Your Digital Light Microscope for Guided Inspection. As Simple as it Gets.

ZEISS Smartzoom 5

zeiss.com/smartzoom

ZEISS

Seeing beyond

Smart Design. Smart Workflow. Smart Connectivity.

Digitalization enables automation – in industry and elsewhere. And digitalization has enabled automation in light microscopy. Meet the ZEISS Smartzoom 5 digital light microscope, a turnkey automated microscopy platform with embedded software solutions that addresses classic limitations of light microscopy such as depth of field or reflections from metallic surfaces. It's the light microscope that assists operators with consistent execution of recurring, routine microscopy tasks. And it's the one that is well connected to the digital world around it: to other instruments, to other laboratories, even to other locations.

Smartzoom 5 is the ideal solution for quality assurance applications in virtually every field of industry. Quick and easy to set up, fully automated, and workflow-guided, it is so simple to operate, even novice users will produce excellent results.

▶ Click here to view this video
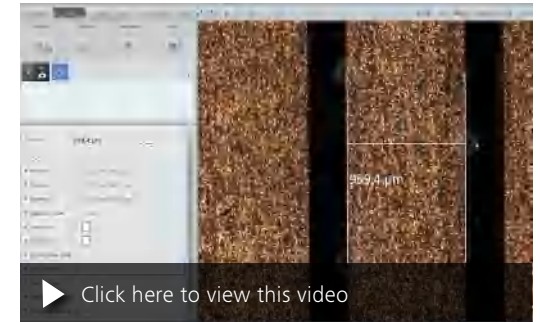
Simpler. More Intelligent. More Integrated.

Smart Design

Two components, two cables. The integrated optical module – including the zoom engine, overview camera, co-axial lighting and encoded objective bayonet adapter – connects with a single cable to the integrated stand – which contains the motorized stage and encoded tilt arm. The stand connects to the operating system with a single USB3 cable. The operating system enables microscope control from the touch screen monitor, the touchpad and dual-knob controller, and/or the mouse and keyboard—catering to individual preferences of users who may adapt to digitalization and automation at different paces.

Smart Workflow

Navigate easily on your part or sample with the help of the overview image from the optical module's integrated camera. Set up the microscope with the help of the workflow-guided graphical user interface. Capture imaging and measurement workflows on one or multiple components with the job builder in the Smartzoom 5 software. These smart workflow features reduce the operational complexity of microscopy by enabling quality engineers to execute inspection routines with unprecedented repeatability and without requiring deep microscopy knowledge.

Smart Connectivity

Digitalization also means microscopy is no longer a specialized, isolated craft. Digitalization allows microscopy data to be connected to data from other modalities, with the combined information shared between operators, laboratories and even locations. For this reason, Smartzoom 5 – with ZEN core, the ZEISS connected laboratory software infrastructure – is a prime component of the ZEISS connected industrial microscopy portfolio for multi-modal industrial quality assurance and failure analysis applications.

# Extended Depth of Field and Glare Removal

Anyone who has ever worked with light microscopes knows that depth of field and reflections are the classical challenges in light microscopy. During some inspection tasks, depth of field can be enhanced by stereoscopic viewing, so reflections may be helpful for articulating contrast between features or structures on the sample surface. But when it comes to documenting image data, depth of field and reflections can be real challenges that are not easily addressed by simply fitting a camera to your microscope.

Airbag fabric: without EDF (left); with EDoF (right)

Extended Depth of Field

Smartzoom 5 provides a workflow-guided software routine to enable automated acquisition of a stack of images at different focus planes, followed by image reconstruction with extended depth of field, or even a 3D reconstruction of the surface. Thanks to telecentric objectives, distortions in the Z direction are minimized. The images with extended depth of field, or 3D surface projection can be saved directly, measured in a 2D profile, or imported into ConfoMap for subsequent 3D surface analysis.
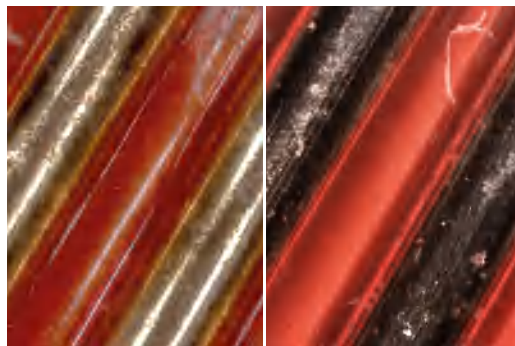
Coil wire: without Glare Removal (left);
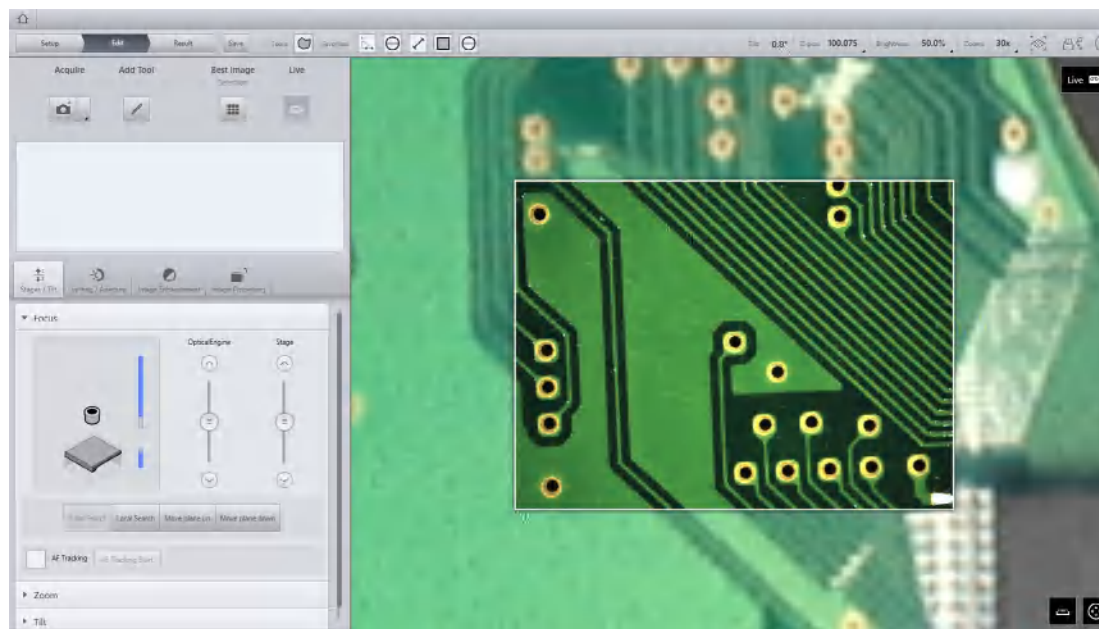*with Glare Removal (right)*

