NEWSLETTER SURFACE
Fall 2015
Surface imaging, analysis & metrology news from Digital Surf

In this issue

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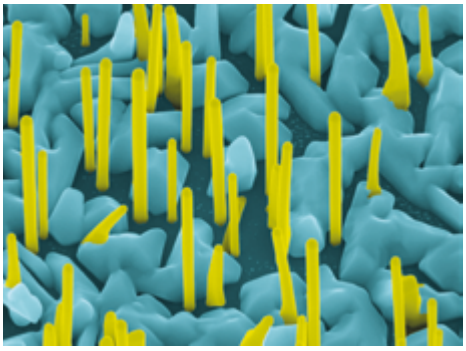
Mountains® 7.3 release:
all the key features explained

Whatever your microscope or profilometer, the new Mountains® 7.3 update to be released this winter has something for you.

New features include automatic detection of step heights on surfaces, revolutionary SEM image colorization, options for advanced profile analysis and much, much more.

Read more overleaf



Probing electrical structure at the atomic scale: Mountains® helps researchers reveal hidden details p. 6

Metrologists: how will the upcoming revision of profile parameters standards affect you? p. 8

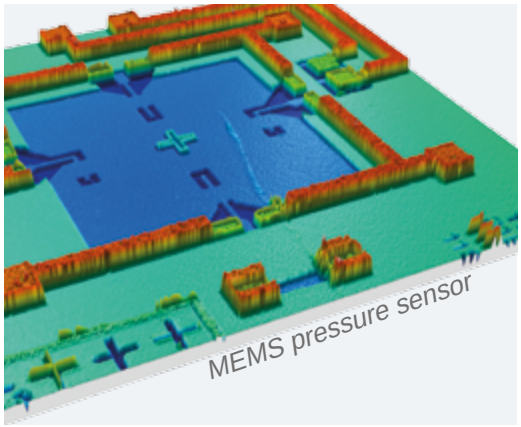
PLUS

Visitors to the 2015 MRS Fall Meeting & Exhibit in Boston, Massachusetts, USA (November 29 - December 4) are invited to preview new Mountains® 7.3 features at Digital Surf's booth 704.

WHAT'S NEW FOR SURFACE TOPOGRAPHY?

Step-height calculation

Just got easier!



Differential parameters	Unit	P2 - P1	P3 - P2	P4 - P3	
Zmean(higher) - Zmean(lower)	µm	0.376	0.441	1.37	
Angle difference	°	0.00105	0.000769	0.00216	
Plane parameters	**Unit**	**Plane 1**	**Plane 2**	**Plane 3**	**Plane 4**
Zmin	µm	0.132	0.492	0.918	1.94
ZMean	µm	0.293	0.669	1.11	2.48
Zmax	µm	0.426	0.886	1.34	2.95

Step height calculation has never been easier thanks to Mountains® new automatic detection method.

Whereas previously it was necessary to manually define the different planes of a surface, Mountains® now does the work for you.

In just one click, see your different step heights instantly appear as different color-coded areas on the surface.

The color-code allows you to quickly find measurements related to each plane in the parameters table.

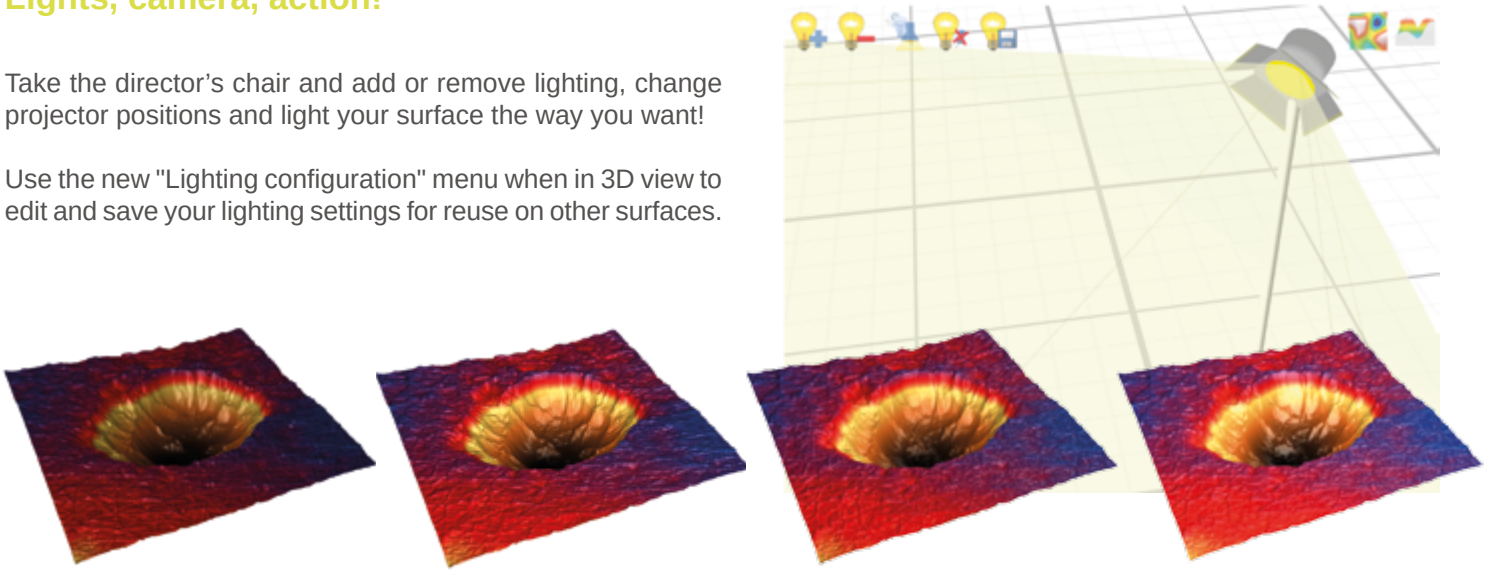
A particularly useful feature for measuring step heights on complex surfaces such as electrical components!

