spatial (Sal, Str and Std) and hybrid (Sdq and Sdr) parameters – ISO 12178 flatness (FLTt, FLTp, FLTv and FLTq) parameters.

Study functional characteristics
Study the bearing ratio curve and depth distribution histogram and subtract profiles to assess wear.

Study functional volume parameters associated with wear and lubrication graphically
Visualize friction, core and lubrication zones on tribological surfaces.
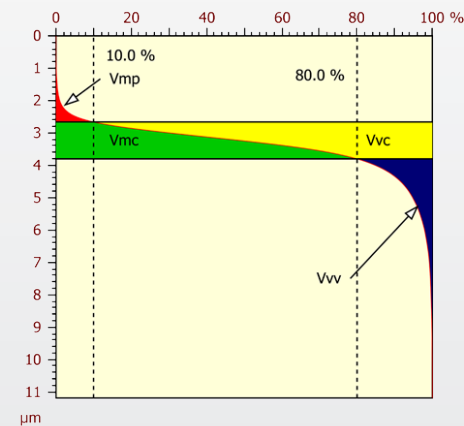
Parameters	Value	Unit
Vmp	0.0279	ml/m2
Vmc	0.533	ml/m2
Vvc	0.608	ml/m2
Vvv	0.182	ml/m2

Study surface isotropy, directionality and periodicity
View dominant surface directions on a compass rose and calculate parameters.

Apply morphological filters to surfaces
Erosion, dilation, opening, closing, and sequential filters.

Study circular profiles with the abscissa in degree units.

MATLABTM compatibility
Use MATLABTM scripts to define custom filters for 3D surfaces – execute the scripts in SensoMAP. (Note: MATLABTM and SensoMAP must be installed on the same PC).

Analyze furrows
Visualize furrows and calculate furrow parameters.

Analyze fractal dimensions of surfaces
Using the enclosing boxes and morphological envelopes methods.
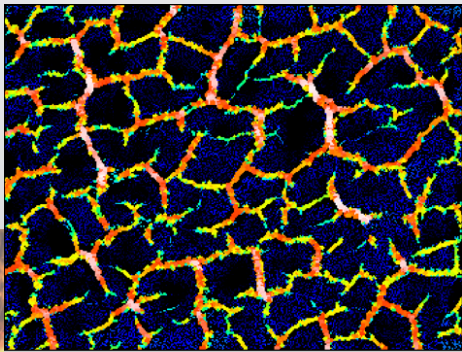
All furrows are displayed.

Parameters	Value	Unit
Maximum depth of furrows	110	µm
Mean depth of furrows	17.7	µm
Mean density of furrows	1206	cm/cm2

Contour
Fast geometric dimensioning of component contours

Extract vertical (x,z) or horizontal (x,y) contours from a surface.

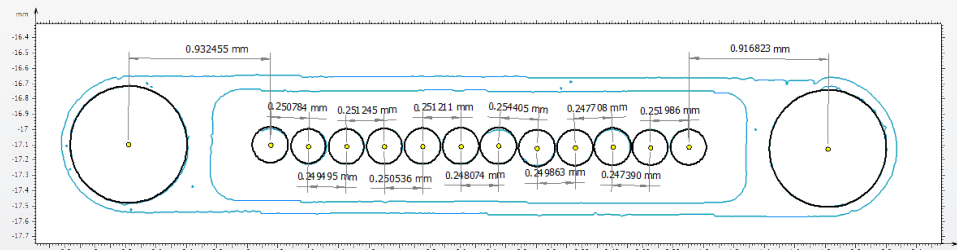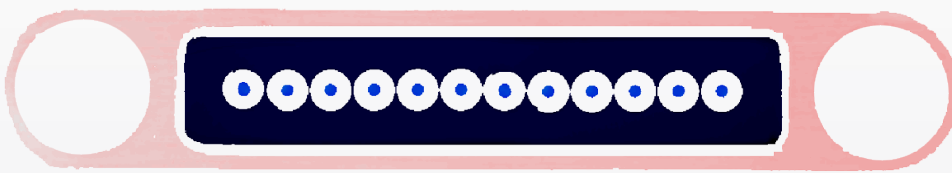Define nominal form using straightforward interactive tools.