Glare Removal

All of the Smartzoom 5 objectives feature integrated segmented LED ring lighting, the alternative to using a polarization filter to suppress glare from reflective surfaces. Images illuminated by different sectors of the segmented ring light are automatically combined by the software to filter out glare that occurs differently for each ring light sector. And, segmented ring light illumination can be combined with co-axial lighting for all objectives. The advantage to digital glare removal is in its consistent application, unlike a polarization filter that may be applied in different directions. Digital glare removal is a true repeatable alternative to the classical polarization filter.

Workflow-guided User Interface

Smartzoom 5 comes with an extraordinarily easy to use graphical user interface. It is laid out in a logical order: from capturing the overview image – through automated height adjustment and autofocus – to the selection of "best image" from the image tiles automatically generated using all possible lighting options. Next, select to acquire an image with extended depth of field, or a 3D image; or, choose a function from the image analysis menu. Then generate the report and the job is done!

Overview Image

Once the overview image is captured, you can use it to aid navigation, zooming out at any time to locate or change the microscopic regions of interest, even for large components or multiple components arranged on the stage.

Inspection workflow recorded

The images you record and the tools you used are displayed in a clearly arranged manner to give you an overview of your entire inspection workflow at a glance. This workflow can be saved as a job by the system supervisor so that operators with little prior knowledge of microscopy can log in as "routine users" with access to only the job macro.

Automation through encoding

All Smartzoom 5 components are either encoded or motorized; therefore, the software continuously monitors the status of each component and stores the information together with the imaging data. Smartzoom 5 also features a user management system that ensures reproducibility by restricting the adjustments that individual operators can make.

Smartzoom 5 user interface: the overview image enables easy sample navigation.

Repeatable Workflows

Digitalization and automation do not necessarily benefit the most experienced microscopist in academia and research. They do, however, benefit engineers in industrial quality laboratories who are not microscopists per se, but who still have that quality inspection job to do. And it must be done consistently from engineer to engineer without operational variations, otherwise data cannot be correlated from part to part, from batch to batch, and between laboratories or other locations.
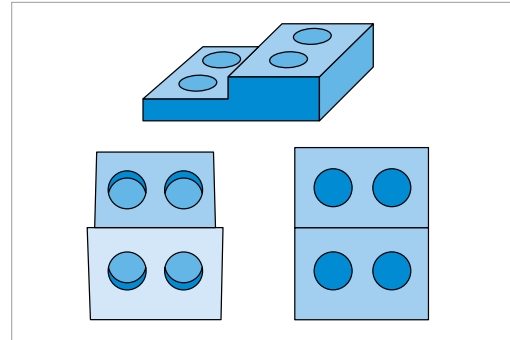

Smartzoom objectives 1.6×, 5× and 10× are telecentric to mitigate risks of incorrect image scaling when a sample or part is not imaged at the exactly prescribed working distance. A standard, non-telecentric lens results in a distortion of perspectives (left). A telecentric lens ensures that the perspectives remain undistorted (right).

Automated illumination features such as Best Image and Glare Removal enable inexperienced operators to select and apply preferred lighting settings consistently.

Smartzoom objectives 0.5×, 1.6× and 5× are of sufficiently long working distance to enable tilting of the arm throughout the -45 to +45 degree tilt range, without risk of crashing the edge of the objective into large components, for example PCBs.
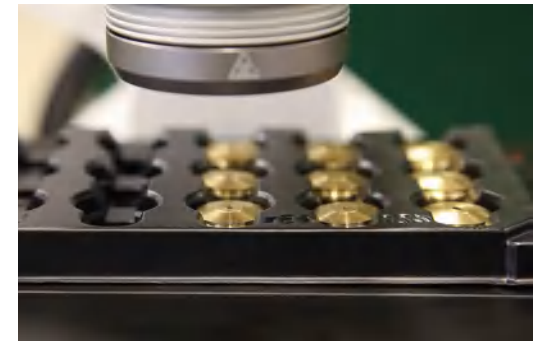

Job Mode is a form of macro recording that reduces the complexity of a microscopy workflow to a step-by-step execution of inspection and measurement tasks. With predefined regions of interest, magnification, lighting, data acquisition and reporting settings—all arranged in a logical and consistent workflow order job templates then can be applied to multiple similar parts in a production batch.

Connected Workflow Solutions

- ZEN core is the ZEISS connected laboratory software solution. It includes modules that provide image analysis, data reporting and archiving solutions for images and data acquired with Smartzoom 5 and other ZEISS industrial microscopy solutions.

- Shuttle & Find enables seamless relocation of identified regions of interest: from Smartzoom 5 to any other light microscope for basic to advanced optical inspection and documentation; from Smartzoom 5 to ZEISS scanning electron microscopes for metallography or surface analysis applications; or from Smartzoom 5 to confocal microscopes for topography and roughness applications.

- ZEN Connect, a module for ZEN core, enables the visualization and reporting of data from multiple modalities, different laboratories, or even different locations, in a single correlative microscopy workspace.