Lighting customization for your 3D models

Lights, camera, action!

Take the director's chair and add or remove lighting, change projector positions and light your surface the way you want!

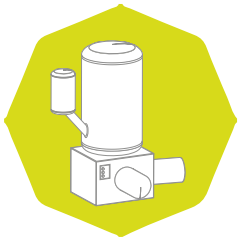
Use the new "Lighting configuration" menu when in 3D view to edit and save your lighting settings for reuse on other surfaces.



Different lighting types and positions applied to a surface, allowing better visualization of otherwise hidden features

Other new features for Surface topography: graphical scale enhancement, export a study as a new image studiable in the workflow, new options for aligning series of surfaces or images etc.
Read more: www.digitalsurf.com/whatsnew

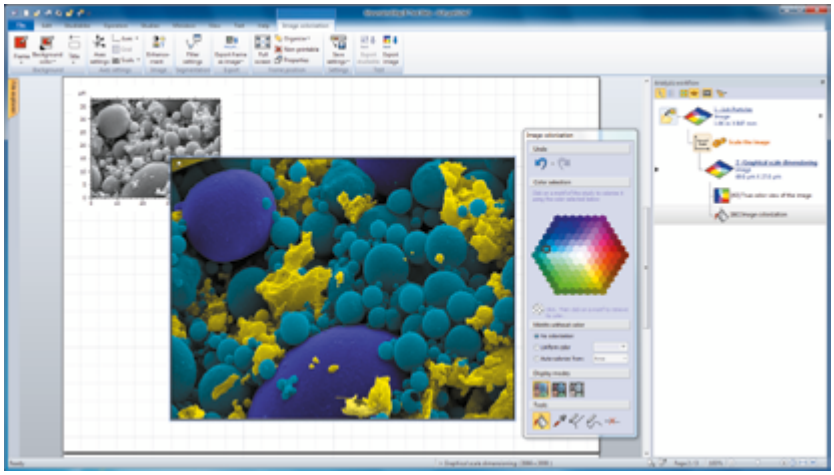
WHAT'S NEW FOR SCANNING ELECTRON MICROSCOPY?



Built-in click & color colorization

Saves you hours

Colorizing your SEM images can really aid visualization and interpretation of the information they contain, as well as making them more aesthetically pleasing for publication purposes.



Colorizing images using Mountains® couldn't be easier. Simply choose a color from the color picker and apply.

Example: secondary electron image of ash particles recorded by Randolph Shannon, Lab Manager, PMET Inc., New Brighton, PA

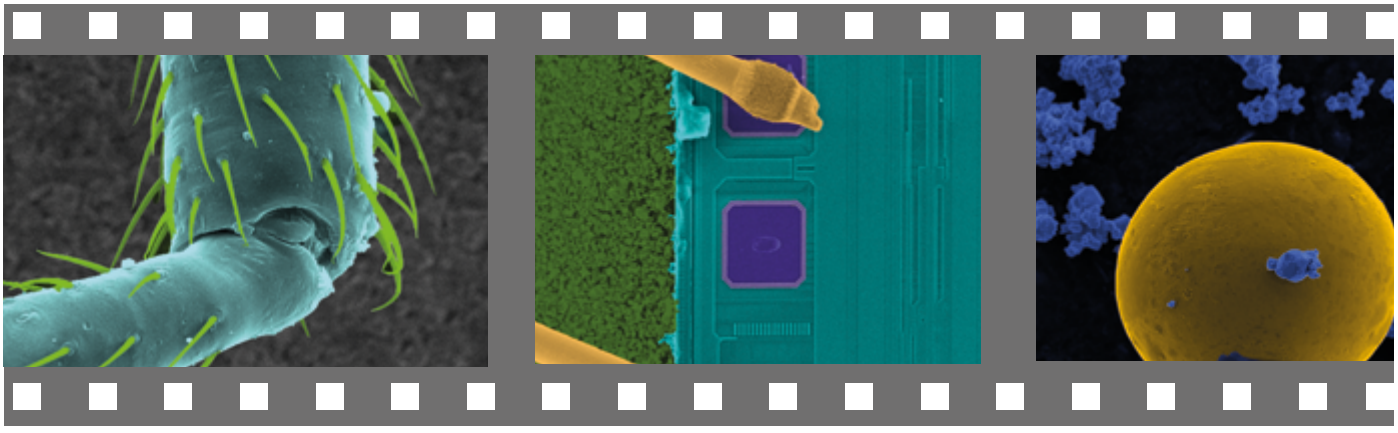
Here are 3 reasons to use Mountains® for colorizing your SEM images

1. It's quick. One click of the mouse is enough to color an object in your image.

2. Objects are detected automatically. No need to create layers or play with transparency levels. Mountains® does the work for you

3. Use the same software for image processing & analysis. Once you've colorized your image in Mountains®, making objects easier to see, you have access to a comprehensive range of tools to carry out different types of analysis: 3D reconstruction, surface geometry analysis, surface roughness measurement.