Use auto-dimensioning tools to calculate dimensions including distances, radii, diameters and angles.
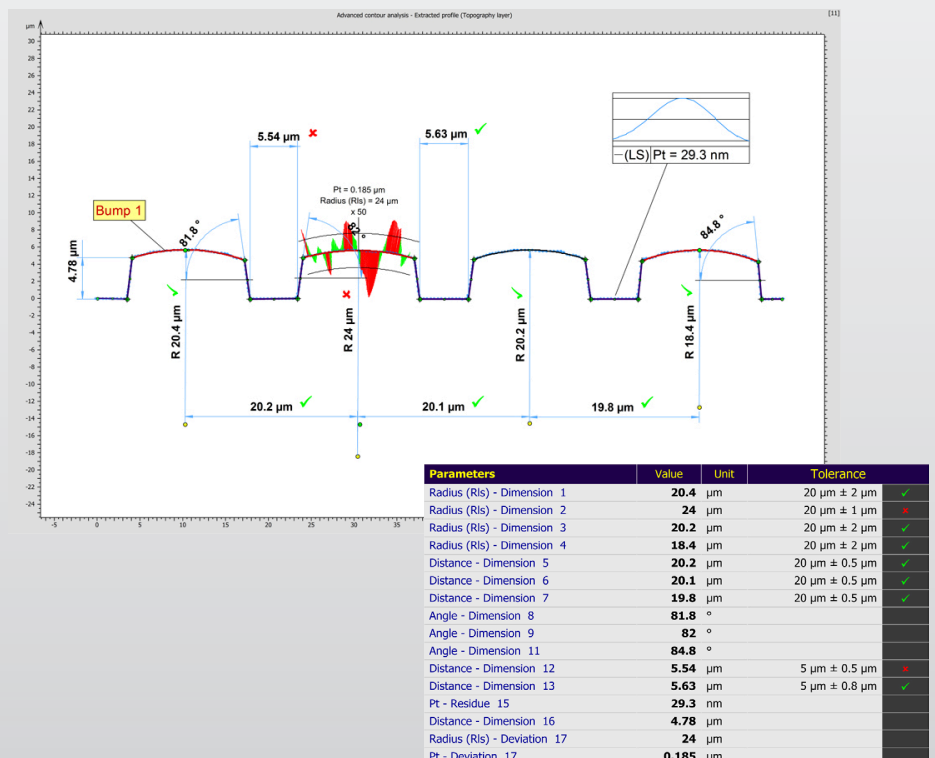

Advanced contour
Comprehensive form deviation analysis with tolerancing

Compare measured contours with CAD data (DXF) or user-defined nominal form.

Specify tolerances including large positional tolerances if required.

Visualize form deviations easily with magnified graphics.

Automatically generate a table of results including pass/fail status.

| Parameters	Value	Unit	Tolerance	
Radius (Rls) - Dimension 1	20.4	μm	20 μm ± 2 μm	✓
Radius (Rls) - Dimension 2	24	μm	20 μm ± 1 μm	✗
Radius (Rls) - Dimension 3	20.2	μm	20 μm ± 2 μm	✓
Radius (Rls) - Dimension 4	18.4	μm	20 μm ± 2 μm	✓
Distance - Dimension 5	20.2	μm	20 μm ± 0.5 μm	✓
Distance - Dimension 6	20.1	μm	20 μm ± 0.5 μm	✓
Distance - Dimension 7	19.8	μm	20 μm ± 0.5 μm	✓
Angle - Dimension 8	81.8	°		
Angle - Dimension 9	82	°		
Angle - Dimension 11	84.8	°		
Distance - Dimension 12	5.54	μm	5 μm ± 0.5 μm	✗
Distance - Dimension 13	5.63	μm	5 μm ± 0.8 μm	✓
Pt - Residue 15	29.3	nm		
Distance - Dimension 16	4.78	μm		
Radius (Rls) - Deviation 17	24	μm		
Pt - Deviation 17	0.185	μm		