- ZEN Data Storage provides a solution for image data management—for laboratories, across laboratories or even across locations.
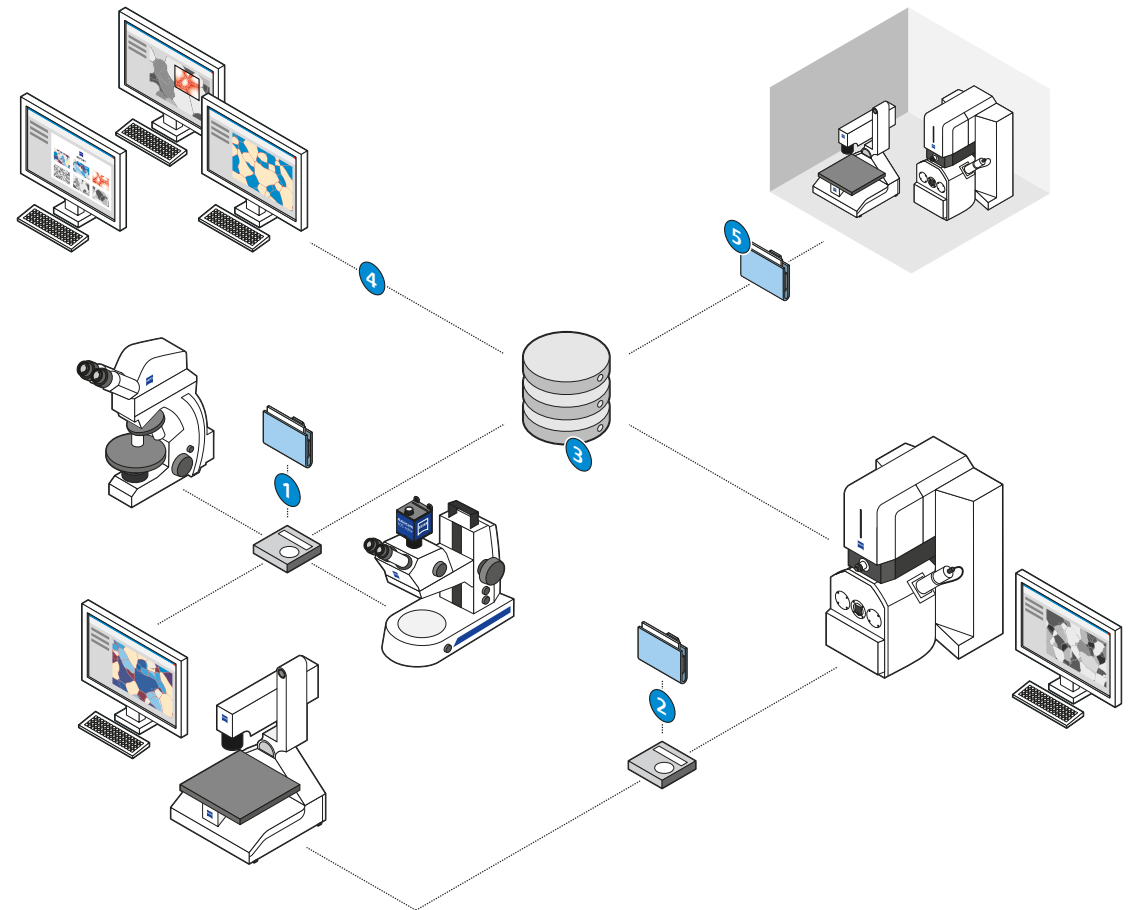

*Smartzoom 5 in a laboratory environment connected by ZEISS ZEN core:*
1) Shuttle & Find between Smartzoom 5 and other light microscopes
2) Shuttle & Find between Smartzoom 5 and ZEISS EVO scanning electron microscope
3) Central data management enabled by ZEN Data Storage
4) ZEN Connect: image processing, analysis, and reporting on separate office workstations
5) Exchange of images and analysis data, instrument presets, workflow templates, and reporting data between laboratories and locations

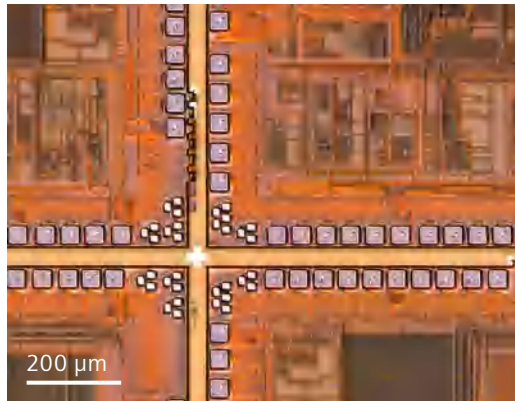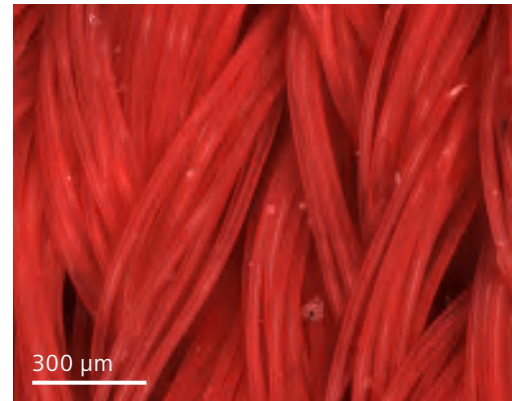# ZEISS Smartzoom 5 at Work: Optical Inspection & Documentation
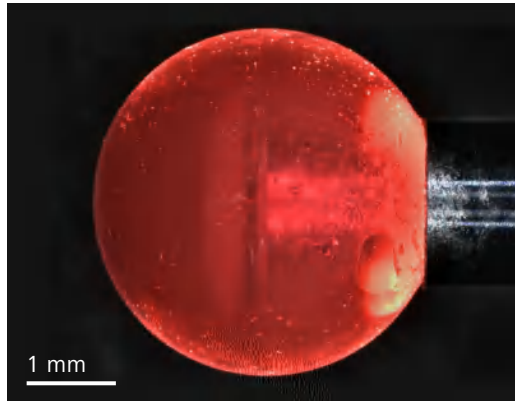
Optical inspection of a CMM stylus tip, magnification: 60×, ring light illumination, Glare Removal mode
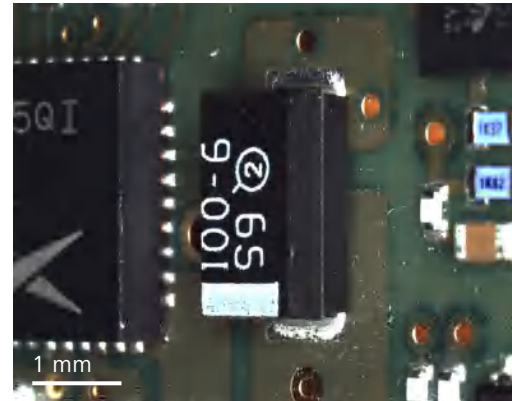
PCB components inspection, viewing angle: 45°, magnification: 60×, ring light illumination