See more examples and watch the Mountains® video tutorial by visiting www.digitalsurf.com



Other new features for SEM: new operators on images (lighting, resampling etc.)
Read more: www.digitalsurf.com/whatsnew

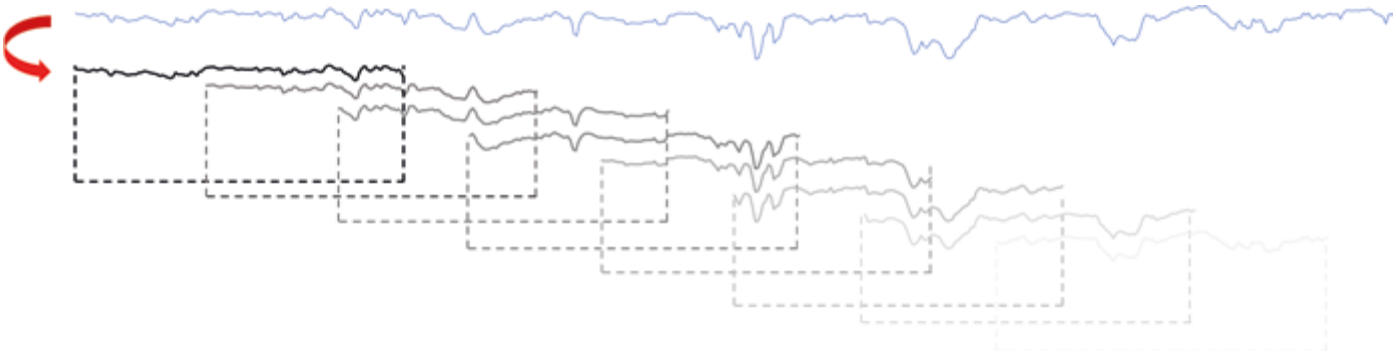
WHAT'S NEW FOR PROFILE ANALYSIS?

Generate sliding profiles

For improved measurement reliability

To assess the dispersion of values along a profile and hence the statistical reliability of surface texture parameters, it may be useful to calculate these parameters, for instance Ra (average surface roughness), on several sliding profile segments, rather than on the total measurement length.

The new "Sliding profiles" operator in Mountains® generates a series of profiles on each of which average parameters may be calculated.



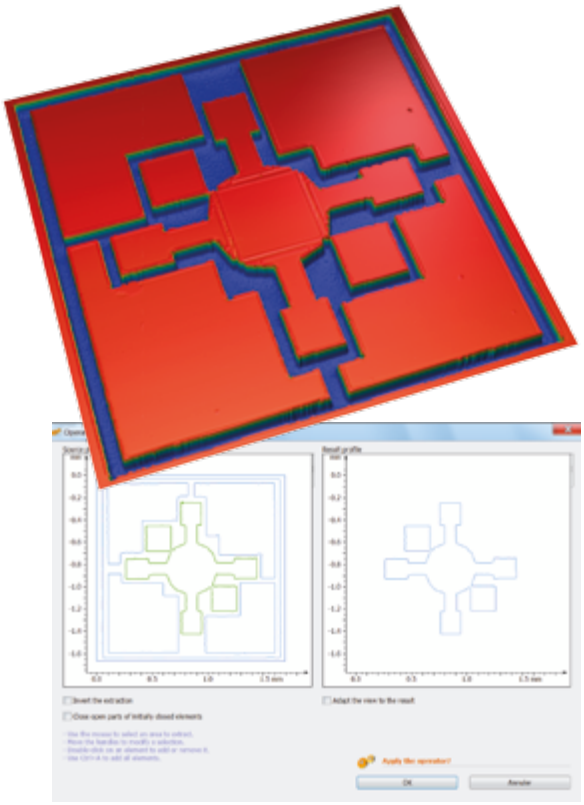
The new operator generates several consecutive or overlapping profiles.

New extract area operator

Zoom in on parametric profiles

As for basic profiles and surfaces, it is now possible to extract areas or zones from parametric profiles, e.g. resulting from the horizontal profile extraction of a surface object.

Select elements to extract simply by double clicking on them in the dialog. This is a useful feature for zooming in on a region of interest.



Other new features for profiles: new parameters, profile enhancement features (line thickness...), zoom etc.
Read more: www.digitalsurf.com/whatsnew

WHAT'S NEW FOR SCANNING PROBE MICROSCOPY?

