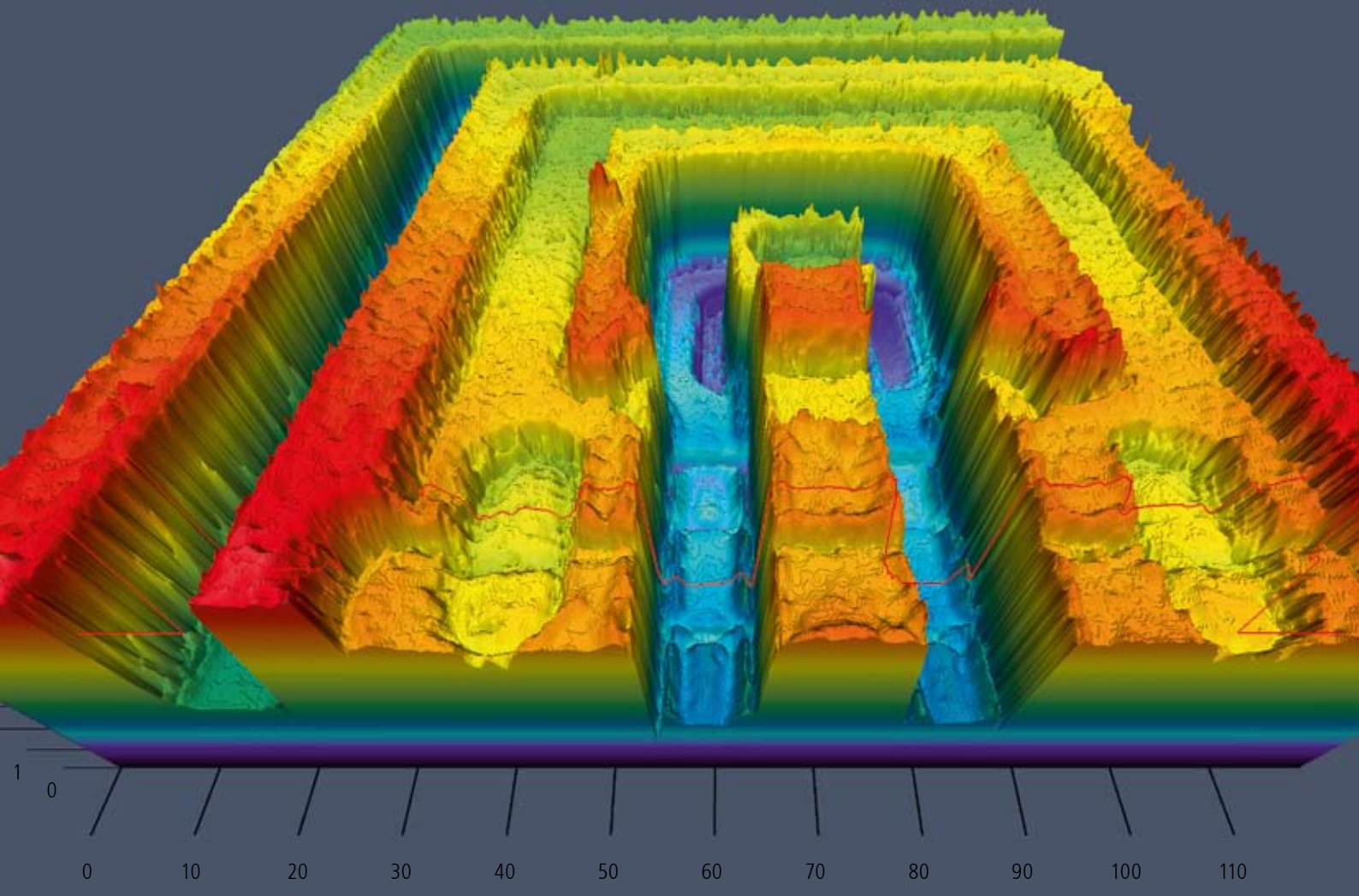
LSM 700

Flexibility Without Contact



Confocal Laser Scanning Microscope:

3D-Topography for Materials Analysis and Testing

ZEISS

We make it visible.

Outstanding Functionality

In materials analysis and testing, new innovative optical approaches are now required to meet the challenges posed by the pioneering progress currently being made in the fields of microtools and bio-MEMs, new and biocompatible materials, microsystems technology and nanotechnology.

The LSM 700 Laser Scanning Microscope from Carl Zeiss offers unparalleled optical resolution, excellent repeatability and extensive measuring functionalities and all at an affordable price. This leading-edge system from Carl Zeiss is the efficient answer to your complex measuring tasks on microstructures and material surfaces.

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LSM 700

Confocal Principle

Astounding Resolution, Amazing Contrast

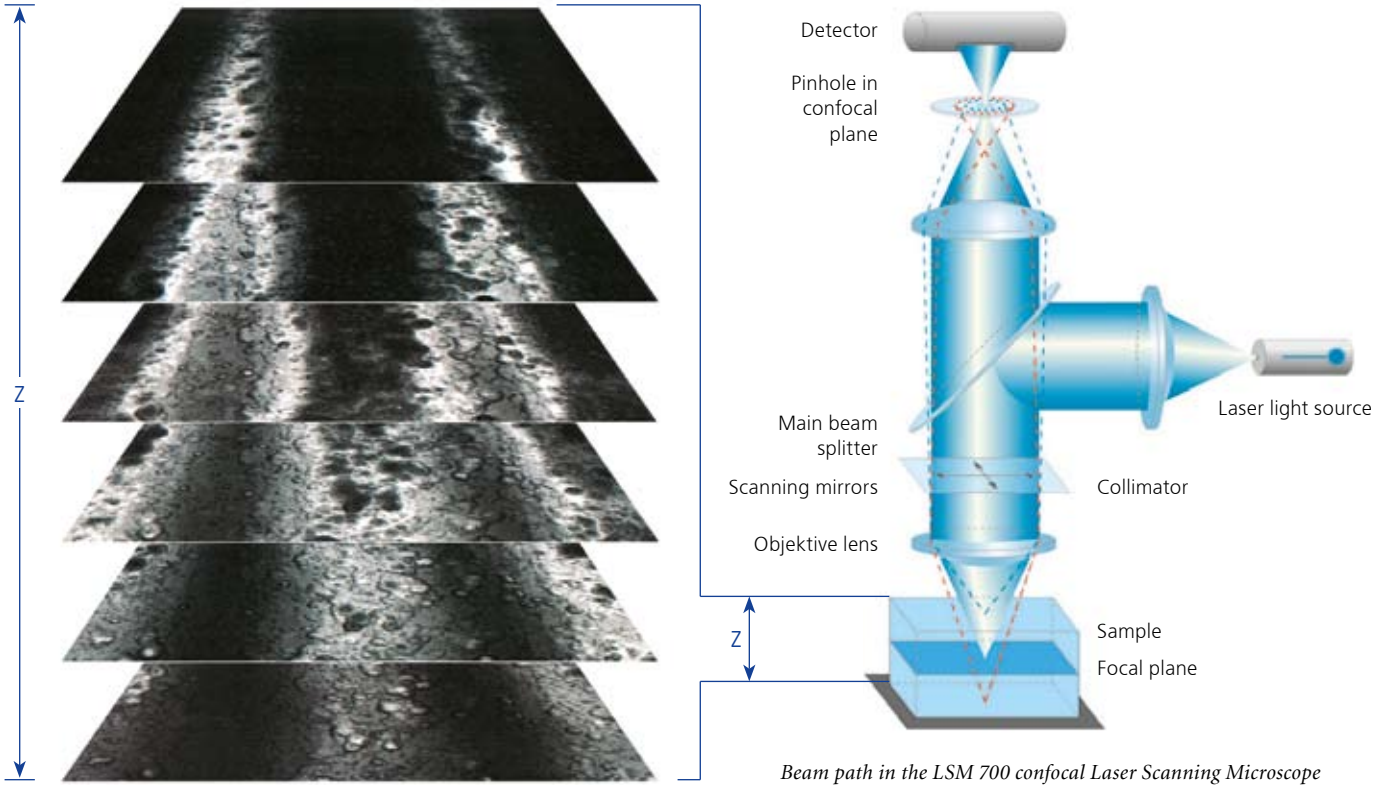
The LSM 700 is a light microscopy system which uses laser light in a confocal beam path to capture defined optical sections of your material sample and combine them into a three-dimensional image stack.

Ultra-fine optical sections in the micrometer range

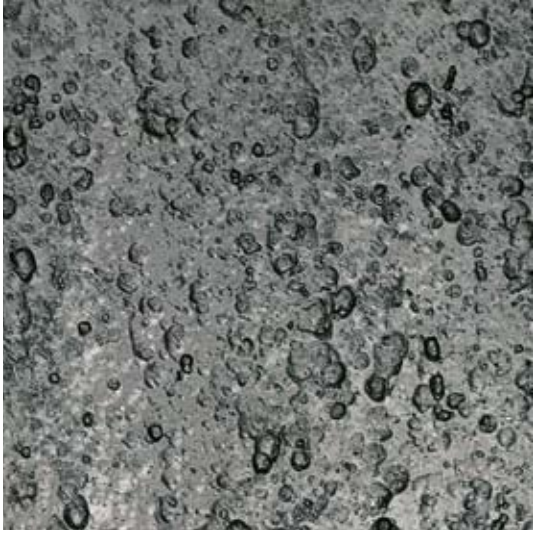
Laser light is coupled into the microscope and strikes the sample at the focal point of the objective lens. The light reflected or emitted by the sample surface passes through the objective lens and is then collected by a tube lens. In this way, the laser beam converges at a second focal point, which is optically conjugate to the first. A pinhole in this confocal plane guarantees that only light originating in the focal plane is imaged on the detector. Light from regions above or below this plane is completely blocked out, enhancing contrast and importing lateral and axial resolution.

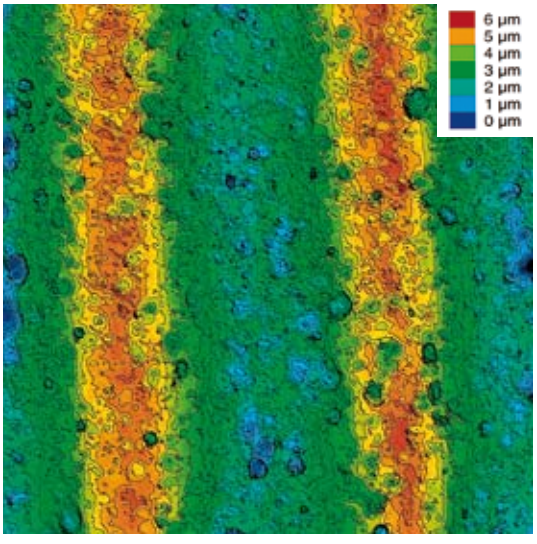
Section – Image stack – Topography

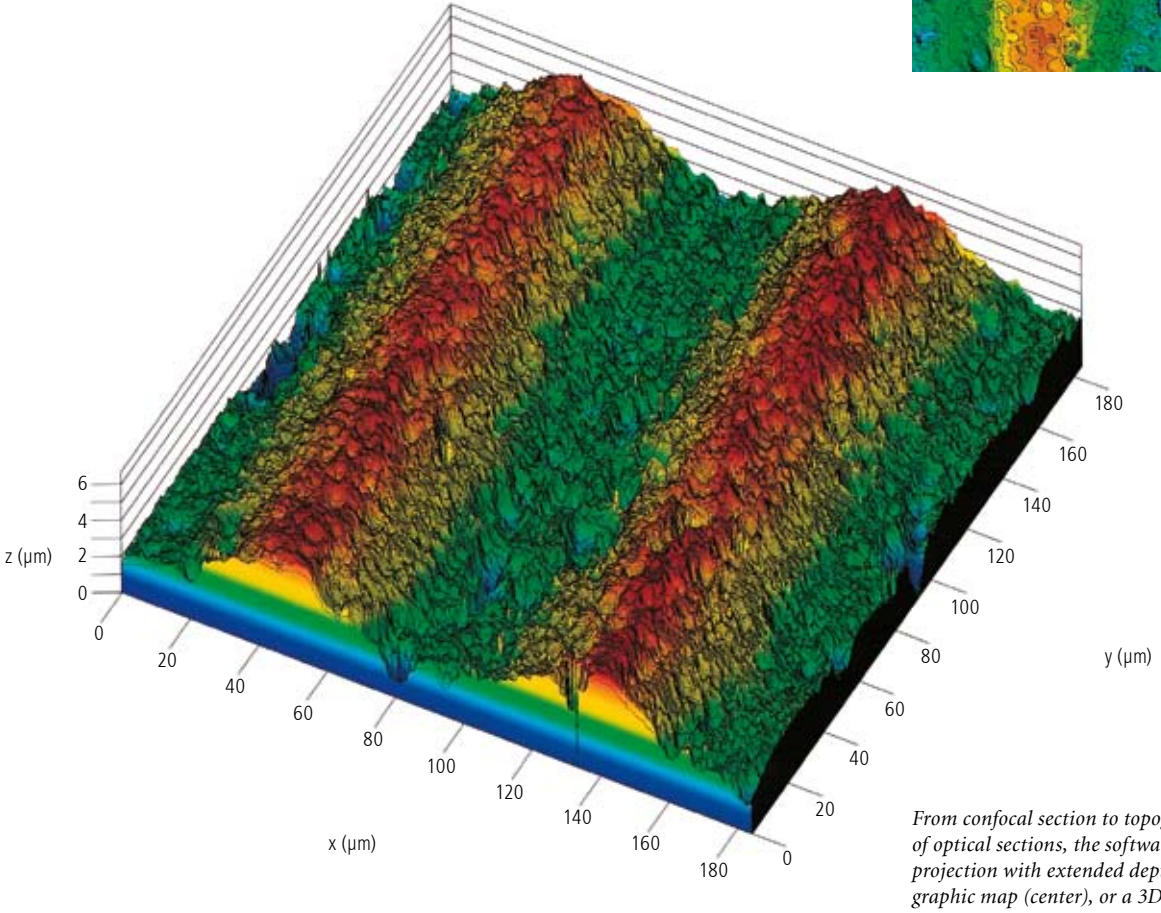
The laser beam is deflected in the X and Y directions across the sample – point by point, line by line. The change in the X and Y coordinates generates an optical section of the sample. If the object position is changed perpendicularly to the optical axis, a second optical section of the sample is produced. Successive variation of the Z position results in a three-dimensional image stack. This contains the digitized brightness levels for each individual point defined by the laser focus coordinates X_i Y_j Z_k. This data record is used by the software to compute intensity projections with extended depth of field, intensity or height profiles, topographic maps or 3D surface topographies of our sample with outstanding speed and simplicity.