Structural details of a semiconductor wafer, magnification: 300×, coaxial brightfield illumination

Incoming goods inspection of fiber material, magnification: 200×, ring light illumination, Glare Removal mode

Typical tasks and applications

- Optical inspection of parts and components with different dimensions, at different viewing angles
- Documentation from images of the highest detail, clarity and quality
- Identical execution of inspection routines to avoid data deviations
- Acquisition of combined results from other modalities, laboratories or locations

How you benefit from ZEISS Smartzoom 5

- Choose from 4 objectives for the flexibility to meet different inspection requirements, covering a 10× to 2020× magnification range.
- Never worry about crashing the objective into the part; long working distance objectives allow unrestricted arm tilt.
- Automate acquisition and reconstruction for images requiring extended depth of field.
- Use software to reliably remove glare from reflective surfaces.
- Implement Job Mode to assure repeatable optical inspection and workflow execution.
- Connect to other ZEISS solutions through ZEISS ZEN core connected laboratory software suite.
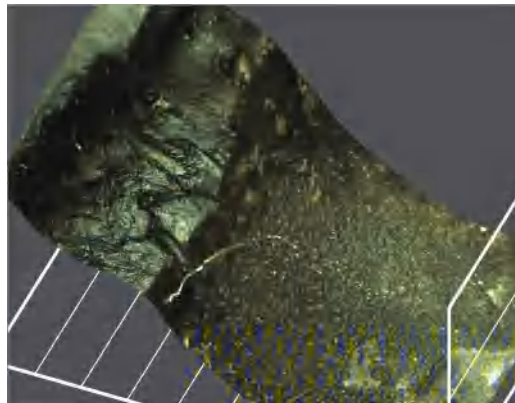
# ZEISS Smartzoom 5 at Work: Surface Topography
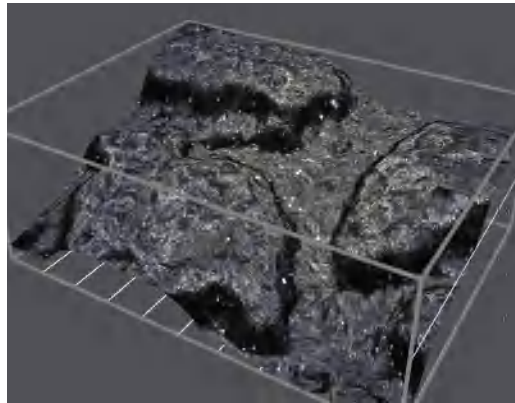
3D surface characterization of synthetic leather, segmented ring light illumination, extended depth of field (EDF), magnification: 60×
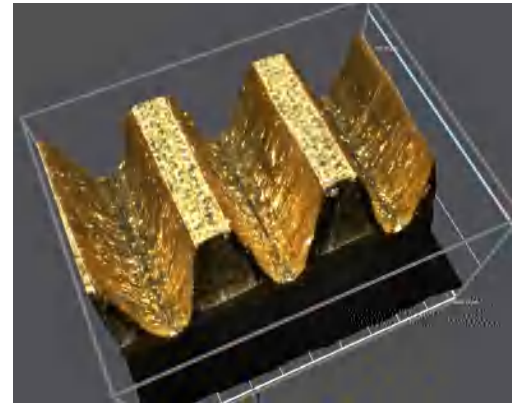
Surface profile of a gear wheel; 3D reconstruction reveals production residue. Ring light illumination, Glare Removal mode, extended depth of field (EDF)

Exhaust residues on outlet valve, segmented ring light illumination, extended depth of field (EDF), magnification: 45×
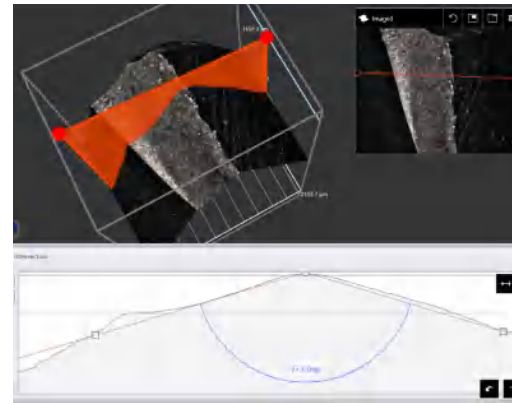
Abrasion measurement of a drill bit, segmented ring light illumination, Glare Removal mode, extended depth of field (EDF)

Typical tasks and applications

- Surface inspection to assess friction or wear
- 3D visualization of surface topography
- Height/depth measurements from line profiles
- Advanced 3D image visualization and measurement – norm compliant

**How you benefit from ZEISS Smartzoom 5**

- Use automated acquisition for 3D reconstruction of the sample surface.
- Adjust the tilt arm to +/- 45 degrees for oblique viewing.
- Tilt the arm with a single touch; magnetic brake and stop technology is in control.
- Get line profile measurements from the measurement software utility.
- Export your .czi files to ConfoMap, the ZEISS solution for 3D surface visualization and measurements.
- Use the Shuttle & Find correlative microscopy utility to relocate regions of interest from other analytical solutions like scanning electron microscopy, or confocal microscopy.