Distinguish elements in a series

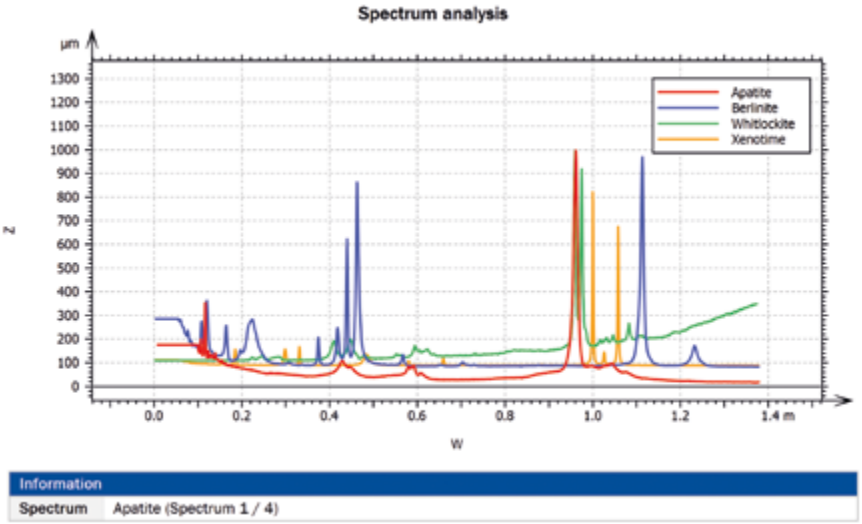
Extended flexibility for publication in your research papers

Graphs and other display items play an important role in enhancing the quality of manuscripts. They offer the reader a quick overview of the study findings, and allow authors to present detailed results and complex trends in a clear and concise way.

To better serve the needs of the thousands of researchers who use Mountains® for their work, the software now offers the possibility of distinguishing elements on series of profiles, series of spectrum or force curves.

Different styles (color, line width, line style) can be associated with each element.

A key visible on the top right clearly identifies what each element in the graph stands for.



Other new features for SPM: map study on force volume curves, display spectrum in normalized mode, features for STM and STS data (see overleaf).
Read more: www.digitalsurf.com/whatsnew

GENERAL FEATURES

User interface now available in Russian

"привет" (Privyet) to all our Russian users! The Mountains® software interface is now available in Russian. To enable Russian simply go to Preferences and select Russian from the list of our 11 working languages!

Other new general features: improved compatibility with external applications, video compression, clipboard enhancements, user interface adapted to high resolution display, new file formats etc.

Read more: www.digitalsurf.com/whatsnew

Get MountainsMap® 7.3!

Keeping your Mountains® software up-to-date will ensure you have all the latest features and bug fixes as well as improving the overall security of your computer.

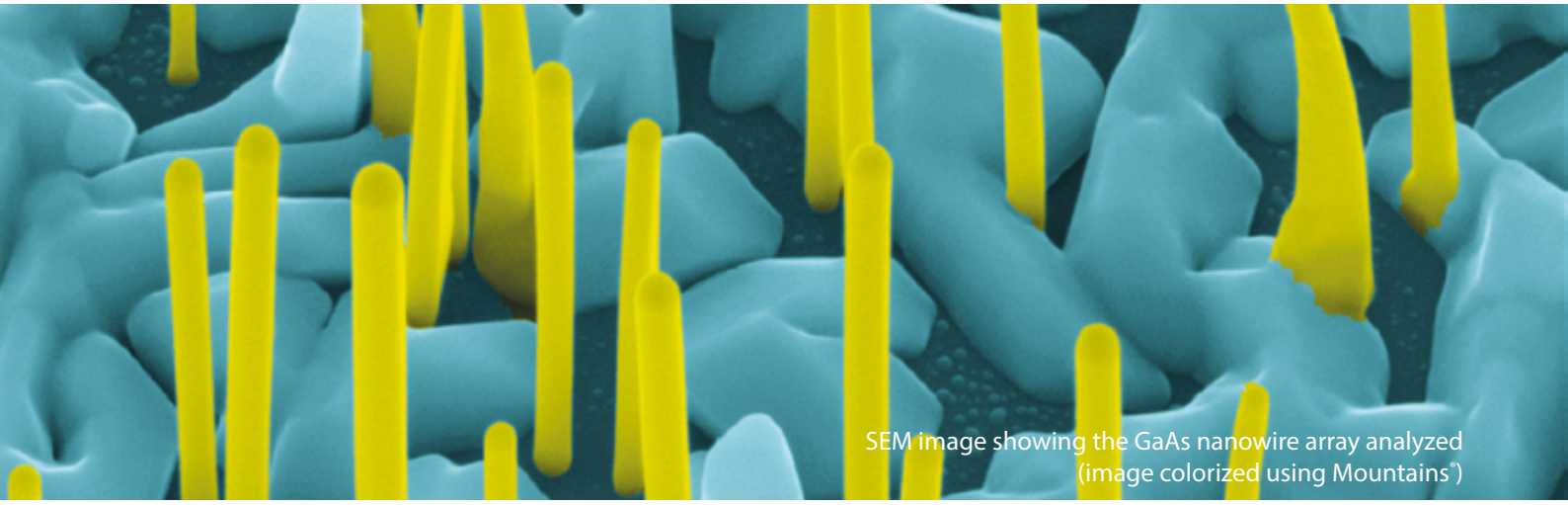
- MountainsMap® users will receive an email inviting them to update their software online as soon as the new version is available.