Beam path in the LSM 700 confocal Laser Scanning Microscope







From confocal section to topography: From a succession of optical sections, the software computes an intensity projection with extended depth of field (top), a 2D topographic map (center), or a 3D surface topography (bottom) Sample: Textured ceramic surface

Resolution and Lateral Scanning Range

Localization the Precise, Efficient Way

Image of entire object – Re-enlargement of section – High resolution result.
With the LSM 700, you immediately see what you want to see.

Rapid orientation

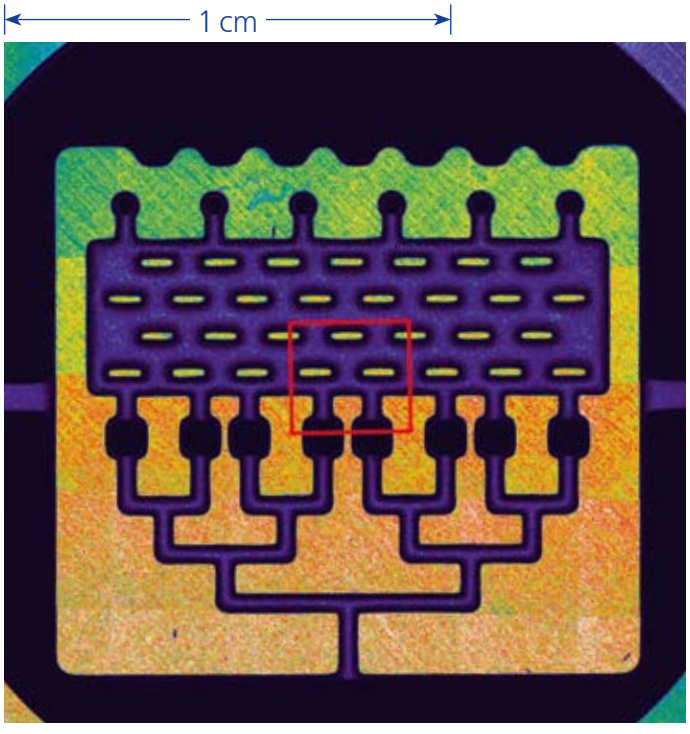
To obtain a fast overview of the specimen, you can use the LSM 700's Tile Scan mode to initially capture a mosaic of images (confocal or non-confocal) with a motorized XY scanning stage. With the aid of these overview images which are often macroscopic in size, you can rapidly identify areas of interest in the sample.

Efficient navigation

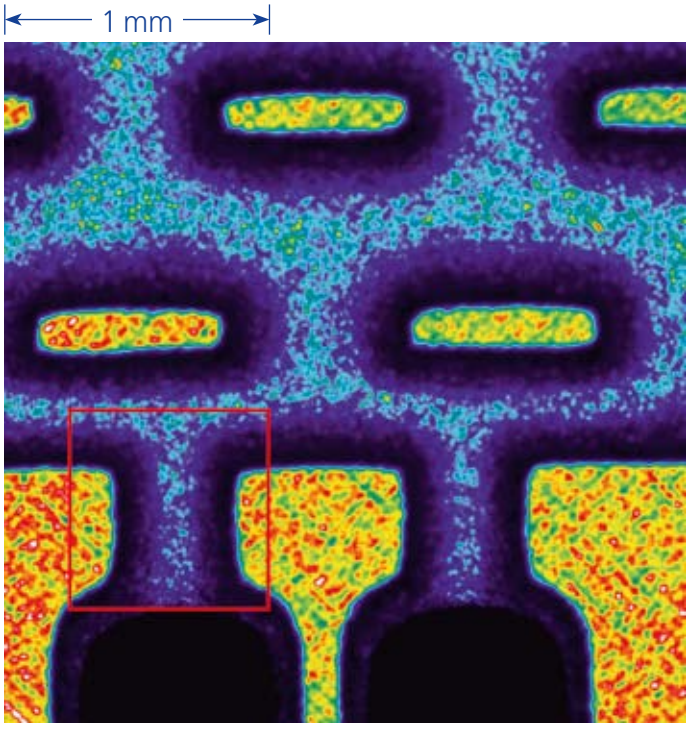
In a second stage you can make any number of re-enlargements by means of software-driven objective change, mouse-controlled navigation, and the Scan Zoom and Scan Rotation functions. The scanning field continuously adapts to any detail size – from millimeters to a few micrometers. Effortless re-localization of sample details is therefore possible at any time.

Micro fluid channels

Non-confocal overview
Tile Scan comprising 6 x 6 individual images,
EC Epiplan-Neofluar 5x/0.13,
14288.7 µm x 14288.7 µm, 3072 x 3072 pixels



Non-confocal section enlargement
Individual photo with slightly rotated scanning field
(compare red square in left photo), EC Epiplan-Neofluar 5x/0.13,
2381.1 µm x 2381.1 µm, 2048 x 2048 pixels

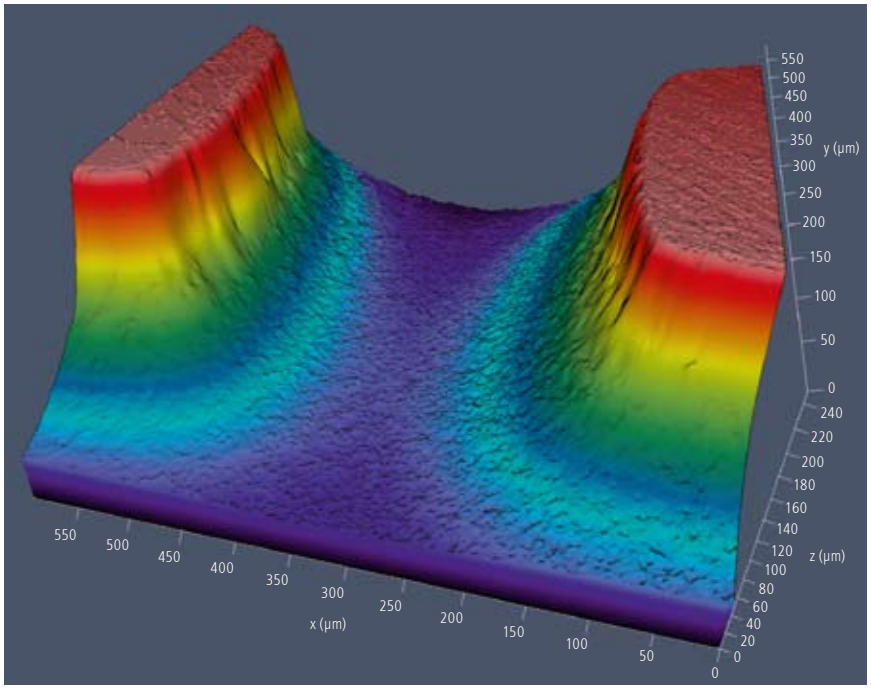


Highly resolved detailed structures

The actual measuring procedure for the non-contact 3D analysis of the surface details now begins. Due to the use of laser light in the violet spectral range in combination with high-aperture precision optics and sensitive detectors, ultra-fine lateral details down to approx. 120 nm (line-space pattern) are optically resolved. This way, the LSM 700 precisely determines and locates minute surface defects extending over a few tens of nanometers.

Reliable evaluation

Measurement results are analyzed using the LSM 700 ZEN software. The topography module offers numerous possibilities, e.g. for roughness and waviness analysis as well as three-dimensional views and distance and angle measurement. Also fluorescence micrographs can be three-dimensionally displayed with different volume and surface rendering modes using the Image VisArt plus module.



3D surface topography
Section re-enlargement with rotated scanning field, EC Epiplan-Neofluar 20x/0.5, original stack:
595.0 µm x 595.0 µm x 253.6 µm,
512 x 512 pixels x 254 sections

Resolution and Axial Scanning Range

Flexible and Optimized Separation

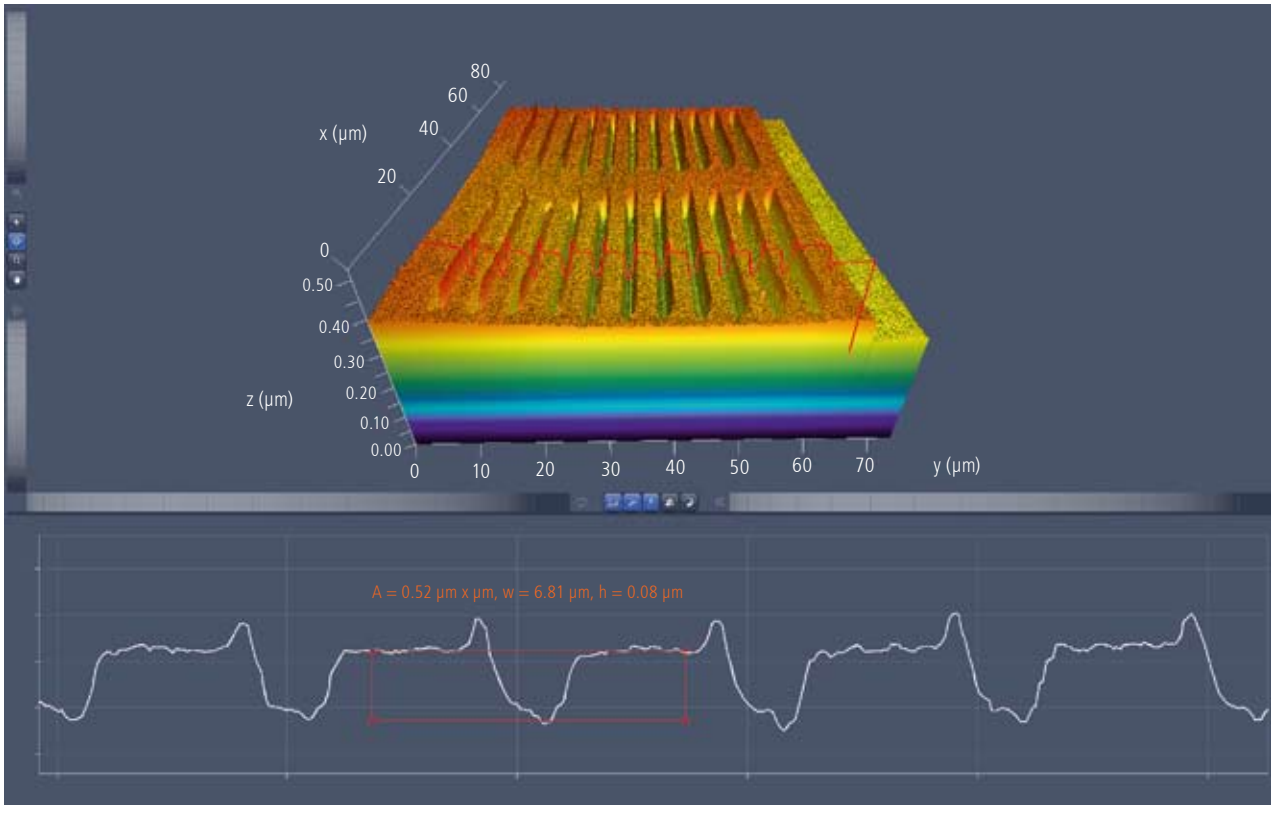
Whether it is used to measure tiny height differences or examine highly textured surfaces, the LSM 700 masters it all – thanks to the enormous flexibility of optical sectioning.