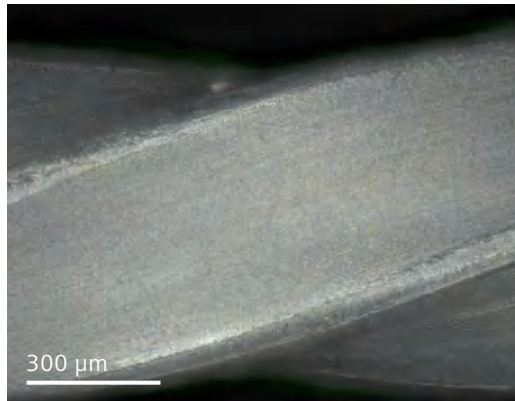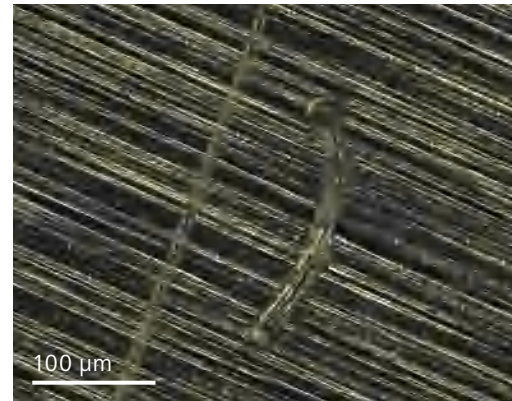# ZEISS Smartzoom 5 at Work: Metallography/Fractography

Laser weld, coaxial brightfield illumination, magnification: 35×
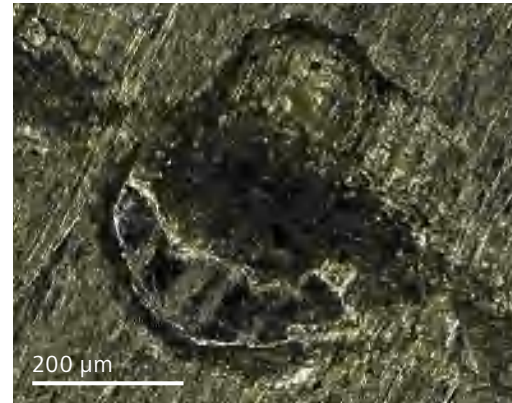
Metal crack, ring light and HDR illumination, magnification: 335×

Galvanized wire, ring light illumination, Glare Removal mode, magnification: 300×

Scratched aluminum surface, ring light and HDR illumination, magnification: 600×

Typical tasks and applications

- Inspection, analysis and documentation of metal fractures or cross sections of metal and steel samples
- Detection of failure root-causes
- Characterization of microstructure, such as layer thickness, grain size, inclusions etc …

How you benefit from ZEISS Smartzoom 5

- Select the 10×/0.6 objective to get both the high magnification and resolution needed for metallographic investigations.
- Access the metallographic analysis modules within ZEISS ZEN core to evaluate layer thickness and grain size or perform multiphase analysis.
- Use the Shuttle & Find correlative microscopy utility to easily relocate regions of interest from other metallographic solutions like scanning electron microscopy.

ZEISS Smartzoom 5 at Work: Advanced Dimensional Measurements

Smartzoom 5 in the measurement lab. ZEISS ZAPHIRE offline evaluation enables automated dimensional measurement of component features at a microscopic scale.

Typical tasks and applications

- Measure 2D dimensions of parts or components
- Compare measurements with CAD data to check for deviations
- Assess measurement data statistics and trends

How you benefit from ZEISS Smartzoom 5

- Use the backlight option to enable measurements on transmitted light images.
- Access advanced measurement tools in ZEISS ZAPHIRE offline evaluation for automated metrology on detected shapes.
- Move through the entire zoom range with continuous calibration and no click-stop limitation.
- Assure reliable measurement results with MPE values according to ISO 10360-7:2011 for ZEISS Smartzoom 5. Especially important for metrology labs, achieved by telecentric objectives and factory-calibrated zoom systems.
- Get an on-site MPE ISO 10360-7 reverification and system calibration certificate to show compliance with industry requirements.

>> Request Your Free 30-Day Trial of ZEISS ZAPHIRE offline evaluation

Expand Your Possibilities

Transmitted Light Unit (TLU)

The TLU is used to illuminate samples from below. It mounts to the scanning stage, to generate contrast from transparent samples or sharp contours in opaque samples for advanced measurement applications like ZEISS ZAPHIRE offline evaluation. The TLU can be combined with coaxial and ring light illumination.
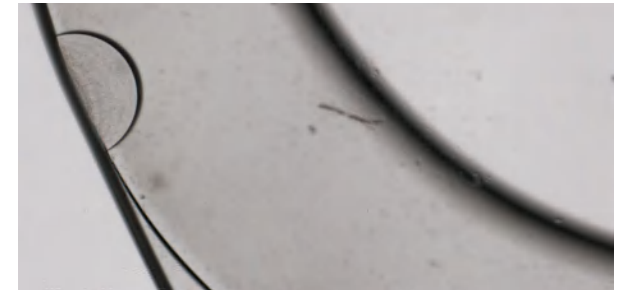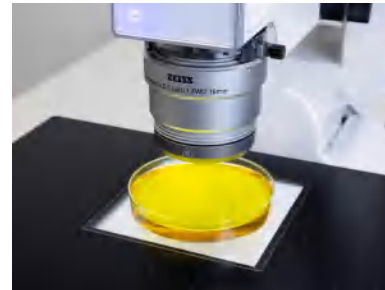
Intraocular lens (IOL), imaged with transmitted light

Polarizer Unit

The polarizer unit is available as an optional accessory for the objectives PlanApo D 0.5×/0.03, PlanApo D 1.6×/0.1, and PlanApo D 5×/0.3. It is used to minimize reflections from strongly reflecting surfaces (e.g. metal surfaces). The polarizer unit consists of a rotatable polarizer and a fixed analyzer.

PCB component: without Polarizer Unit (left); with Polarizer Unit (right)

Diffuser

The diffuser is available as an option for the objectives PlanApo D 0.5×/0.03, PlanApo D 1.6×/0.1, and PlanApo D 5×/0.3. It causes a diffuse illumination, which results in more even brightness distribution across the sample surface. Reflections are reduced and softened. To enhance the effect of the diffuser, up to two additional diffuser disks can be inserted.