- If you are still using MountainsMap® 6 or an earlier version of the software, please contact us directly to talk about an update.

Phone +33 38150 4800 or email us at contact@digitalsurf.com

PROBING ELECTRICAL STRUCTURE AT THE ATOMIC SCALE

Mountains® helps researchers reveal hidden details



SEM image showing the GaAs nanowire array analyzed (image colorized using Mountains®)

Using SPM to investigate semiconductor surfaces

Scanning tunneling microscopy (STM) belongs to the surface science tools that enable both imaging of surfaces at the atomic scale and investigation of their spectroscopic properties. Bruno Grandidier of the Institut d'Électronique, de Microélectronique et de Nanotechnologies (IEMN) in Lille, France, tells Surface newsletter how he and his team of researchers use this technique, along with Mountains® software, to analyze electronic states of GaAs nanowire shells.

When used in spectroscopic mode, STM gives access to the electronic states of a surface within a given energy window. This window depends on the bias applied across the tunneling junction formed by the surface of a material and the STM probe.

This technique is particularly well suited to investigating semiconductor surfaces. By measuring the dependence of the tunneling current on the applied voltage, one can deduce key information from an I-V characteristic, such as the width of the semiconductor band gap and the spectral position of electronic bands.

However, several difficulties have to be overcome before obtaining this information.

> The electronic properties of the sample can only be obtained once all these procedures have been applied. The good news is, Mountains® software now provides the extraction and processing methods required to handle these delicate operations.

1 As a general rule, a large number of I-V characteristics are acquired under identical feedback conditions. Sets of reproducible characteristics must be averaged in order to increase the signal-to-noise ratio.

2 Despite averaging, I-V characteristics are strongly dependent on the transmission probability. Related changes in the spectrum may hide small variations induced by the electronic properties of the semiconductor. Moreover, the current is obtained from the integration of states within the energy range for which tunneling occurs. Thus, obtaining the electronic structure of the sample usually requires acquiring the derivative of the current and vertically moving the STM tip in a controlled manner so that the dynamic range increases.

3 The differential conductance must then be normalized with regard to the average I-V characteristic, convoluted to a suitable function to get rid of the dependence of the transmission probability and avoid any divergence.

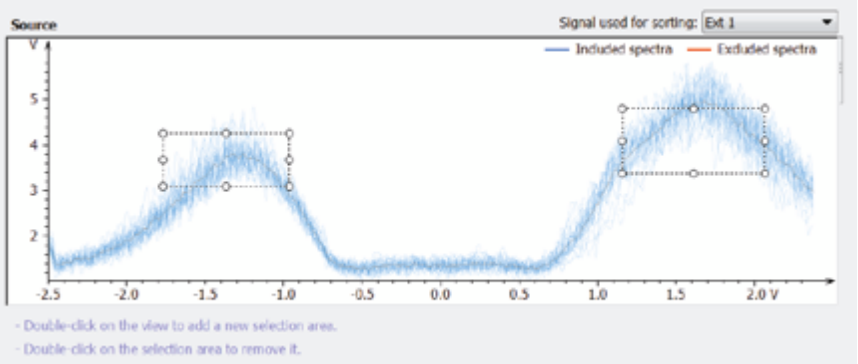
Research into the structural and electronical properties of GaAs (gallium arsenide) nanowires is of great interest for the next generation of compact terahertz sources and detectors with numerous applications in astronomy, communications, sensing, imaging and medical diagnostics.

Obtaining information on electrical structure using Mountains® software

Let's have a closer look at these new tools, unveiled in the new 7.3 version of the software. Here we show an example of operators that can be used to process tunneling spectroscopic measurements performed on core-shell GaAs nanowires. The unique properties of the nanowires are caused by their shell that is grown at low temperature and thus contains a high concentration of As antisite defects. These atomic defects are visible in STM images of the nanowire sidewalls and show a particular spectral signature, with two peaks in the band gap of GaAs that are of great interest for obtaining ultra-short carrier lifetimes.

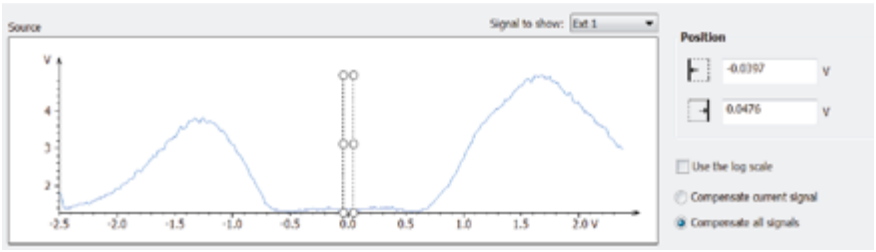
1 Sort spectra

Spectra obtained are sorted using the Sort Spectra operator in order to remove unwanted spectra and generate the mean spectrum.
This operation, which previously had to be done by reviewing each spectra individually, is made quick and easy.