Layer thickness measurement on the nanometer scale

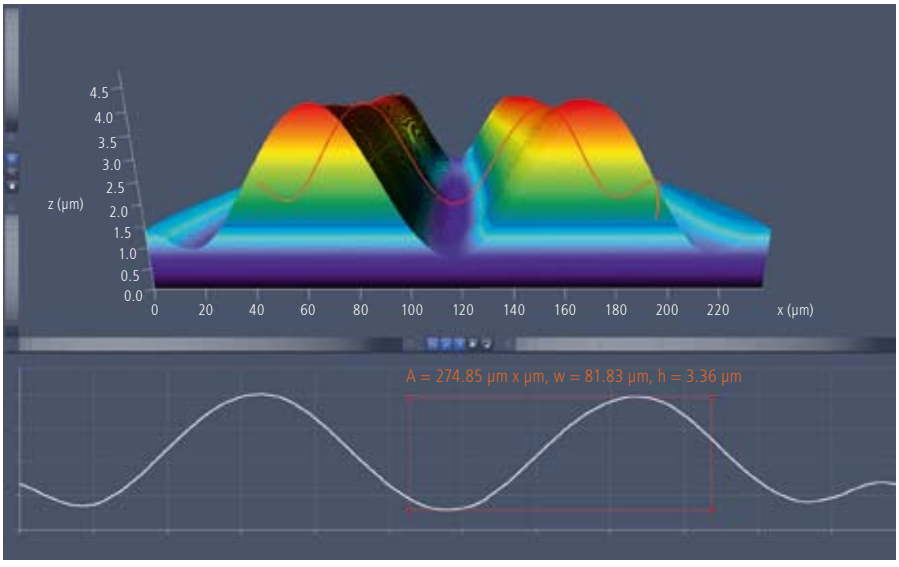
The LSM 700 offers special benefits for the detection and quantification of height differences: it enables reliable determination of height information from the nanometer to the millimeter range. This is permitted by the extremely small 10 nm increments of the focus drives in the Axio Imager.Z1m and Axio Observer.Z1m stands.

Height differences in the millimeter range

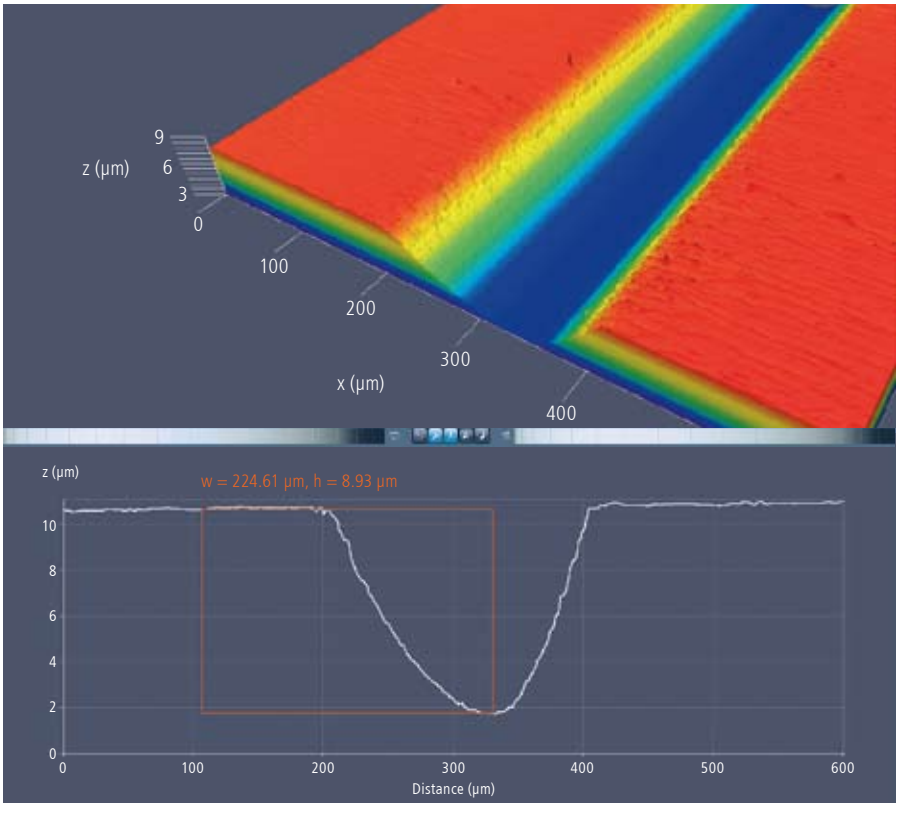
The LSM 700 performs just as reliably when it comes to analyzing highly textured surfaces with heights into the range of millimeters. With a wide range of reflected-light objective lenses and the variable, motorized pinhole, the system offers all the flexibility needed to adapt the thickness of the optical sections to the existing range of structure heights.



Etched height structure, nominal height 85 nm (Material: chromium). 3D surface topography with section of measured profile, EC Epiplan-Apochromat 50x/0.95, original stack: 85 µm x 74 µm x 1.3 µm, 1168 x 1017 pixels x 53 sections



Roughness standard, groove depth 3.34 µm 3D surface topography with section of measured profile, EC Epiplan-Apochromat 50x/0.95, original stack: 236.9 µm x 236.9 µm x 4.9 µm, 2048 x 2048 pixels x 50 sections



Depth measurement standard, groove depth 8.90 µm 3D surface topography, EC Epiplan-Neofluar 20x/0.5, original stack: 601.9 µm x 600.6 µm x 13.6 µm, 473 x 472 pixels x 45 sections

Depth measurement standard, groove depth 8.90 µm (Material: steel) Confocal XZ measurement profile, EC Epiplan-Neofluar 20x/0.5, 601.9 µm x 13.6 µm, 473 pixels x 45 sections

Measuring in Reflected Light

The All-Around Tool for Materials Samples

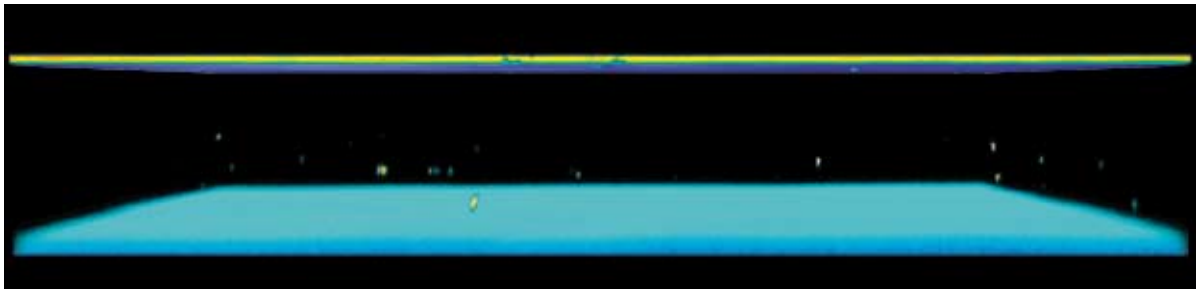
For materials displaying low or high reflectivity, for rough or smooth materials, whether on or under the surface, whether semitransparent or opaque: you will always receive meaningful results in the reflection mode of the LSM 700.

Sub-surface interfaces and details

The LSM 700 can generate information about sub-surface structures in multilayer systems and semi-transparent materials. Inhomogenities, cavities, inclusions and interfaces can all be analyzed. If the refractive index of the medium is known, layer thickness and optical path lengths can be measured.

High-contrast images with extended depth of field

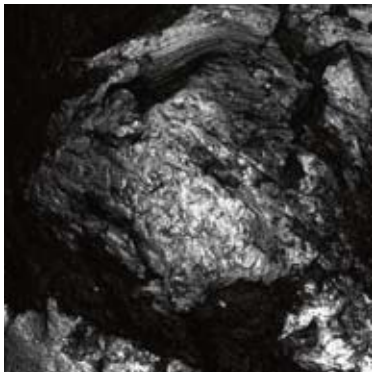
The LSM 700 offers the flexibility you need to adapt to various materials used in your applications. The LSM 700's combination of precise laser control and highly flexible signal detection sets new standards. Your material surface is optimally imaged so that high-resolution, high-contrast photos combine into one image with outstanding depth of field.



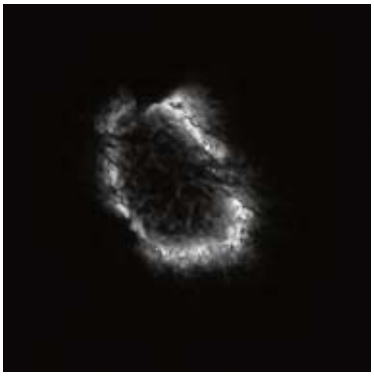
Polymer film on polymer substrate, 3D projection in the Mixed Rendering mode, X-Z section, EC Epiplan-Apochromat 50x/0.95, original stack: 119.6 µm x 119.6 µm x 50.2 µm, 512 x 512 pixels x 105 sections

Steel screw broken by torsion, EC Epiplan-Apochromat 50x/0.95, original stack: 237 µm x 237 µm x 153 µm, 512 x 512 pixels x 384 sections

Intensity projection with extended depth of field



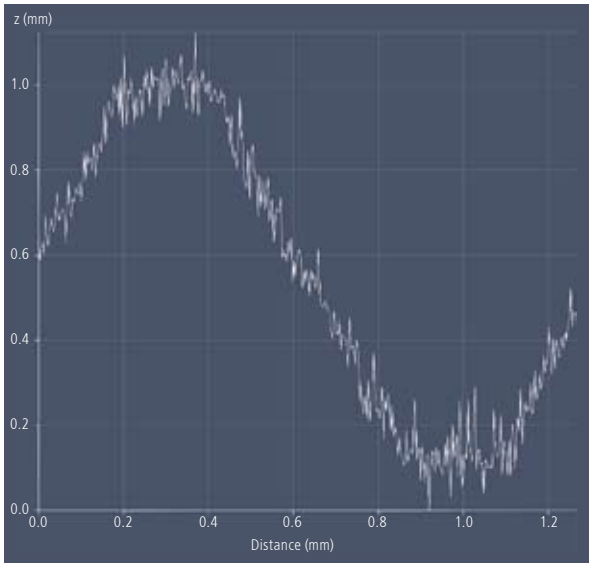
Non-confocal single section with pinhole diameter of 460 µm



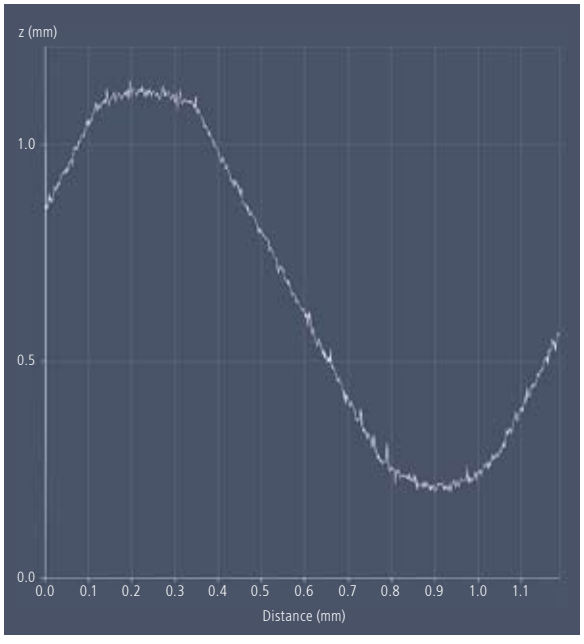
Confocal single section with pinhole diameter of 12 µm

Topography of Textured Surfaces

The 3D structure of microstructured material surfaces is computed on the basis of stacks of reflected-light images. Metal surfaces with high specular reflectivity can be reconstructed with the same reliability as objects of low reflectivity. You can analyze scattering ceramic surfaces with the same certainty as nearly-transparent polymer structures. It is with diffusely reflecting materials in particular that the LSM 700 really outperforms other optical techniques: it reliably detects edge slopes much steeper than half the objective's aperture angle.



EC Epiplan-Neofluar 5x/0.13,
1242.6 µm x 1166.2 µm, 512 pixels x 160 sections



EC Plan-Neofluar 10x/0.3,
1188.8 µm x 1224.0 µm, 512 pixels x 613 sections

Drill bit, titanium on steel

With higher numerical aperatures,
higher quality steep profiles can be acquired
Confocal XZ measurement profiles.
All profiles shown are raw data.

Fluorescence Measurements

Glowing with New Colors

Examining material defects and properties in different ways: In the fluorescence mode the LSM 700 generates complementary information on the properties and structure of your materials. This provides new insights and simultaneously increases the reliability of your analysis.

