



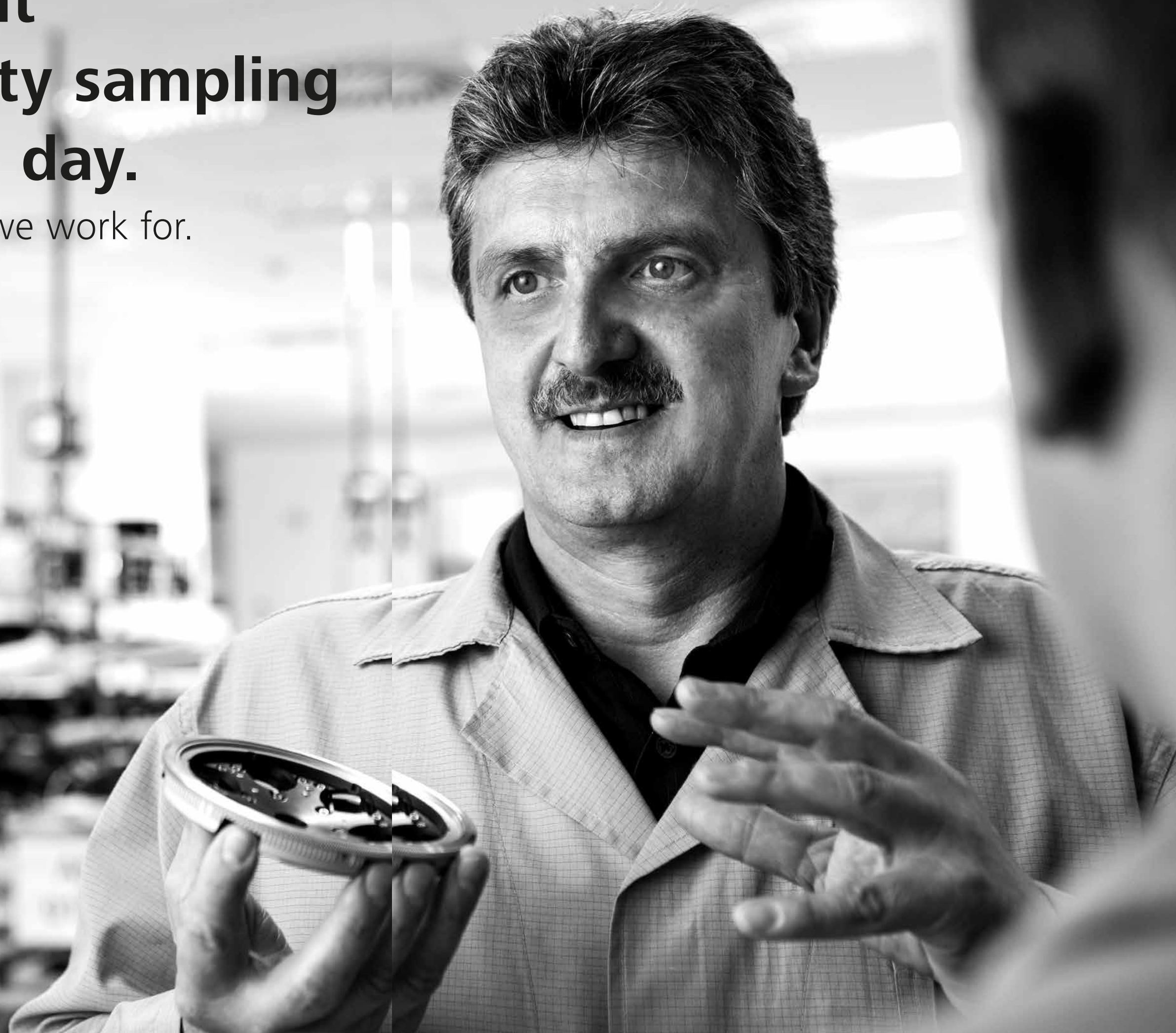
Microscope and Measurement Systems for Quality Assurance and Quality Control