SensoMAP
Modules

Grains and particles
Study isolated surface features

Use multiple complementary methods to detect, count and analyze grains, particles, islands, bumps, holes and texture cells (motifs), including binarization with respect to a horizontal plane, thresholding with respect to height, and segmentation by watersheds.
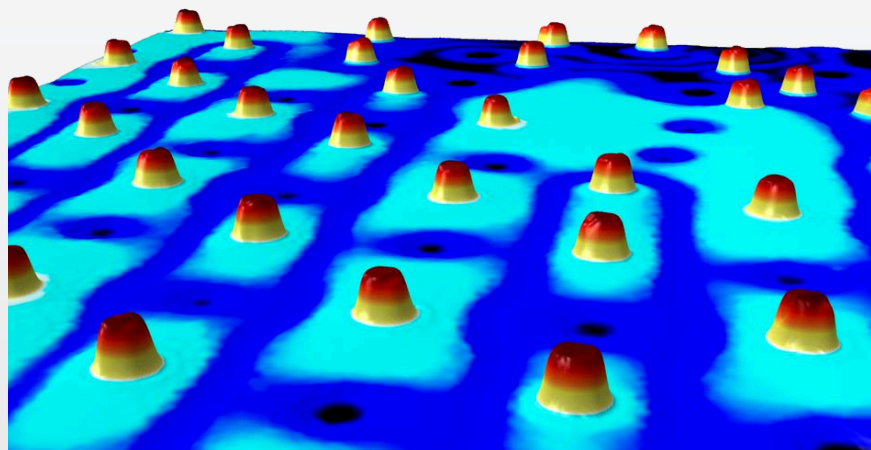
Calculate morphological parameters for individual grains, motifs, etc.

Generate statistics for all grains, motifs, etc. or subsets selected with respect to any parameter.
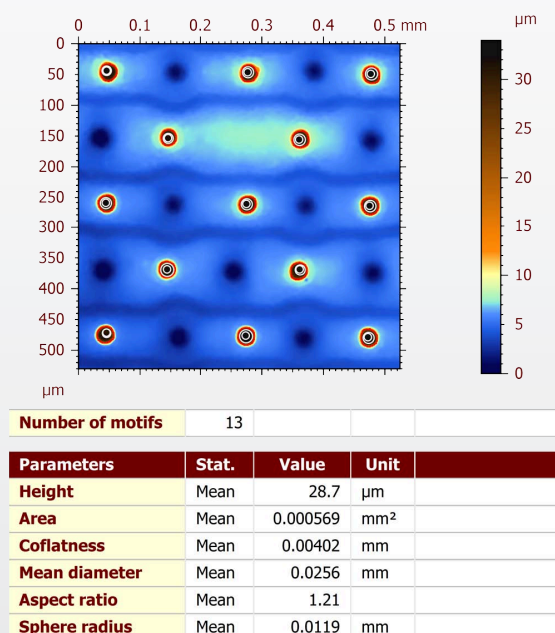
Calculate ISO 25178 features parameters (Spd, Spc, S5p, S5v, S10z, Sha, Sda, Shv and Sdv).

Special features for microlens arrays include the display of spherical caps and the calculation of spherical parameters.

Number of motifs	13		

Parameters	Stat.	Value	Unit
Height	Mean	28.7	µm
Area	Mean	0.000569	mm²
Coflatness	Mean	0.00402	mm
Mean diameter	Mean	0.0256	mm
Aspect ratio	Mean	1.21	
Sphere radius	Mean	0.0119	mm

4D series
Visualize and analyze surface evolution

Combine a series of surface measurements for 4D analysis with respect to time, temperature, magnetic field or another dimension.