Complex materials analysis

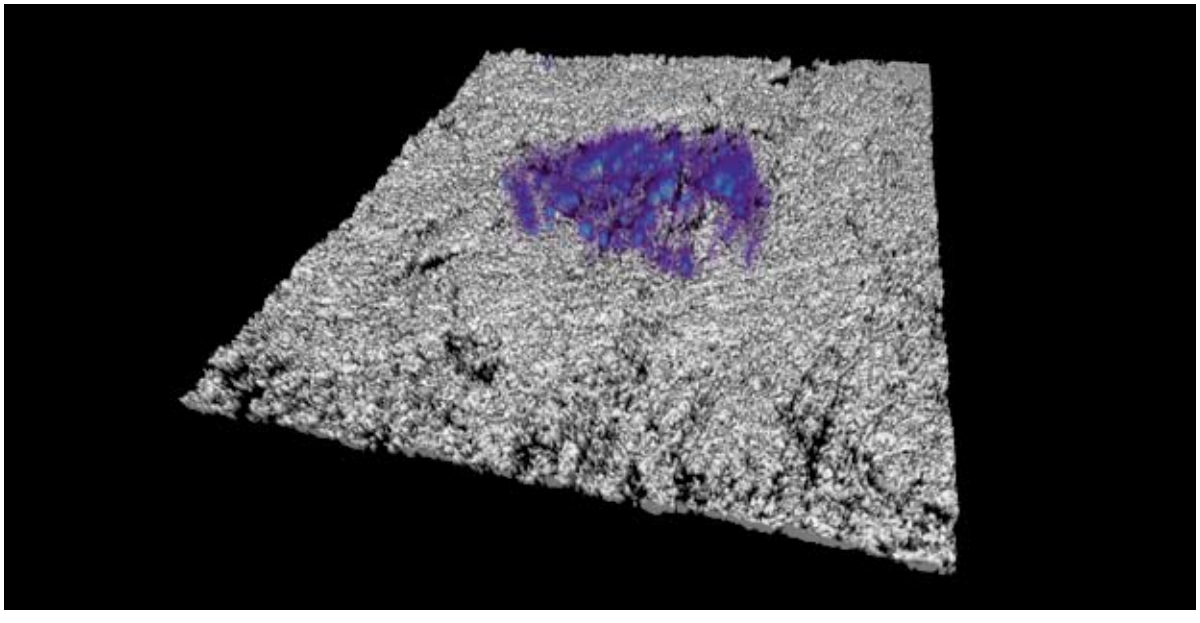
Does a material change when subjected to mechanical stress? Are structural defects present? Are the constituents of material mixtures distributed homogenously, or are there phase separations? These are questions which may arise during the examination of polymer and fiber materials – questions to which the LSM 700 can give a precise answer in fluorescence mode. In a semi-transparent matrix autofluorescent inclusions, phases and particle accumulations can be identified and quantified at a depth of up to a few hundred micrometers.

Any slope angle

The use of fluorescent dyes is also very useful for the visualization and subsequent examination of tear structures or holes. Here, unlike in reflection contrast, any slope angle up to 90 degrees can be recorded and displayed.

Multiple fluorescence in bio-materials

Bio-materials are becoming more and more important in basic research and industrial applications. Examples include development of neuro and protein chips at the interface of information and biotechnologies of bioactive materials in medical and dental technology. Particularly for research into cell aggregates and tissues in combination with inorganic, high-performance materials, multifluorescence with the LSM 700 provides fascinating insight that could only be obtained with great difficulty, or not at all, with other microscopy techniques.



Fluorescent flake in paper, reflection/fluorescence excitation at 555 nm 3D projection in mixed rendering mode, EC Epiplan-Neofluar 20x/0.5, original stack: 595.6 µm x 595.6 µm x 73.6 µm, 1024 x 1024 pixels x 30 sections

Functional Surfaces

Profilometry the Reliable, Intelligent Way

For the characterization of material surfaces, the LSM 700 offers the complete functionality of a non-contact optical 3D profilometer.

Reliable assessment of surface quality

The LSM 700 is absolutely ideal for the quality inspection of technical surfaces, e.g. in the tribological analysis of high performance ceramics in the automotive industry or in the precision machining of metal surfaces in the machine and tool-making industry.

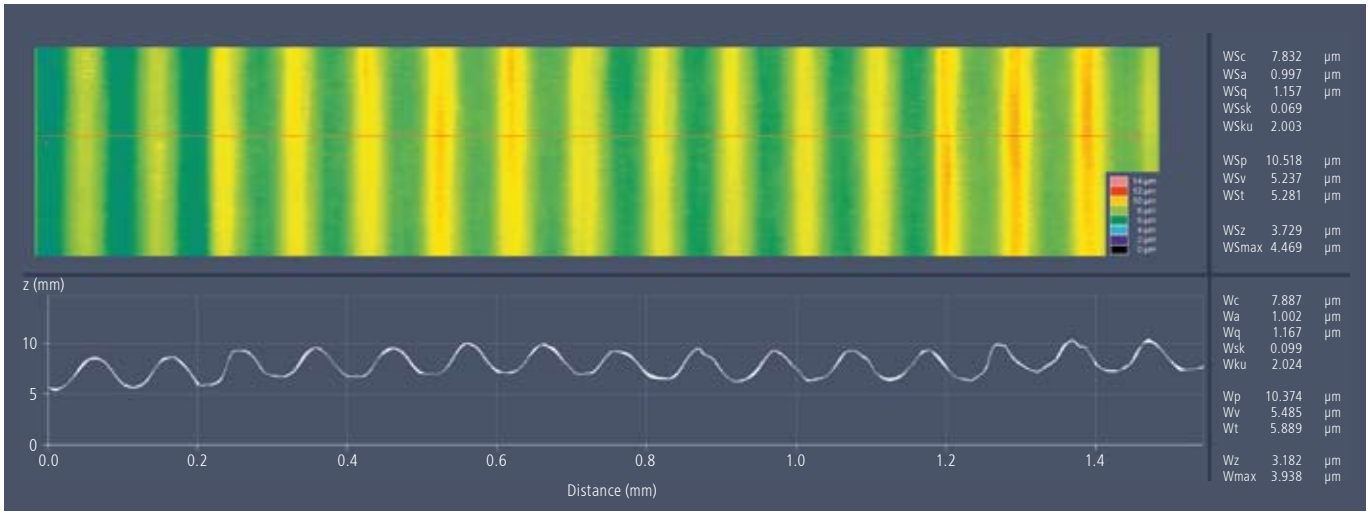
Excellent profilometry – with the LSM 700, you can reliably produce 2D height profiles. With the aid of the high-resolution microscope image, you decide online where and how you wish to capture your height profile – along a free-hand or straight line in order to block out damaged, non-representative areas on the sample, or for precise contour tracing. For a meaningful roughness or waviness analysis of your sample, more than 31,000 profile values are available in less than five minutes.

Imitating nature the clever way

Surfaces displaying a self-cleaning mechanism or reduced air resistance on the basis of microstructured materials are just one example of how nature can be copied in technology. For innovative techniques in material machining and patterning, the LSM 700 offers unique flexibility in the selection of 3D imaging formats. The X, Y and Z extensions of the confocal image stack can be easily adapted to the sample's dimensions after micropatterning.

Informative 3D visualization techniques of the LSM 700's ZEN software allow rapid qualitative assessment of friction and wear tests on innovative surfaces. Numerous geometric measuring functions and functional parameters such as bearing ratio, area and volume properties ensure detailed characterization of the surface structure.

Roughness standard, steel, with Ra = 1.009 µm to be compared with Wa-value of LSM measurement. 3D surface topography with section of the measured profile and roughness results, EC Epiplan-Neofluar 20x/0.5, original stack: 1580.2 µm x 292.3 µm x 15.0 µm, 2688 x 498 pixels x 26 sections



Microsystems Technology

Optimal, Targeted Miniaturization

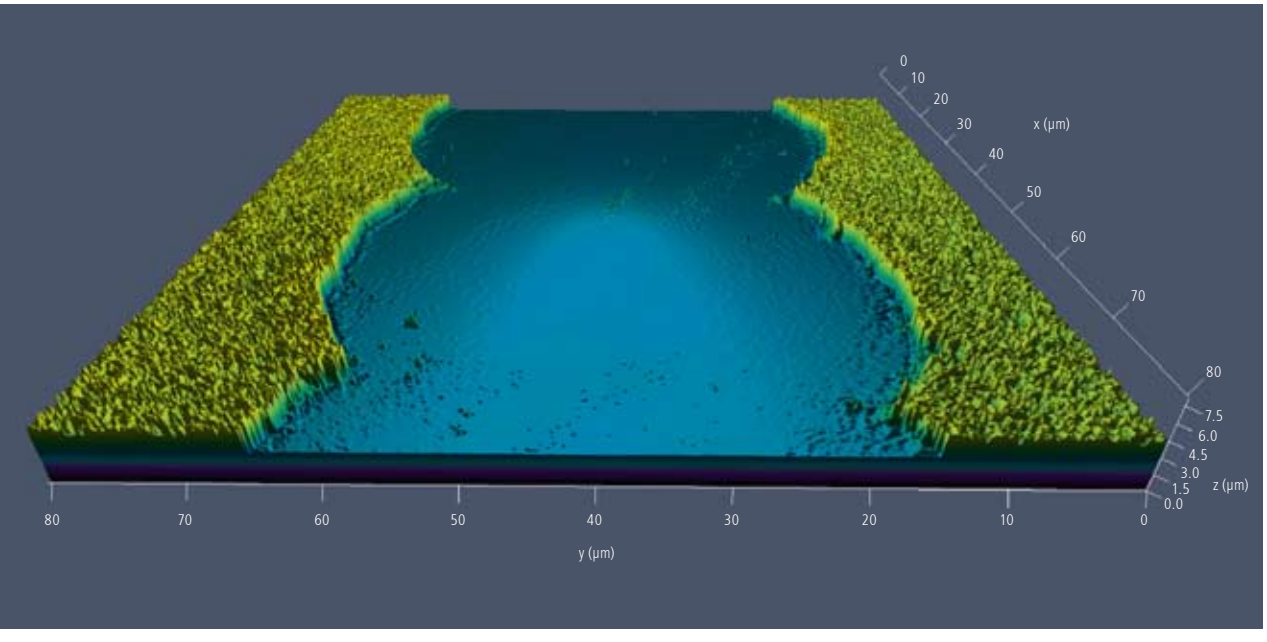
The LSM 700 guarantees reliable control of the structural accuracies of microsystem components and hence reproducible etching and molding processes.

Visualization of high aspect ratios without artifacts

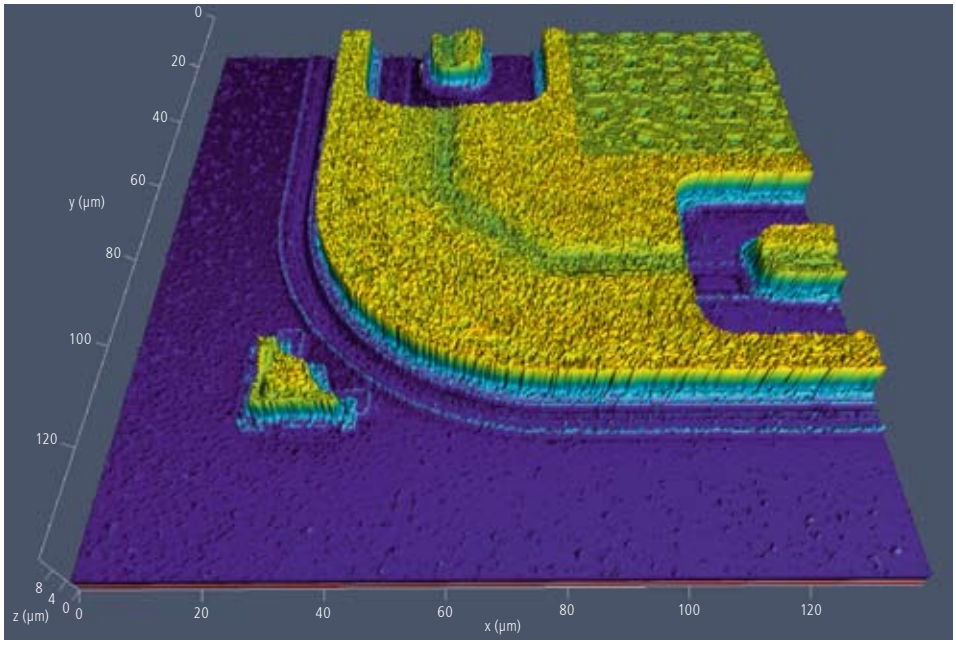
In assembly and bonding technology, as well as in micromechanics, structure heights of well over 100 µm are often generated. High aspect ratios and slope angles of nearly 90 degrees (e.g. in UV patterning or X-ray depth lithography) pose a challenge to any topographic analysis method, whether optical or contact. Due to its unparalleled flexibility, the LSM 700 can be used not only to image without artifacts but also to quantify scattering or autofluorescent polymer lacquer structures. In the fluorescence mode the LSM 700 accurately detects vertical edges, reliably identifies undercuts in semitransparent layers and dependably evaluates edge steepness.

Precise examination of thin films

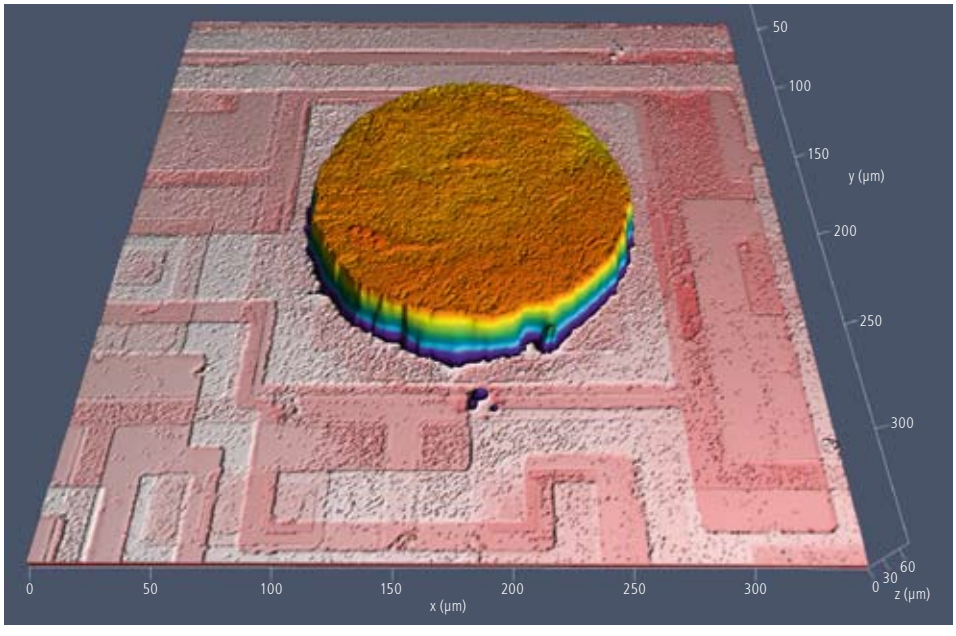
Coatings with a thickness of between 50 nm and 5 µm, such as those generated for semiconductor circuits and thin-film sensors are steadily gaining importance in microsystems technology. The diversity of materials and substrates requires a high degree of flexibility in surface and micropattern analysis. With the LSM 700, you can capture surface contours and profiles of micropatterned components and quantify film thickness, profile depths and pattern widths using a fast, non-contact technique. You can do this directly, non-destructively and effectively – without the additional coating of non-conducting materials and without time-consuming vacuum work.