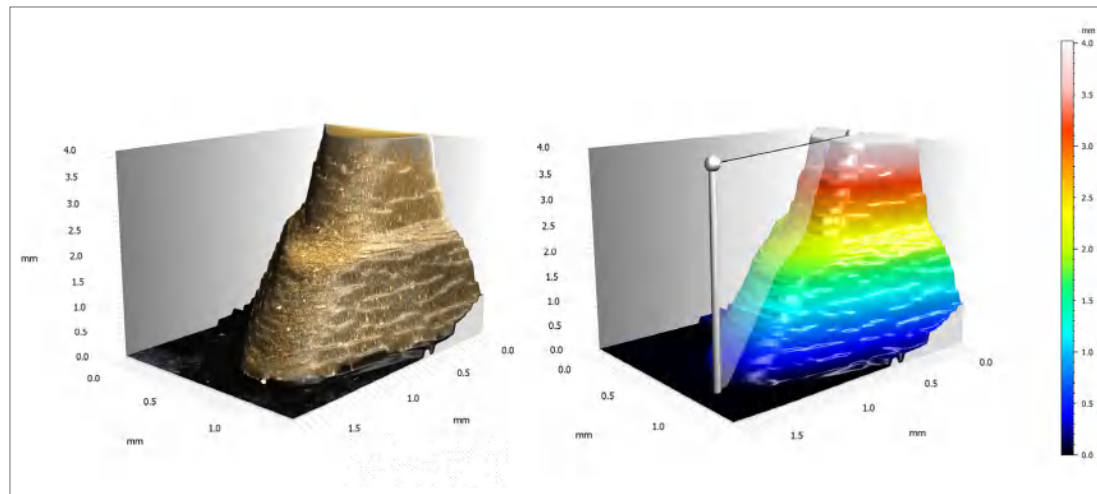*Cutting insert: EDF without Diffuser (left); EDF with Diffuser (right)*

Expand Your Possibilities

Facing Your Surface. With Ease. ZEISS Confomap Lite

ZEISS Confomap Lite is an optionally available entry-level software for rendering, analysis and measurement of surfaces. ZEISS Smartzoom 5, used for the development and production of advanced materials, benefits particularly strongly from ZEISS Confomap, as the software offers the latest standards and procedures in surface metrology as well as an intuitive user interface. It offers the ability to generate topography data and to perform advanced 3D analysis for ZEISS Smartzoom 5 3D images.

The software also provides high-quality 3D visualization, basic surface data correction and analysis, distance measurements, step height on profiles, volume calculations, Abbott-Firestone curve, histogram analysis and more.

In 3D profile cutting, precision-fit segments, arcs and circles can be created and distances, radii and angles can be measured with the Contour Analysis module.

A visual report of the surface analysis is generated directly while working with ZEISS Confomap. Shown here is a 3D profile of the tip of a cutting insert, recorded with objective 10×, ring light illumination, magnification 2022×. ZEISS Confomap Lite visualizes texture renderings and renderings in rainbow palettes with 3D profile cut.
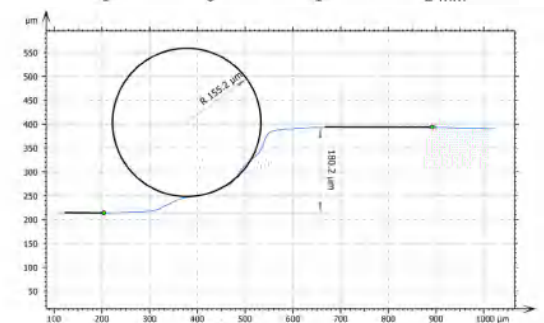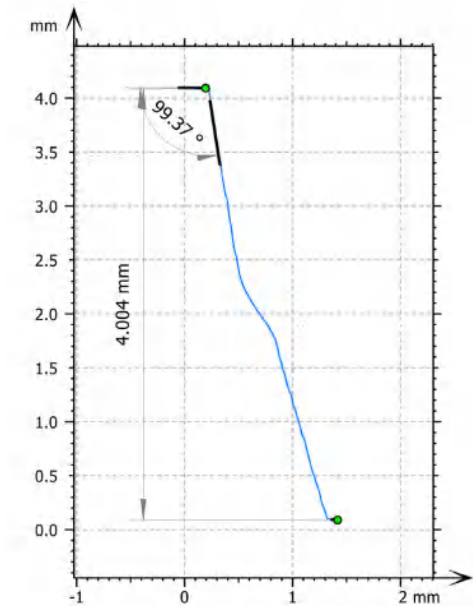
3D profile cut of the tip and the inner part of a cutting insert, evaluated with segmentation and measurement functions of the Contour Analysis module.