Visualize surface, profile and point evolution, even fly over a surface as it changes and record a movie for presentations.

Generate statistics on surface change.

Highlight areas of preponderant change using the Karhunen-Loève transform (principal component analysis).

Colocalization

Combine surface data obtained by imaging and metrology instruments of different types

Colocalize surface data obtained by different technologies

For example correlate interferometric surface data with nice color images from the confocal scanning. The module correlates the 3D data and the image until it fits and can render the final 3D image with the color overlay.
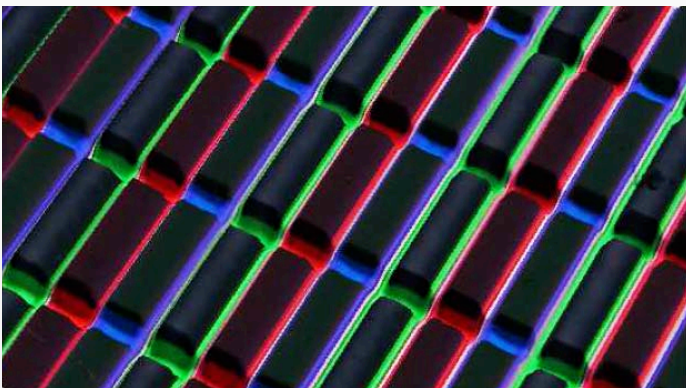
Colocalize surface data obtained by different instruments

For example colocalize surface data obtained by 3D optical profilers and scanning probe microscopes with limited field of view and images obtained by scanning electron, fluorescence and other microscopes. (Note: instrument compatibility depends on the configuration of the installed SensoMAP software).

Statistics

Automated statistical analysis of static and dynamic measurement data populations

### Prepare data automatically using templates

Include all parameters for statistical analysis in a predefined analysis workflow – use it as a template for automatically generating analysis reports on one or more populations.

Generate statistical reports

Select the static or dynamic population(s) to be analyzed and create a report with parameter tables, control charts, histograms, box plots and scatter plots as required – statistics for dynamic populations are updated automatically.

Monitor key parameters and process capability

Control charts include standard deviation limits (1 to 3 sigma), control limits and vertical bars separating different populations, together with yield capability (Cpk) and other parameters.
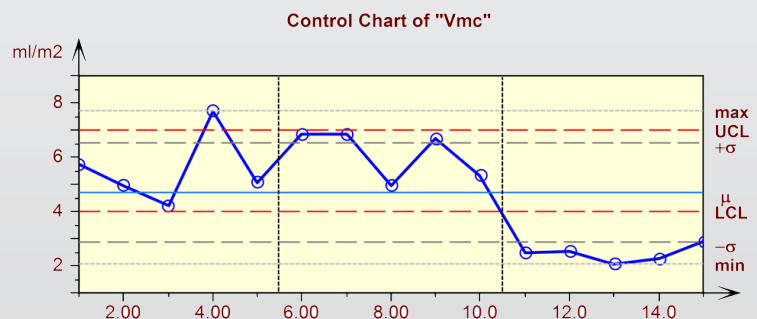
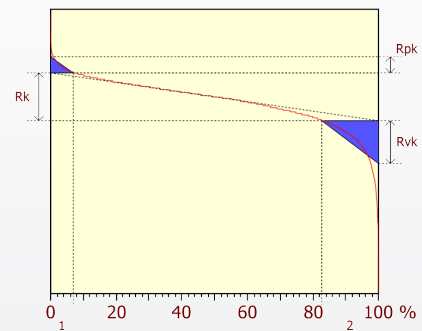| Parameters	Value	Unit
Yield	60.0	%
Cp	0.274	
Cpk	0.128	

SensoMAP
Modules

2D automotive
Assess functional performance with parameters developed by the automotive industry

Calculate a comprehensive set of 2D parameters
ISO 13565-2 Rk parameters – ISO 13565-3 parameters – ISO 12085 motifs parameters – ISO 12780 straightness parameters – ISO 12781 roundness parameters.