Solar cell with laser scribe, 3D surface topography, EC Epiplan-Apochromat 50x/0.95, original stack: 80.1 µm x 80.1 µm x 8.2 µm, 512 µm x 12 pixels x 55 sections



Semiconductor wafer, measurement of film thickness and homogeneity, 3D surface topography, EC Epiplan-Apochromat 50x/0.95, original stack: 138.2 µm x 138.2 µm x 11.7 µm, 512 x 512 pixels x 88 sections



Solder pad on semiconductor wafer, measurement of height, width and roughness, 3D surface topography, EC Epiplan-Apochromat 20x/0.6, original stack: 345.5 µm x 345.5 µm x 76.8 µm, 512 x 512 pixels x 107 sections

Polymer Materials

Detailed, Comprehensive Characterization

The LSM 700 also proves its excellence in the plastics industry and in polymer research. It is ideally suited for the surface analysis of soft and light plastics and the defect analysis of new materials with increasingly complex chemical compositions and microstructures.

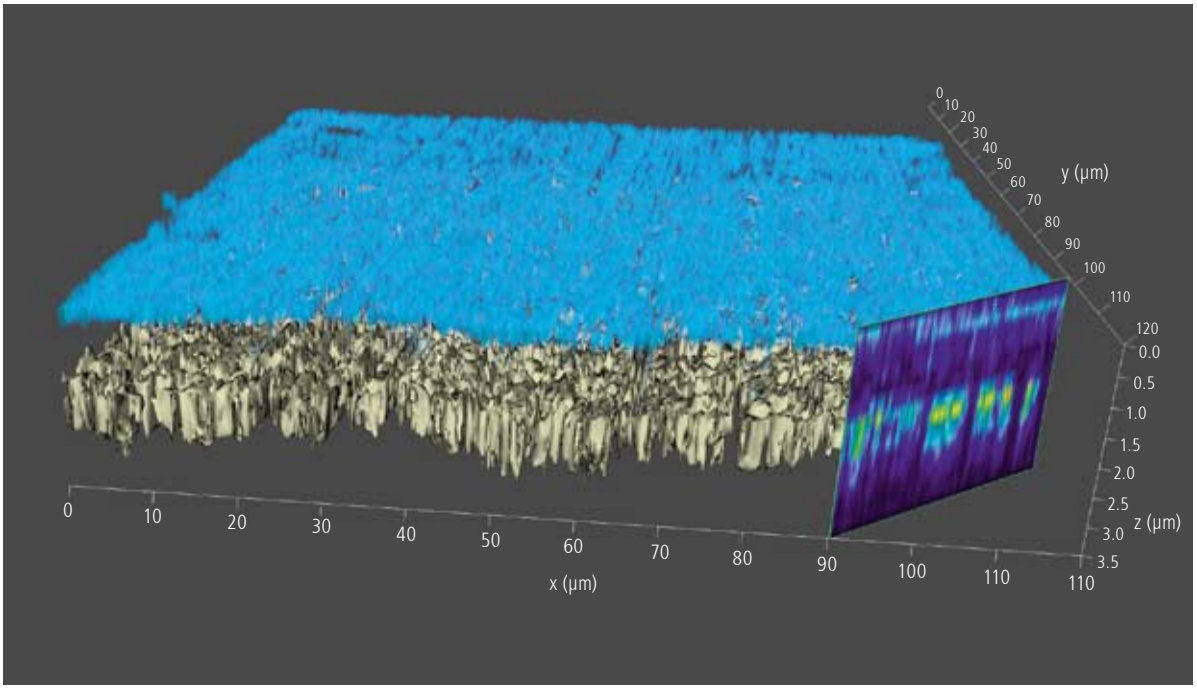
Multifunctional materials

Polymers are being used more and more in different areas of construction materials, e.g. for lightweight designs and medical applications. The advantages of low density and comparatively high toughness are further increased in the field of composite materials, where polymer matrices and high-strength fibers are used. This allows considerable weight savings in the automobile and aerospace industries.

Multimode analysis of blended and composite materials

Use the reflection mode of the LSM 700 to determine the porosity of foamed materials or the roughness parameters of soft plastic films. With the aid of fluorescence, you can observe mixing and demixing processes in polymeric blends in 4D time-lapse series. Use volume rendering or transparent projection in the fluorescence mode to visualize the spatial distribution of pigments or fillers. Or employ polarization to optically evaluate stress states and stress propagation at fiber-matrix interfaces in tensile stress tests.

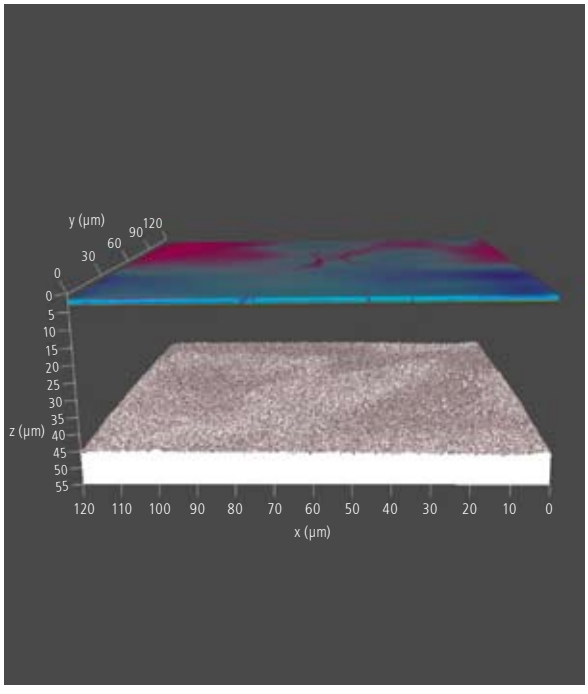
Finish on aluminum, 3D projection in mixed rendering mode, EC Epiplan-Apochromat 50x/0.95, original stack: 119.6 µm x 119.6 µm x 3.4 µm, 512 x 512 pixels x 68 sections



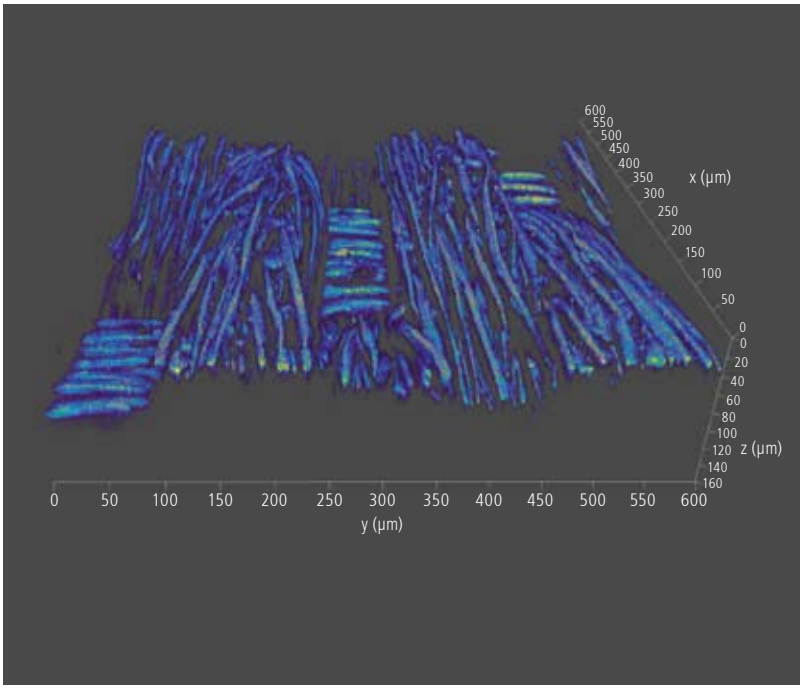
Identify defects under the surface

The LSM 700 permits the perfect analysis of transparent matrix materials. Inhomgeneities and defects deep below the surface, e.g. cavities, pores and inclusions, are elegantly and reliably detected with the system's auto-Z correction facility. Use the StitchArt plus option to also capture reflected-light images of the surface condition, distribution and orientation of microfibers in fabrics and fleeces – images that combine a large-area overview with high resolution.

Polymer film on polymer substrate, 3D projection in mixed rendering mode, EC Epiplan-Apochromat 50x/0.95, original stack: 119.6 µm x 119.6 µm x 50.2 µm, 512 x 512 pixels x 105 sections



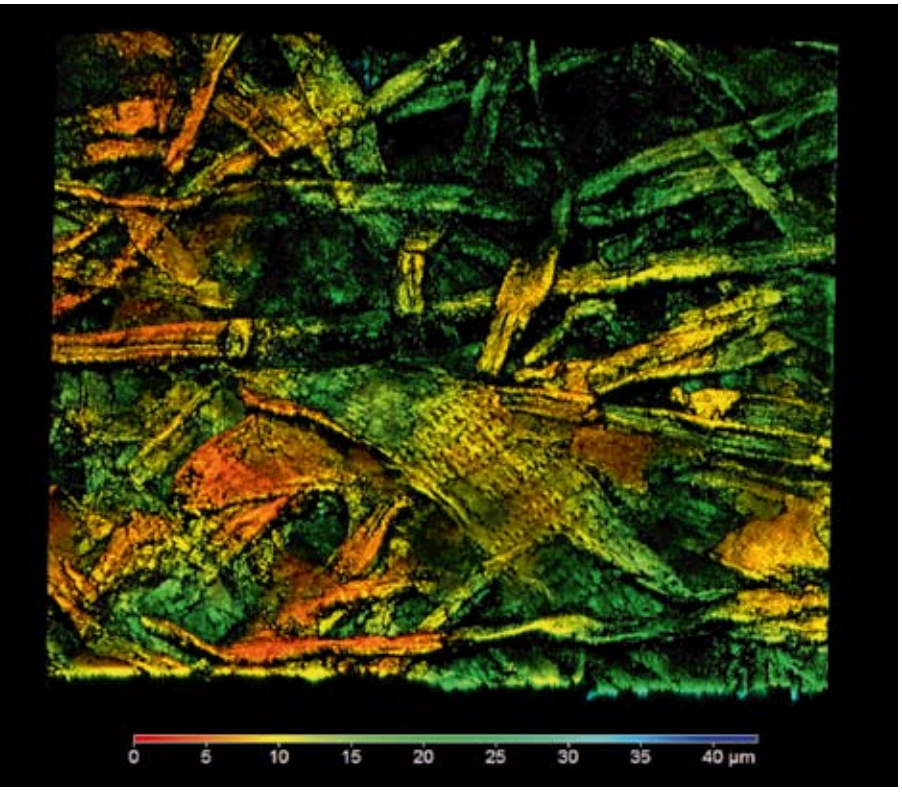
Mousepad, 3D transparency projection, EC Epiplan-Neofluar 20x/0.5, original stack: 595 µm x 595 µm x 159 µm, 512 x 512 pixels x 160 sections



Multiplicity of Innovative Materials

Efficient, Reliable Examinations

The LSM 700 is the optimal solution for a large number of problems in quality assurance, materials testing, and research. Your application can also be optimized by the many LSM 700 configurations – on the basis of either turnkey or customized solutions.



Paper fibers (notebook paper), 3D transparency projection with height coding, EC Epiplan-Apochromat 20x/0.6, original stack: 449.6 µm x 449.6 µm x 43.0 µm, 1024 x 1024 pixels x 90 sections

From crystalline to amorphous

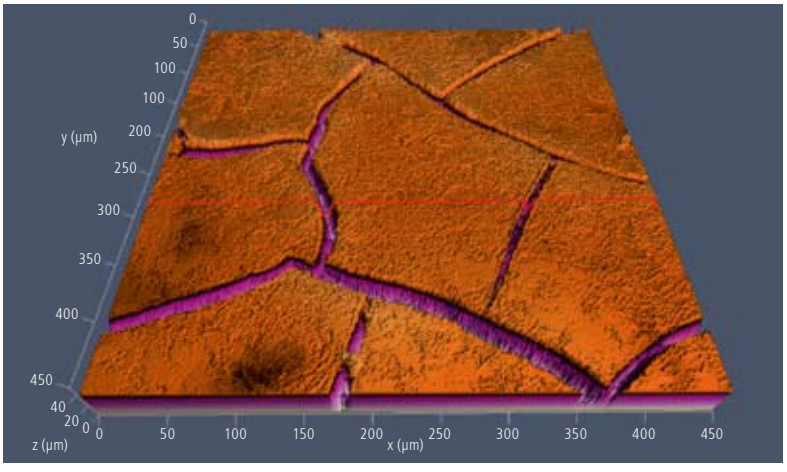
Innovative crystalline materials are giving rise to new branches of industry. Ceramic materials serve as the basis for innovative substrates and molded parts in such fields as medicine, the electronic industry, or even in the household. Glass is also constantly opening up new application fields, e.g. microfluid channels, safety glass, or modern display panels. Use the LSM 700 to check properties like thermal resistance, wear, frictional properties, or biocompatibility.