Request Your Free 3-Day Trial of ZEISS Confomap 9

Expand Your Possibilities

**Facing Your Surface. More Advanced.
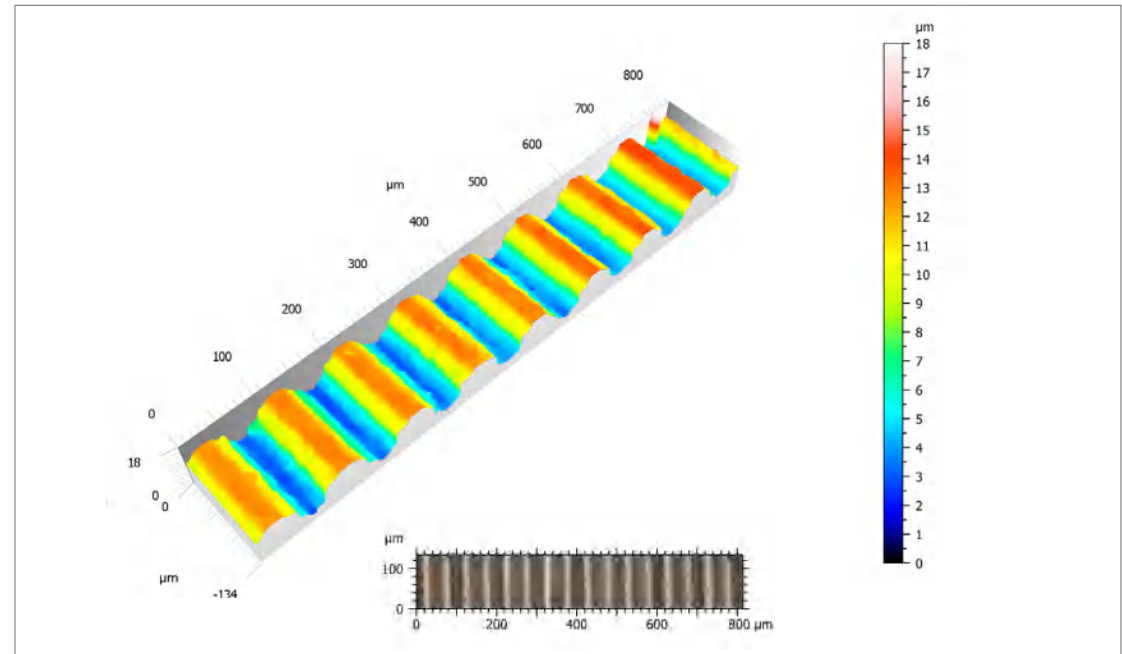ZEISS Confomap ST**

With ZEISS Confomap ST, more advanced 3D analyses such as profile roughness and waviness measurements, stitching of images and surfaces, outlier removal and multifocus reconstruction can also be performed quickly and easily. With ZEISS Smartzoom 5 and Confomap ST, roughness values Ra >3 µm can be evaluated according to ISO 21920 - Roughness (S-L).

Results table of roughness measurements in ZEISS Confomap ST with amplitude parameters Rq (root mean square of profile ordinates), Rsk (profile skewness), Rz (largest height difference of the profile) and Ra (arithmetic mean of profile ordinates).

Shown here is a 3D profile of a roughness measurement standard E-MC-S24C (Ra = 3.18 µm), taken with objective 10×, mixed illumination, magnification 2022× and displayed with ZEISS Confomap ST, shown in a rainbow palette rendering.
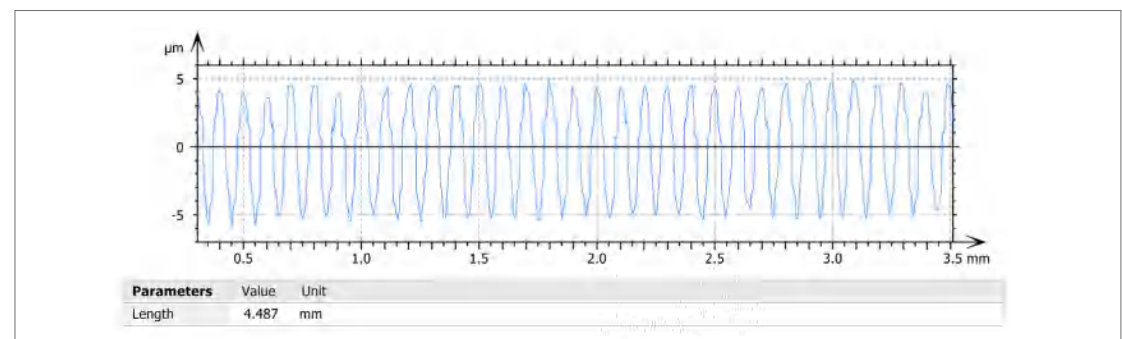
3D profile cut of roughness measurement testing standard.

Request Your Free 3-Day Trial of ZEISS Confomap 9

Your Flexible Choice of Components

1 Microscope

ZEISS Smartzoom 5 (motorized), consisting of:
- Stand
- Optical engine
- Stage

2 Objectives
- PlanApo D 10×/0.6 10 mm (telecentric)
- PlanApo D 5×/0.3 FWD 30 mm (telecentric)
- PlanApo D 1.6×/0.1 FWD 36 mm (telecentric)
- PlanApo D 0.5×/0.03 FWD 78 mm
- All objectives suitable for segmented ring and coaxial light

3 Illumination

Segmented ringlight (integrated in the objectives)
Coaxial reflected light (integrated in the optical engine)
Transmitted Light Unit (optional)

4 Cameras
- Overview camera (integrated in optical engine)
- Microscope camera (integrated in optical engine)
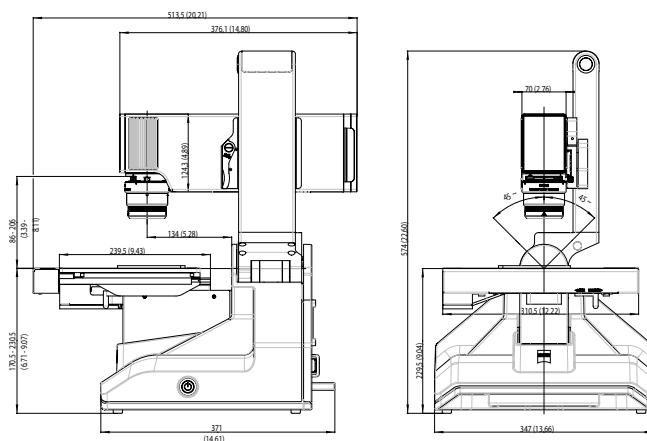
5 Computer System
- All-in-One PC
- Smartzoom 5 software
- Touchpad and controller
- Keyboard and mouse

Accessories
- Transportation case
- Polarizer for 0.5×, 1.6× and 5× objectives
- Diffuser for 0.5×, 1.6× and 5× objectives

Technical Specifications

System Components	
Optical Unit	Containing the camera, coaxial reflected light, 10× optical-motorized zoom, and overview camera.
Objectives	Connected to the optical unit via a bayonet mount. They contain switchable ringlight and storage module in which the exact magnification is saved.
Stage	Powered by a stepper motor with integrated controller which makes it possible to move in a reproducible manner to relevant areas of the sample.
Stand	Powered by a motorized z-drive for focusing and a swing arm to adjust the viewing angle in relation to the surface of the sample. In addition, the stand contains a second motorized drive to correctly adjust the pivot point in relation to the sample height.
Controller	Comprising a dual rotary wheel for controlling zoom, focus, and stage movement; a touch pad for gesture controlling hardware and software; touch display for operating software features; and detachable wireless keyboard.
All-in-One PC	Containing the Smartzoom 5 application software and connected to the controller via USB 2 and to the stand via USB 3.