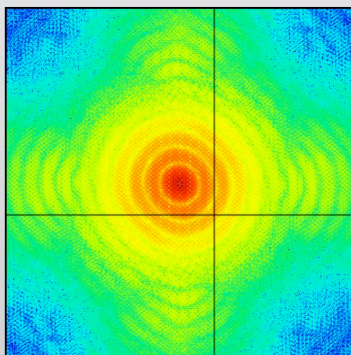Study Rk parameters associated with wear and lubrication graphically
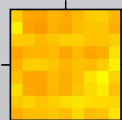Visualize friction, core and lubrication zones on tribological profiles.

Information			
Filter settings	Double Gaussian filter, 0.080 mm.		

Parameters	Value	Unit	
Rk	0.321	µm	
Rpk	0.108	µm	
Rvk	0.288	µm	
MR1	6.91	%	
MR2	82.7	%	
A1	3.72	µm2/mm	
A2	25.0	µm2/mm	

3D Fourier
Use advanced FFT-based tools to analyze process-surface interactions and denoise surfaces

Work with a wide range of FFT-based plots
Interactive frequency spectrum, interactive power spectrum density, autocorrelation and intercorrelation.

Calculate isotropy, directionality and periodicity
View dominant surface directions on a compass rose and calculate parameters.

Denoise surfaces using the FFT plot editor.

Parameters	Value	Unit
X	12.8	µm
Y	-14.8	µm
Wavelength	9.68	µm
Angle	-41	°
Magnitude	-21.8	dBc
Phase	59.5	°
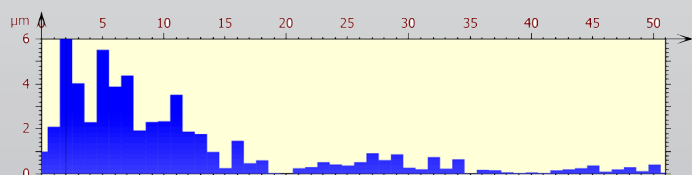
Parameters	Value	Unit	
Wavelength # 2	0.263	mm	
Magnitude	6.01	µm	
Phase	6.15	°	

SensoMAP Product Line
Scalable to meet your exact needs

	Standard	Premium
Features		
User interface	English, German, French, Italian, Spanish, Polish, Japanese, Chinese, Korean, Brazilian Portuguese	
Reference manual	English, German, French, Japanese	
Analysis modules		
2D automotive	Option	✔
3D Fourier	Option	✔
4D series	Option	✔
Advanced 2D surface texture	Option	✔
Advanced 3D surface texture	Option	✔
Advanced contour	Option	Option
Colocalization	Option	Option
Contour	Option	✔
Grains & particles	Option	✔
Statistics	Option	Option
Requirements		
Minimum	Windows 8, 7 or Vista (64-bit or 32-bit), 4 GB RAM, OpenGL or Direct 3D hardware accelerated graphics board, 1280 x 768 resolution in thousands of colors, 800 MB HDD free space, 1 free USB port.	
Recommended	Windows 8 or 7 64-bit, quad core processor, 1600 x 1024 resolution in thousands of colors.	

SensoMAP powered by Mountains Technology[R] from Digital Surf

SENSOFAR is a leading-edge technology company that has the highest quality standards within the field of surface metrology.

Sensofar Metrology provides high-accuracy optical profil-ers based on interferometry and confocal techniques, from standard setups for R&D and quality inspection laboratories to complete non-contact metrology solutions for online production processes. Sensofar Metrology offers technology that enables our customers to achieve real breakthroughs, particularly in the semiconductor, precision optics, data stor-age, display devices, thick and thin film and material testing technology fields.

The Sensofar Group headquarters is located in Barcelona, the technological heart of Spain. The Group is represented in over 20 countries through a global network partners and its own offices in Asia, Japan and the United States.

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