From liquid to solid

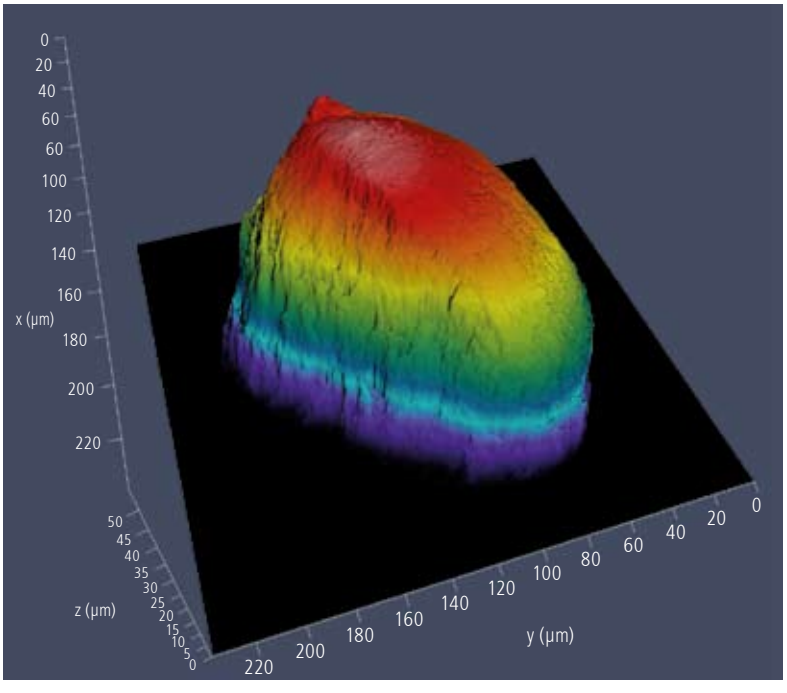
The microscopic analysis of solutions, gels, colloids, emulsions and dispersions plays a decisive role in the basic research into and in the production of everyday necessities such as shampoos, creams, paints, lubricants, or fuels. Whether for 3D or 4D analysis, the Multi Time-lapse series option of the LSM 700 helps you optimize the properties of complex liquids and their time response.

From biological to culinary

In the automotive industry the use of natural fibers like sisal, flax, jute yarn, cotton and hemp is becoming an integral component of many products, especially in the interior of the vehicle. The packaging and paper industry is also enjoying a new dawn of environmentally-sound alternatives, thanks to the use of renewable raw materials. The LSM 700 additionally renders excellent services in porosity testing on pasta or confections and in the quality inspection of powdered milk. The combination of reflection and fluorescence contrast is often instrumental to the successful examination of natural raw materials and products.



Ink on glossy paper, showing cracks formed during drying process, 3D surface topography, EC Epiplan-Apochromat 50x/0.95, original stack: 179.7 µm x 179.7 µm x 35.8 µm, 512 x 512 pixels x 185 sections



Bristle of toothbrush, 3D surface topography, EC Epiplan-Apochromat 50x/0.95, original stack: 236.6 µm x 236.6 µm x 55.8 µm, 512 x 512 pixels x 267 sections

Hardware Components

The Perfect Team

For the optimum configuration of your LSM 700, Carl Zeiss offers a large number of high-quality, perfectly-matched components. The combination of confocal with traditional light microscopy contrasting techniques provides the user with unprecedented flexibility and reliability.

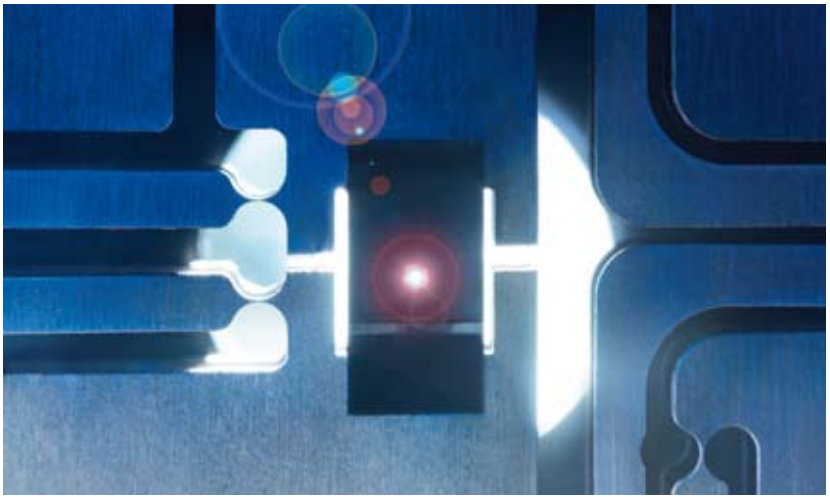
Optimized working platforms

Depending on the application, upright or inverted research microscopes of the Axio Imager and Axio Observer lines are available. All can be equipped with a wide variety of contrasting techniques such as brightfield, darkfield, DIC, C-DIC, polarization and fluorescence. Many solutions and imaging modes will lead more quickly, easily, and reliably to your goal than one. And the objects you are examining will appear in a totally new light, ensuring maximum flexibility and certainty when assessing your sample.

Objective lenses –
our unique expertise at your fingertips

Providing maximum image information is a standard that Carl Zeiss also applies to the objective lenses used in confocal microscopy in particular. The new EC Epiplan-Apochromat objective lenses, which feature an extra-high numerical aperture, resolve even the finest structures in the submicrometer range and can reliably detect tiny defects and impurities in the sample.

In combination with the materials configuration of the LSM 700, which contains a violet laser diode ($\lambda = 405$ nm) suitable for measurements in the reflectance and fluorescence modes, current resolution limits in the visible spectral range are considerably surpassed. More than 40 reflected-light objective lenses with magnifications from 1.25x to 100x leave practically nothing to be desired.



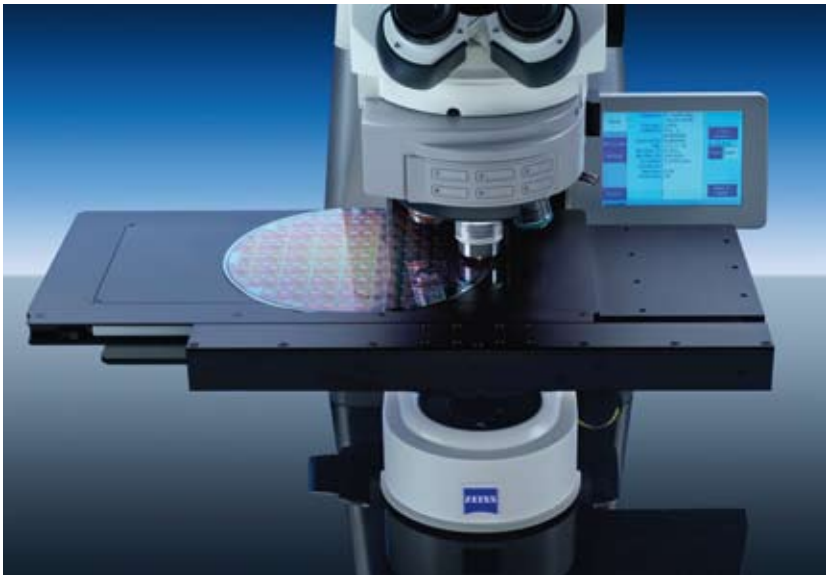
The new variable-diameter pinhole diaphragm enables confocal sections with the highest precision.

Enjoy all the possibilities of a flexible system

The scanning head of the LSM 700 contains the precise XY deflection system for the laser beam, the freely positionable, variable-diameter pinhole diaphragm and the high-sensitivity detectors. The linear scanner control, the symmetric design of the two scanning mirrors, the digital signal processor (DSP), sensitive point detectors and continuously variable laser attenuation enable new degrees of freedom in scanning probe technology regarding

- frame size (from 4 x 1 to 204800 x 204800 pixels)
- capture mode (freehand profile, topography, time-lapse series, Tile Scan, stack array),
- scanning field orientation (from 0 to 360°).

The newly-developed VSD (Variable Secondary Dichroic) beam splitter gives you the possibility of free control of the fluorescence emission. The detection windows can be optimally adapted to the dyes used and do not need to be adjusted to wavelength ranges defined by filters. Polarizing and emission filters – especially for one-channel systems – can be easily changed or retrofitted.



Motorized scanning stage on the microscope Axio Imager.Z1m

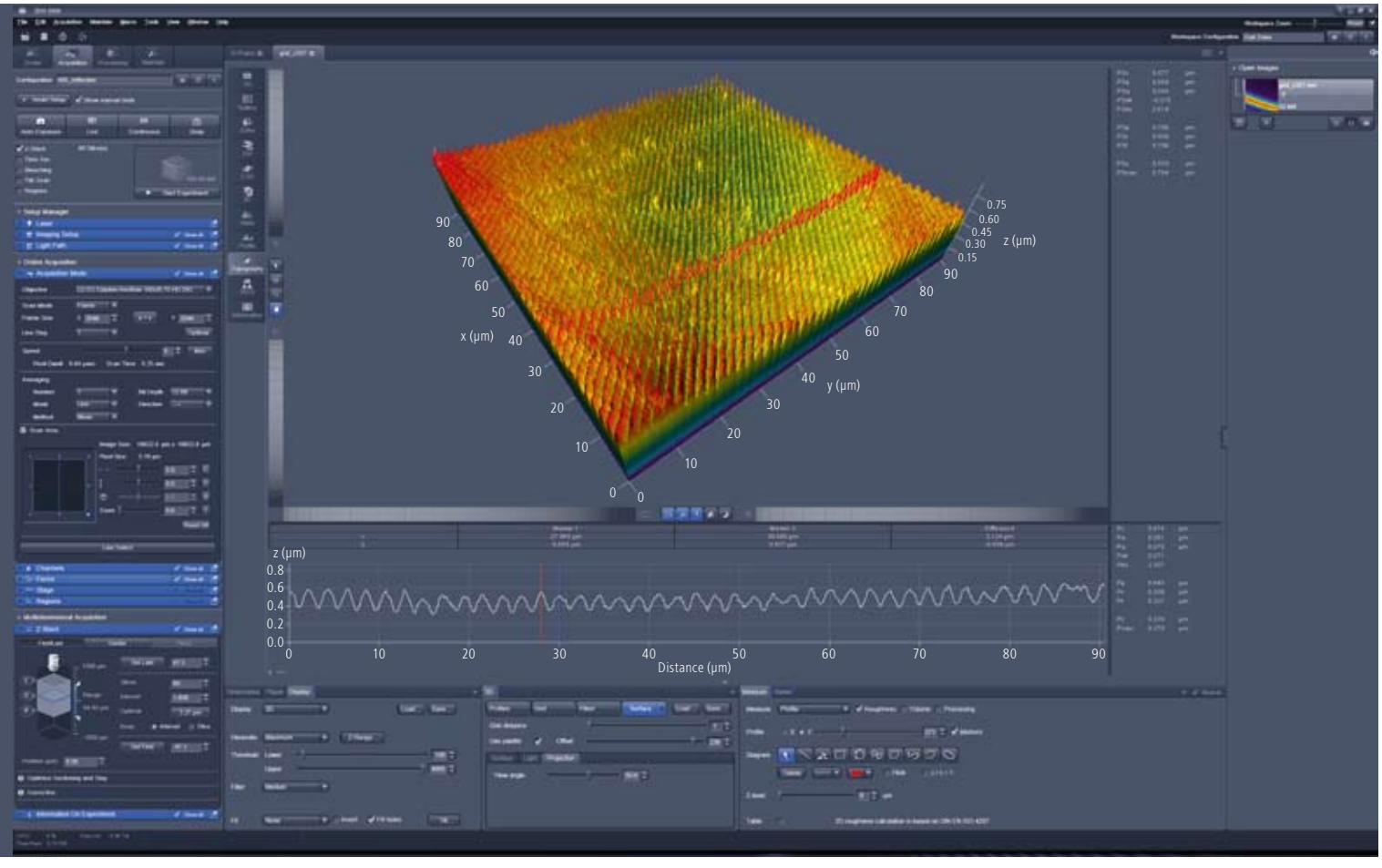
Highly precise stages

You may need long travel distances for your samples, minute height intervals, dependable vibration damping, or simply a complete, compact, ergonomic workstation. This is where the various stages and stage drives come in, matching the outstanding precision of the LSM 700's optics. Manual or motorized, active or passive vibration damping, harmonic drive, or piezo technology, we will configure a system that precisely meets your requirements.