Technical Data	
Maximum Resolution	~ 0.56 µm
Maximum Magnification	2,020× (with respect to a 17.5" display diagonal and an aspect ratio of 4:3)
FWD at Maximum Magnification	10 mm
FOV at Minimum Magnification	39 mm
Camera	Sensor type: CMOS
	Sensor size: 1", 4.2 megapixel
	Total pixels: 2,048 × 2,048
	Available pixels: 1,920 × 1,440
	Effective pixels: 1,600 × 1,200

Technical Specifications

Technical Data	
Image Resolution	Standard: 2 megapixel
	True RGB: 2 megapixel
	High definition: 18 megapixel
Image Format	.czi
	Export: .czi, .jpg, .tif, .png
Frame Rate Live Image	Up to 30 fps
Optical Zoom	Zoom factor: 10×
	Zoom range: 0.5× to 5.0×
Objectives Data	PlanApo D 0.5×/0.03 (FWD 78 mm); PlanApo D 1.6×/0.1 (FWD 36 mm); PlanApo D 5.0×/0.3 (FWD 30 mm); PlanApo D 10.0×/0.6 (FWD 10 mm)
Length Measurement Error MPE complies with ISO 10360-7:2011	$E_{UV, MPE} = 0.5$ µm + L [µm] / 200*; $E_{UV, MPE} = 1$ µm + L [µm] / 200**
Motorized Stage	Travel (x/y): 130 × 100 mm; travel (z): ~60 mm; maximum load: 4 kg; reproducibility: ±1 µm; absolute accuracy: ±5 µm
Stand	Tilting angle (encoded): ±45°
	Maximum sample height: ~120 mm
	Smallest step size 0.25 µm
	Reproducibility: ±1 µm
	Absolute accuracy: ±10 µm
	Passive vibration absorption
Illumination	Coaxial LED reflected light
	LED ringlight with 4 individual selectable segments
	Mixed illumination: coaxial and ringlight (brightness and ratio adjustable)
	Optional: Polarizer set and diffuser for objectives 0.5×, 1.6× and 5.0×, individual diffuser disk for diffuser
	Optional: Transmitted Illumination Unit (TLU), combination with incident illumination possible
All-in-One PC	Operating system: Windows 10 IoT Enterprise 2019 LTSC; monitor size: 23.8"; resolution in pixels: 1,920 × 1,080
Weight	~22 kg (system without PC)
	~30 kg (entire system)

* measured with Objective PlanApo 5×, coaxial illumination at V = 800×, in single image for L < 400 µm, ZEISS ZAPHIRE offline evaluation
** measured with Objective PlanApo 1.6×, coaxial illumination at V = 270×, in single image for L < 1000 µm, ZEISS ZAPHIRE offline evaluation

Technical Specifications

Software Concept	
User Level	Administrator
	Operator
Software Modes	Routine examination
	Free examination
Operating System	Windows 10 IoT Enterprise 2019 LTSC
Magnification Calibration	Factory calibration
	Manual calibration
Units	Metrical (nm, μm, mm)
	Imperial (nm, mil, inch)
White Balance	Factory default
	2 individual manual white balance settings

Software Features	
Image Acquisition	2D
	EDF (Extended Depth of Field)
	3D (method depth of focus 3D reconstruction)
	Stitching (ad hoc, area), stitching + EDF, stitching + 3D
	Best image functionality
	Times series
	Relief display
	Digital contrast
	Color segmentation
Acquisition Mode	Auto exposure / manual exposure
	Aperture control
	3D/EDF: continous / stepwise
Workflow Features	Overview image: microscopic image is displayed in context of overview image for easy navigation
	Coordinate system for position tracking of recurring parts
	Tilting workflow (automatic pivot point)
	Workflow covers inspection tasks in their entirety
	Shuttle & Find Calibration Workflow (optional)

Technical Specifications

Software Features		
Image Enhancements	Realtime HDR	
	Noise filtering	
	Automatic shading correction	
	Sharpening	
	Image stabilization	
	Brightness / Contrast	
	High resolution image acquisition	
	Ringlight glare removal	
Autofocus	Global autofocus	
	Local autofocus	
	Autofocus tracking	
3D Rendering Options	Wire frame	
	EDF texture	
	Height texture	
	z-scaling	
2D Tools	Annotations (arrow, circle, rectangle, text, scalebar)	
	Measurement tools (distance, height, perpendicular line, parallel lines, multi line, connected angle, disconnected angle, contour, circle radius, circle diameter, circle-to-circle distance, reference point)	
	Area tools (circle, rectangle, polygon, contour, brightness)	
	Marker (count tool)	
	Shuttle & Find (points, region) (optional)	
3D Tools	Distance	
	Profile (height, width, 3-point angle, 4-point angle, radius, diameter, distance, parallel lines, perpendicular lines, marker, multiline)	
	Volume	
	Angle	
Smart Tools	Area measurement	
	Repetitive objects (replicate tools on each object found)	
	Golden sample comparison	
Reporting	MS Word format	
Languages	Multi language support	
Optional Software	Shuttle & Find, Confomap ST; Confomap Lite	

ZEISS Service – Your Partner at All Times

Your microscope system from ZEISS is one of your most important tools. For over 170 years, the ZEISS brand and our experience have stood for reliable equipment with a long life in the field of microscopy. You can count on superior service and support - before and after installation. Our skilled ZEISS service team makes sure that your microscope is always ready for use.

Procurement

- Lab Planning & Construction Site Management
- Site Inspection & Environmental Analysis
- GMP-Qualification IQ/OQ
- Installation & Handover
- IT Integration Support
- Startup Training

Operation

- Predictive Service Remote Monitoring
- Inspection & Preventive Maintenance
- Software Maintenance Agreements
- Operation & Application Training
- Expert Phone & Remote Support
- Protect Service Agreements
- Metrological Calibration
- Instrument Relocation
- Consumables
- Repairs

New Investment

- Decommissioning
- Trade In

Retrofit

- Customized Engineering
- Upgrades & Modernization
- Customized Workflows via APEER

Please note: Availability of services depends on product line and location

>> www.zeiss.com/microservice

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