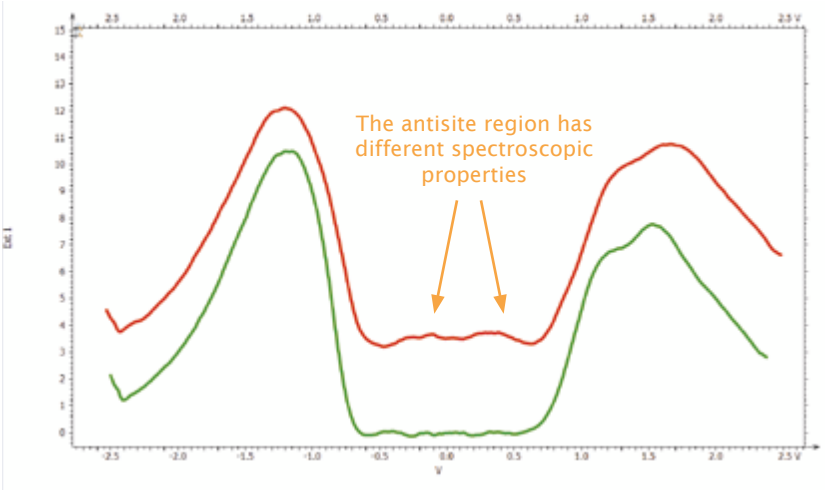
2 Compensate offset

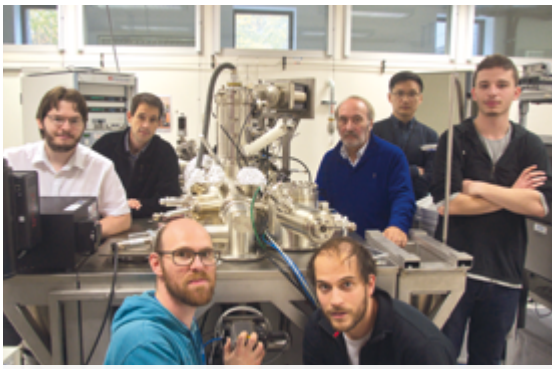
At this point, it is necessary to readjust things a little.
The Compensate offset operator is used to define a value on the x-axis which will become the new zero value.
It is possible to display the graph using a log scale at this stage.



3 Normalize the conductivity

Finally the conductivity is normalized to prevent any divergence.
In the final graph, spectroscopic properties of an As antisite (red curve) are compared with those of a region free of antisites (green curve).





Bruno Grandidier (second from the left at the back) with the IEMN research team and the STM system used in the study

Read more:
Non-stoichiometric low-temperature grown GaAs nanowires:
pubs.acs.org/doi/10.1021/acs.nanolett.5b01802
Nano Letters, September 2015.
Contact: bruno.grandidier@isen.iemn.univ-lille1.fr

Hear more:
MRS Fall Meeting in Boston, Symposium P, December 1, 2015:
www.mrs.org/fall-2015-program-p

Measurements obtained using a standard UHV-STM type commercial system.

PROFILE STANDARDS ARE SET TO CHANGE

What you need to know

The upcoming revision of profile parameter standards is set to change the way metrologists, technicians and engineers perform and analyze measurements.

François Blateyron, Digital Surf's ISO surface metrology expert, reveals more.

Surface metrology is vastly dominated by profile measurements and profile parameters specifications. Many international standards related to profile specifications, measurements or analysis have been developed with the aim of guiding metrologists and designers:

- ISO 1302 explains how to specify surface texture on drawings
- ISO 4287 describes the main profile parameters (Ra, Wa and so on)
- ISO 4288 explains how to apply parameters and select cut-offs
- ISO 16610-21 describes the Gaussian profile filter (replaces ISO 11562:1996)
- ISO 3274 describes the basic requirements for stylus profilometers
- ISO 12179 explains how to calibrate a stylus profilometer
- ISO 5436 describes the material measures used to calibrate instruments
- ISO 12085 describes the motifs method and parameters (also called “French motifs”)
- ISO 13565 describes a robust filter and functional parameters used in the automotive industry

Most of these standards were published or last revised in the late 1990’s and have since been regularly confirmed without modification. However, the recent publication of ISO 25178 established a new universal basis for surface texture by initially targeting areal surface texture. It makes sense today to apply the same concepts to profile surface texture and therefore revise or replace existing standards.

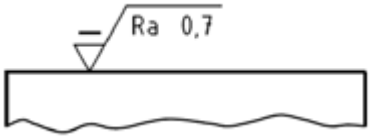
The ISO TC213/WG16 has already started work on this subject and has been discussing the draft of a new three-part standard for eighteen months now. This draft should become an official work item in 2016 (with an ISO number) and could be published within the three next years.

A new standard in three parts

This project is organized into three parts, exactly as the first three parts of ISO 25178 which correspond to the first three columns of the GPS matrix (see ISO 14638):

1. Indication of profile surface texture on drawings
2. Terms, definitions and surface texture parameters
3. Specification operators

Example of roughness specification on a drawing.



Note the line segment above the triangle on the left of the radical sign, which identifies the specification as a profile surface texture specification.

See ISO 25178-1 for areal surface texture specification.