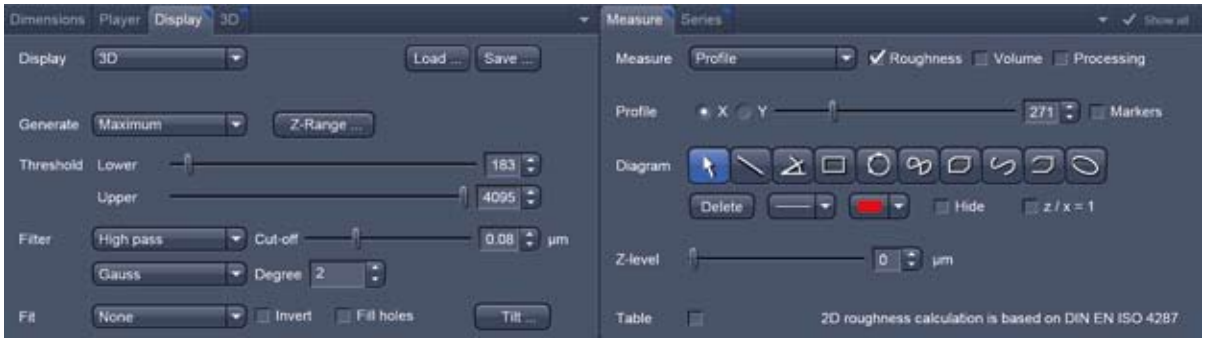
ZEN Software

Efficient Navigation from Carl Zeiss

One glance at the neat, clearly structured user interface of ZEN will convince you. The screen is organized into three areas, following the workflow typical of your experiments. With ZEN we have made it possible for the user to focus on the essentials. Discover a new era in Laser Scanning Microscopy.



Clear and easy to use: The software of the LSM 700. 3D topographical reconstruction of the surface topography of a semi-finished optical grating, shown together with the Acquisition tab (left), the dialog fields for changing the topography display and evaluation (below image and profile)



First-rate tools properly applied: Just a few clicks to get your desired view and values of the surface geometry, e.g. roughness analysis.

Easy navigation for more speed

Everything needed for microscope control and image capture is bundled in the Left Tool Area, located on the left of the screen. All buttons are arranged from top to bottom following the logic of the operations in which they are used. In the middle of the interface – the Central Screen Area – is the area for viewing and interacting with images. All functions for file management are found in the Right Tool Area.

Reproduce with a mouse click

With a click on the ReUse button,  you can reliably reproduce all image capture parameters already used, from the laser intensity and the beam path configuration to the frame size – everything is at your fingertips again for the next image capture.

Brightness levels transformed into surface data

The Topography software option precisely computes the topography of micropatterns and surfaces from the original data. Even with major reflectivity differences on the sample, time-optimized algorithms reliably reconstruct the surface just as reliably as defined positions of semi-transparent multilayer systems.

Convincing graphic display and presentation

You have a wide range of possibilities to visualize your surface section in exactly the way you want in print or on-screen. Use the free-of-charge Image Browser from Carl Zeiss to discuss and print your results immediately, from any number of computer workstations.

Topographic measurement and analysis

Analyze form errors, roughness, area and volume characteristics. Quantify your surfaces with a wide diversity of functional, geometric and statistical parameters.

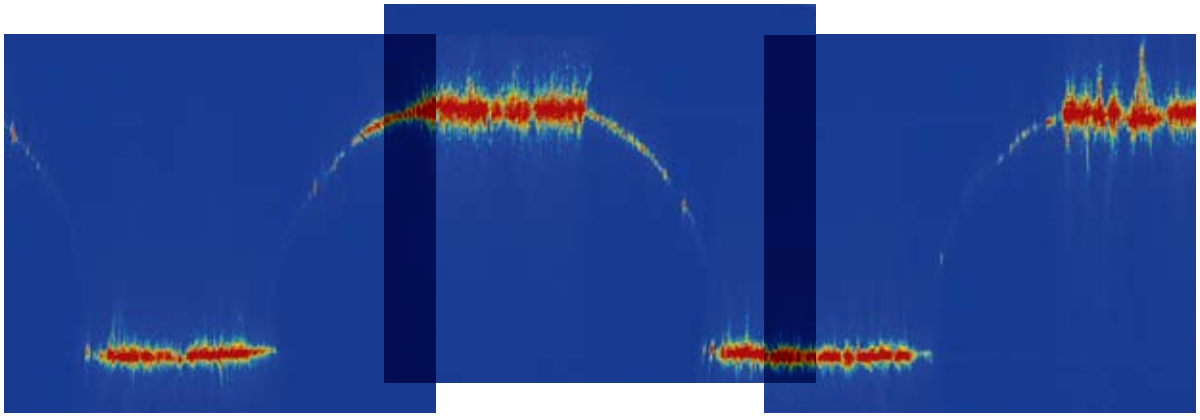
StitchArt plus

Redefining Image Field and Profile Length

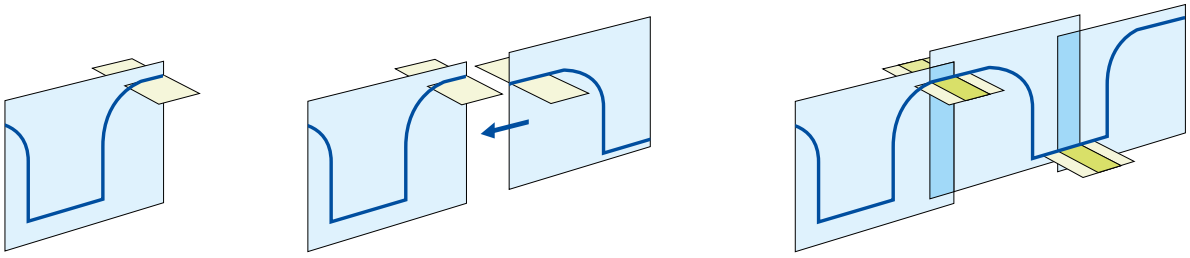
In conjunction with the StitchArt plus software option and a motorized XY scanning stage, the LSM 700 captures assembled image stack arrays and height profiles. This allows you to image and measure long distances and large areas of your samples.

Multiple Profile Scan

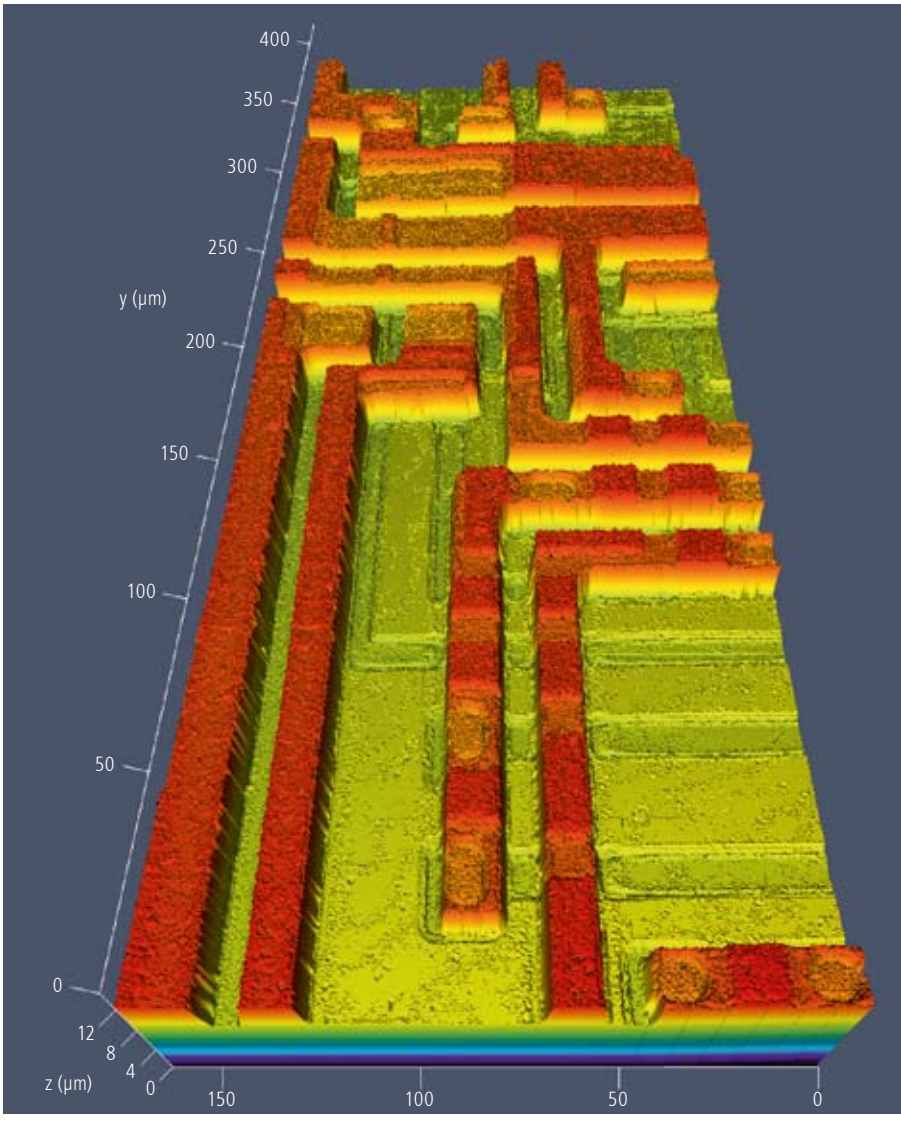
StitchArt plus allows you to measure, with the clearly superior Z-resolution of a 100x objective lens, profile lengths which you could previously only capture in their entirety using a 5x objective lens. To ensure that the XY resolution is not impaired, up to 31,600 data points can be captured with StitchArt plus. Increased axial resolution permits a greater number of optical sections: Depending on the application, up to 2000 sections of the sample can be generated.



Original data of a Multiple Profile Scan



Microelectronic device. Multiple Stack Scan composed of 3 x 8 single stacks, LD EC Epiplan-Neofluar 100x/0.75, 162.3 µm x 422.1 µm x 10.3µm, 1382 x 3558 pixels x 52 slices

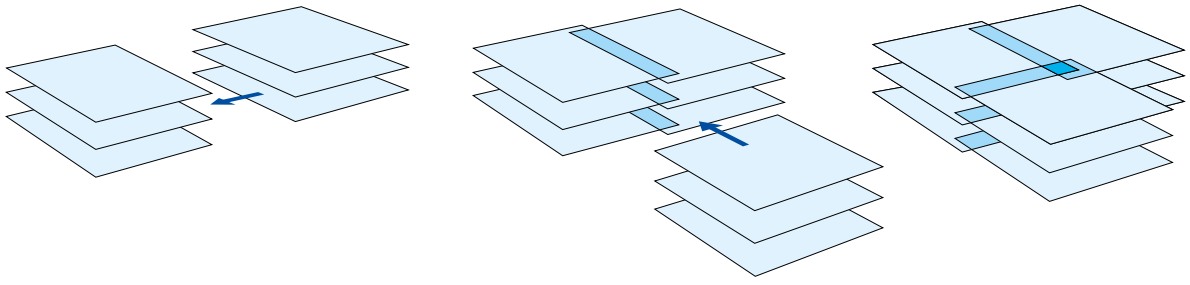


Multiple Stack Scan
Scanning field size: XXL.
Measurement accuracy: NANO.

The size and form of the image stack arrays are adapted to the contours of your samples, with an enlargement of the scanning field up to 830x. Variable scanning speeds, flexible Z increments and Z measuring ranges of up to 4 mm offer many different possibilities. This makes the LSM 700 a versatile optical 3D profilometer. Whether you need two or three dimensions, micro or macro images, the StitchArt plus option increases your options.

Roughness and waviness analysis conforming to standard

Roughness investigations with the LSM 700 can now be carried out with improved repeatability and comparability: With the 10x objective lens, measuring distances of over 20 mm can be measured, of more than 10 mm with the 20x objective and of more than 2 mm even with the 100x objective. The results obtained are comparable with those of contacting methods. In Fourier terms, the large microscopic measuring range allows the detection of very low spatial frequencies. The combination of the StitchArt plus and topography therefore enables the LSM 700 to perform optical waviness analysis.