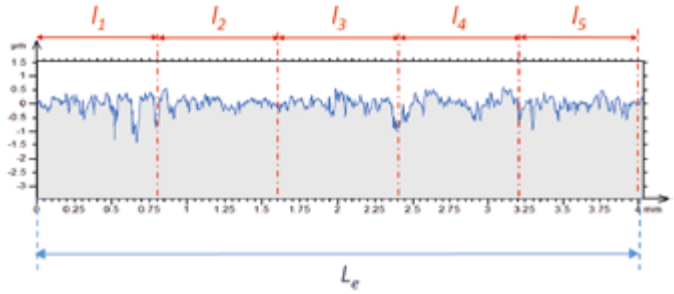
1 Part 1 of this new profile standard will basically incorporate ISO 1302 with some additions coming from ISO 1101 and other specification documents.

2 Part 2 will incorporate all parameters of existing profile standards and add new ones, either old parameters that have been dropped or ones adapted from ISO 25178; for example, Pvv will provide the void volume of the valleys on the primary profile (adapted from Svv).

3 Part 3 will give default specification values that can be omitted on a drawing, such as units, nesting index, filter type, etc.

Changes to profile lengths

One of the main achievements of this draft is that parameters are now defined on the evaluation length. This means they are no longer calculated several times and then averaged. Instead, there will be only one Ra (or Rq) value calculated on the profile. The only exceptions are for Rp, Rv and Rz which will still be averaged to reduce the influence of outliers. Moreover the name "sampling length" is changed to "section length" to avoid confusion with the sampling of points on a discrete profile (see ISO 14406).



Current averaging method (see ISO 4288).
The above profile is divided into five sampling lengths (L1 to L5) on which five estimated values of a parameter are calculated and averaged.
Some parameters are calculated on the evaluation length (Le) such as Rt.
This will no longer be the case with the new standard.

Calculating parameters on the evaluation length is not new. ASME B46.1, the American standard for surface texture already specifies profile parameters without averaging the parameters on a number of sampling lengths.

Mountains® software already allows users to choose the profile length used to calculate parameters. (Go to File menu > Preferences (or F7) and Metrology > Filtering.)

The default setting is five sampling lengths but any number of sampling lengths can be defined. Alternatively, parameters can be calculated on all sampling lengths available on the profile or on the evaluation length.

Replacement of the 16% rule

Another important change concerns the 16% rule defined in ISO 4288, which is quite complex and not very well understood by users. The 16% rule will not be the default rule anymore. It may be replaced, if necessary, by specifying multiple measurements and setting a tolerance on a statistical parameter. Otherwise tolerances and specifications will be verified with respect to a single measurement.

So far, there are no plans to write documents describing instruments as they are already well specified in ISO 25178-60x for their metrological characteristics and ISO 25178-700 for their calibration. Furthermore, ISO 5436-1 is already incorporated into ISO 25178-70 which provides material measures for the calibration of surface texture instruments, areal or profile.

Of course it is too early to speculate on the final versions of these documents as they can be amended by experts at the different stages of voting which will take place before final publication. But one thing is sure: metrology practices will be changed and modernized. Metrologists will likely need to revise their procedures, designers to adapt their specifications and instrument manufacturers to update their analysis software.

What will change in Mountains®

Mountains® software (including MountainsMap® Profile) will be updated accordingly as soon as details of the new standard are agreed. The update will be made available at the FDIS final draft stage allowing Mountains® users to implement the new parameters even before official publication of the standard.

Current standards will, of course, continue to remain available and users will be able to set preferences defining which standards should be applied by default.

More information on profile parameters in our surface metrology guide:

www.digitalsurf.com/guide

A LOOK BACK AT THIS SUMMER'S SHOWS

Microscience Microscopy Conference (MMC)

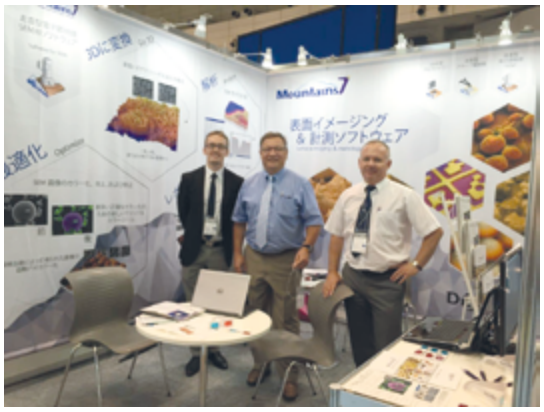
The Digital Surf team were very excited to be part of the trade exhibition held alongside the MMC conference in Manchester, UK (29 June - 2 July).

Over 100 companies participated with a total of nearly 1400 attendees present at the event, representing many different areas of academia and industry.

Anne and Cyrille welcomed visitors to the Digital Surf stand for a demonstration of the all the latest Mountains® capabilities.

A special preview of features for Scanning Electron Microscopes, including 3D reconstruction and colorization drew much interest from attendees.

Japan Analytical & Scientific Instruments Show (JASIS)



Arnaud, François and Damien were on hand to greet visitors at our stand at the Japan Analytical & Scientific Instruments Show (JASIS) in Tokyo (September 2-4).

It was Digital Surf's first participation as an exhibitor at this show which is impressive in its sheer size (over 23 000 visitors & 500 companies exhibiting).