Specifications LSM 700

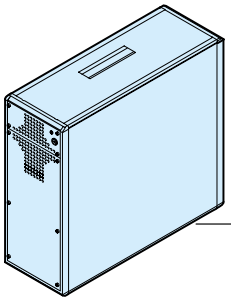
Microscopes	
Stands	Upright: Axio Imager.Z1m, M1m and Axio Scope mot for LSM Inverted: Axio Observer.Z1m SP (side port)
Z drive	Axio Imager: Step motor, smallest increment 10 or 25 nm Axio Observer: DC motor with opto-electronic coding, smallest increment 10 nm
XY stage (option)	Motorized XY scanning stage with Mark & Find (XYZ) and Tile Scan (Mosaic Scan) functions
Objectives	More than 40 reflected-light objectives: EC Epiplans, EC Epiplan-Neofluars, EC Epiplan-Neofluars, EC Epiplan-Apochromats, LD Epiplans, LD EC Epiplan-Neofluars
Accessories	High-resolution AxioCam microscope camera
Scanning module	
Scanner	Two independent galvanometric scanning mirrors with ultra-short line and frame flyback
Scanning resolution	4 x 1 to 2048 x 2048 pixels, continuously adjustable
Scanning speed	13 x 2 speed stages, Up to 5 frames/s with 512 x 512 pixels (max. 154 frames/s with 512 x 16 pixels)
Scanning zoom	0.5 x to 40 x, variable in increments of 0.1
Scanning rotation	Freely rotatable around 360°, variable in increments of 0.1°
Scanning field	Field diagonal of 18 mm (max.) in the intermediate image plane, homogeneous illumination of image field
Pinhole	Motorized master pinhole, diameter continuously adjustable
Detection	One or two confocal channels (reflection/fluorescence), one optional external transmitted-light channel with DIC capability, each with high-sensitivity PMT detector, spectral increment 1 nm
Data depth	Selectable between 8 bit, 12 bit or 16 bit
Laser inserts	
Laser inserts (VIS, V)	Pigtail-coupled solid-state laser with polarization-preserving single-mode fiber; up to 4 V/VIS laser directly connectable to the scanning module; laser lines 405 nm 5 mW or 445 nm 5 mW; 488 nm 10 mW; 555 nm 10 mW; 639 nm 5 mW (at fiber end) Fast (pixel-exact) customized and variable intensity adjustment of all laser lines (direct modulation) Automatic shutdown of laser when not in use
Electronics module	
Control computer	Real-time electronics integrated in PC; communication with user PC via PCI express; Control of microscope, lasers, scanning module and additional accessories, data acquisition and synchronization; Over sampling acquisition for best sensitivity and doubled SNR; possibility of online data-analysis during acquisition
User PC	High-end PC with ample RAM and hard disk storage capacity; ergonomic high-resolution 16:10 LCD-TFT flat-panel display, Windows VISTA operating system with multi-user capability Ethernet connection to local network

Standard software	
System configuration	Convenient control of all motorized microscope functions, laser modules, and scanning module, saving and restoring of application configurations
ReUse function	Restoration of acquisition parameters per mouse click
Capture modes	Spot, Line/Spline, Frame, Z Stack, Time-Lapse Series and combinations: XY, XYZ, XYT, XYZT, XZ, XT, XZT, Spot-T, Averaging and summation (line-wise or frame-wise, configurable) Step Scan (for higher frame rates, configurable)
Crop function	Convenient selection of scanning ranges (simultaneous zoom, offset and rotation)
Spline scan	Scanning along a freehand defined line
Image processing	Image processing options for any kind of computations, addition, subtraction, multiplication, division, ratio, shift, filters (low-pass, median, high-pass, etc., also user-definable)
Presentation	Orthogonal view (XY, XZ, YZ in a single presentation) Cut view (3D section made under a freely definable spatial angle) 2.5D view for time-lapse series of line scans Projections (stereo, maximum, transparency) for single frames and series (animations) Depth coding (pseudo-color presentation of height information) Brightness and contrast adjustments; off-line interpolation for Z stacks Selection and modification of color lookup tables (LUTs), drawing functions for documentation
Analysis	Intensity profile measurement of straight lines and curves of any shape Measurement of lengths, angles, areas, intensities, etc.
Data archiving	ZEN file browser with convenient functions for managing experiments together with their acquisition parameters Multiprint function for creating assembled image and data views. More than 20 file formats (TIF, BMP, JPG, PSD, PCX, GIF, AVI, Quicktime, etc.) for compatibility with all common image processing programs

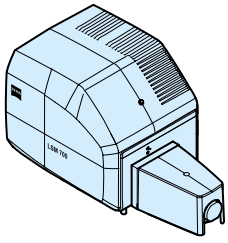
Optional software	
Topography package	Computation and visualization of surfaces (fast rendering modes) and height profiles, plus many measurement functions (roughness, surface area, volume)
StitchArt plus package	Capture of multiple XZ profiles and multiple XYZ stacks with reflected light
LSM Image VisArt plus	Fast 3D and 4D reconstruction and animation (shadow and transparency projection, surface and mixed rendering modes, cutting planes, fly-through mode, distance measurement in 3D)
3D for LSM	3D presentation and measurement of volume data records, on request
3D Deconvolution	Image restoration based on computed point spread functions with fluorescence (Modes: nearest neighbor, maximum likelihood, constrained iterative)

Freeware	
Image Browser **ZEN LE**	Free software packages for display, processing, sorting, printing and Export/import of LSM 5/7 images

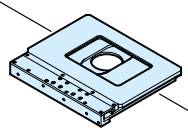
System overview LSM 700



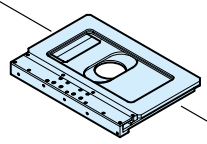
Electronics and laser module
for LSM 700
(4x pigtailed laser 405-639 nm)



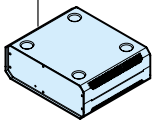
1-2-channel scanning module LSM 700



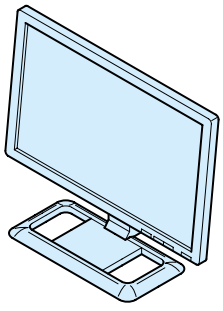
Scanning stage 130x85 PIEZO
for upright stand



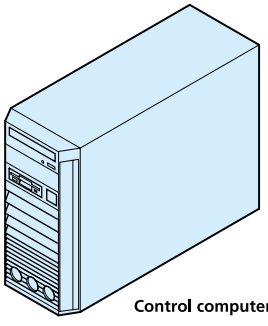
Scanning stage 225x85 PIEZO
for upright stand



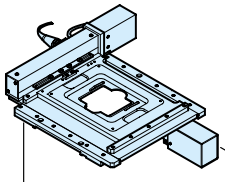
XY-stage controller PIEZO
XY-joystick
for stage controller PIEZO



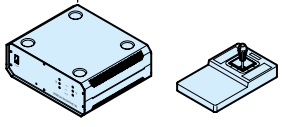
LCD TFT flat screen monitor 30"
16:10 flat screen monitor 24"



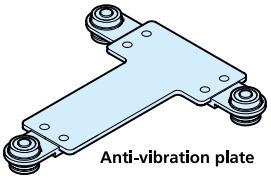
Control computer



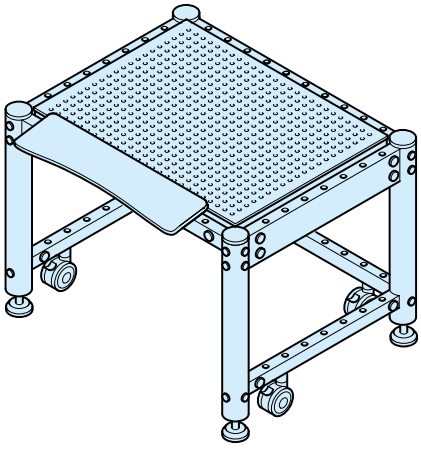
Scanning stage DC 120 x 100
for inverted stand



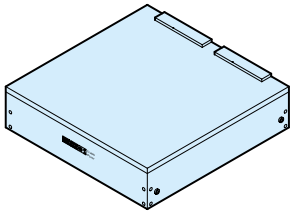
Controller incl. joystick



Anti-vibration plate



System table with breadboard
Wide: 1000x750mm (1200x950 overall)
Narrow: 750x1000mm (950x1200 overall)



Micro 40 active antivibration system
table surface: 45 cm x 40 cm

Micro 60 active antivibration system
table surface: 65 cm x 60 cm

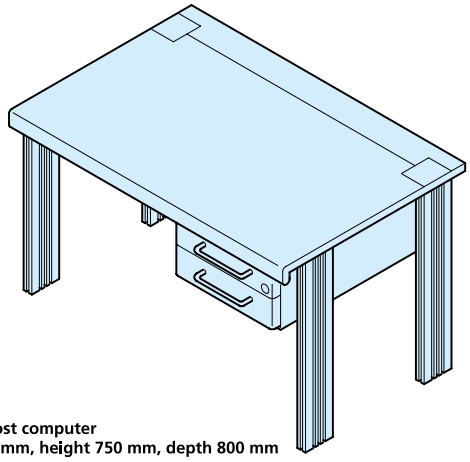
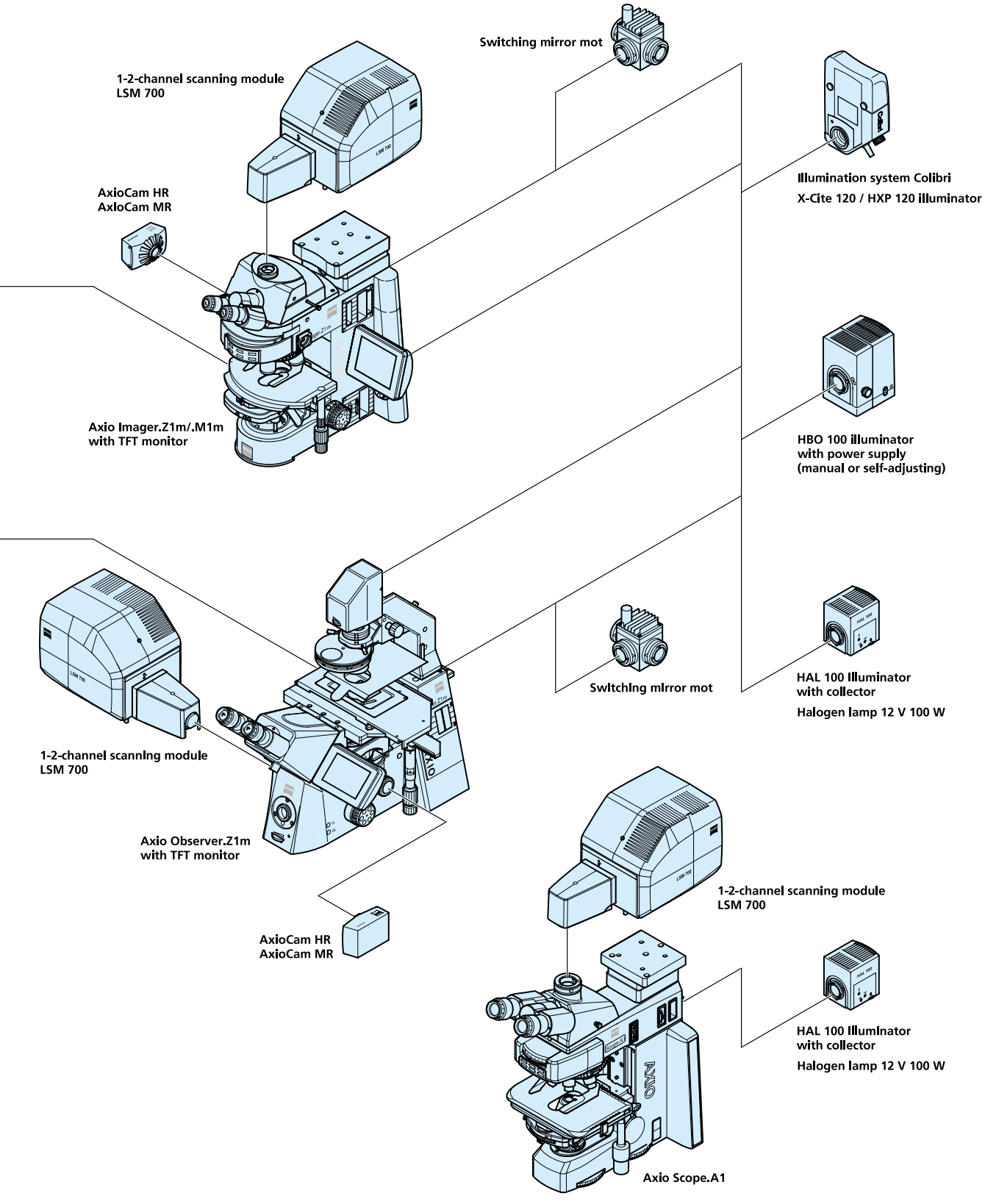


Table for host computer
width 1200 mm, height 750 mm, depth 800 mm


Switching mirror mot
1-2-channel scanning module
LSM 700
Illumination system Colibri
X-Cite 120 / HXP 120 illuminator
AxioCam HR
AxioCam MR
Axio Imager.Z1m/.M1m
with TFT monitor
HBO 100 illuminator
with power supply
(manual or self-adjusting)
1-2-channel scanning module
LSM 700
Switching mirror mot
HAL 100 illuminator
with collector
Halogen lamp 12 V 100 W
Axio Observer.Z1m
with TFT monitor
1-2-channel scanning module
LSM 700
AxioCam HR
AxioCam MR
HAL 100 illuminator
with collector
Halogen lamp 12 V 100 W
Axio Scope.A1

Topographic Parameters

contained in the LSM 700 Software: ZEN

Geometric parameters

Length, width, height, profile angle (edge slope),
radius of curvature, peripheral distance
Area

Roughness parameters*

Volume
Mean height
Arithmetic mean deviation
Root-mean-square deviation
Skewness
Kurtosis

Maximum peak height
Maximum valley depth

Absolute roughness depth (peak-to-valley value)
Average roughness depth
Maximum roughness depth

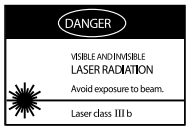
Functional parameters

Surface bearing area
Surface bearing area ratio

True surface
Developed surface area ratio
(surface index)

Material volume (ratio)
Void volume (ratio)

*All roughness parameters can be computed as primary data,
roughness or waviness-filtered data, for 2D profile or for 3D surfaces.



More about our patents under:
www.zeiss.de/micro-patent

Comprehensive functionality and maximum flexibility

The LSM 700 Laser Scanning Microscope from Carl Zeiss offers the user extremely high optical resolution, intelligent scanning techniques, a wide diversity of measuring functions and excellent repeatability. This optical system from Carl Zeiss is the fast, reliable solution to your complex measuring tasks on material surfaces and micropatterns.

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