The team were very pleased to be able to meet so many of our Japanese, Chinese and Korean customers and to be able to offer solutions to their data analysis needs.

Become a Mountains® expert!

Did you know you can now learn how to use Mountains® surface imaging & analysis software by watching one of our video tutorials?

These short but detailed step-by-step demonstrations will enable you to quickly master different features such as:

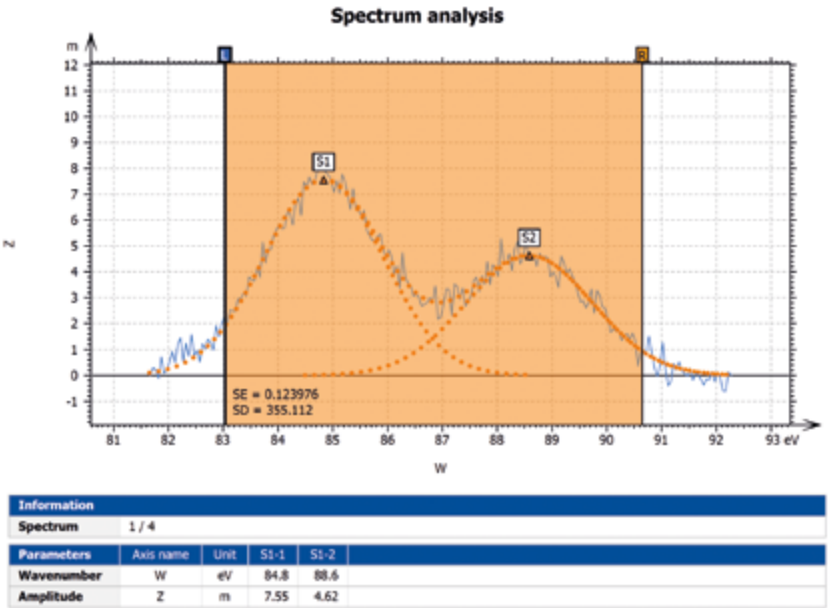
- Getting started
- Removing outliers and non-measured points
- 3D reconstruction from 4 SEM images
- 3D reconstruction from 2 SEM images
- SEM image colorization NEW!
- And more coming soon!

DECONVOLUTING A MULTI-PEAK CURVE

The Digital Surf development team is always interested in hearing feedback from users in the aim of continually improving the Mountains® software experience.

One such improvement currently in the making is a deconvolution feature for separating different peaks from a single broad peak, the aim being to make life easier for scientists analyzing data from X-ray photoelectron spectroscopy (XPS), Raman spectroscopy and other analytical techniques.

Users will soon have access to the initial set of features described below, with more to come!



Information				
Spectrum	1 / 4			
Parameters	**Axis name**	**Unit**	**S1-1**	**S1-2**
Wavenumber	W	eV	84.8	88.6
Amplitude	Z	m	7.55	4.62

Curve fitting

Options for Gaussian, Lorentzian and Voigt curve fitting will soon be available. Simply click on the approximate location of peaks, and Mountains® calculates the different curves accordingly.

It will also be possible to manually move points on the curve or adjust the range in which fitting should be performed (orange area on the image above). When points are moved or the range resized, all results are automatically updated.

Mountains® will also give users options for finding and fitting baselines for data.

As with all kinds of analysis using Mountains®, settings defined by the user can be saved as default settings for repeat use, speeding up the study of multiple data sets.

What are the application areas of curve fitting?

Many fields of science and research using spectroscopy rely on curve fitting to obtain important information on sample structure. These include coatings, polymers, graphene, solar cells, thin films, semiconductors, ceramics and many more.

Dr Ángel Pérez del Pino, Manager of the Laser Processing Research Group at the Institut de Ciència de Materials de Barcelona (ICMAB) manipulates this type of complex spectroscopic data in his work on direct laser irradiation and matrix assisted pulsed laser evaporation (MAPLE) deposition of nanomaterials, which has applications in the development of devices for renewable energy, catalyzers for waste treatment and electronics.

He and his research team recently published findings on the enhanced photocatalytic efficiency of nitrogen doped Ti02/Au/rGO composite thin films. In this study, and many others, curve fitting plays an important part in the investigation of spectroscopic properties of specimens.

Read more:

One-step preparation of nitrogen doped Ti02/Au/rGO composite thin films for photocatalytic applications: http://goo.gl/pNP6Kb

RSC Advances (May 2015).

USEFUL LINKS

TRY MOUNTAINSMAP®

MountainsMap® Premium Software with all the options, free for 30 days!

CONTACT US FOR AN UPDATE

Contact us for information about updating MountainsMap® 6 or earlier software to the latest version of MountainsMap® 7

WATCH A MOUNTAINS® 7 TUTORIAL

Get the most out of Mountains® 7 by watching one of our tutorial videos

DOWNLOAD OUR BROCHURES

Learn more about Mountains® 7 software
Download a Mountains® 7 brochure in English, French, German, Japanese or Korean

MEET DIGITAL SURF

MRS Fall Meeting & Exhibit
Boston, Massachusetts, USA - Nov 29-Dec 4, 2015
Booth 704

Digital Surf
Surface Intelligence

Software solutions for surface metrology, designed for instrument manufacturers, research laboratories and industry

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