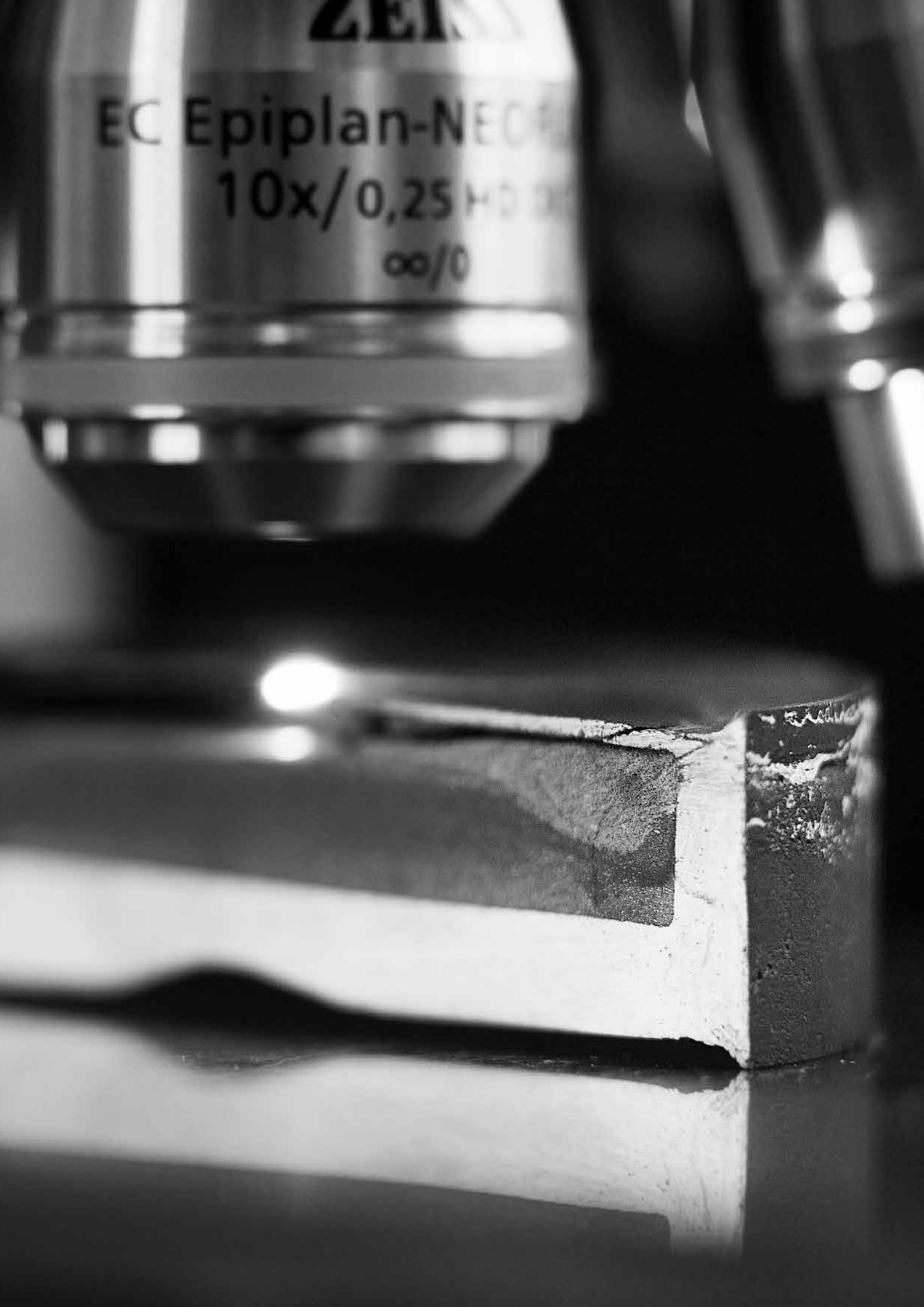
Capture the essentials of your component.
Quickly. Simply. Comprehensively.



The moment smart quality sampling makes your day.

This is the moment we work for.





ZEISS Puts the IQ into Industrial Quality Control

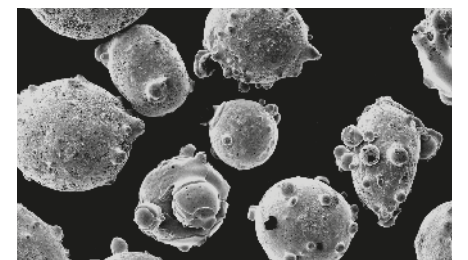
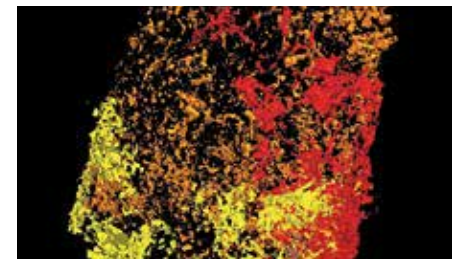
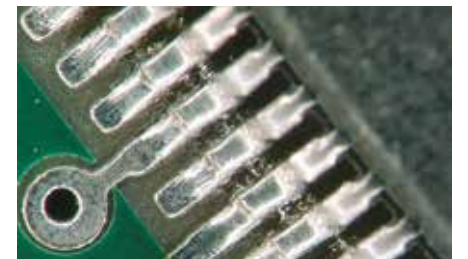
Is the right decision ever clear to see?

Yes, when it is informed by ZEISS microscope systems for quality control and quality assurance.

ZEISS is known across the globe for high-quality, high-performance microscopes. For superior lenses and for outstanding optical performance. The closer you look, the more you see.

With ZEISS products in your quality laboratory, you can count on reliable results – day in, day out. They are simple to operate, even for inexperienced users. And thanks to their high degree of automation, they will reduce your operating costs with more efficient sample throughput. Fully automated system solutions are user-independent, leaving you free to concentrate on what you see while they generate highly precise, reproducible results.

Take advantage of the wide variety of technologies from ZEISS. Light microscopes provide you with information on color, morphology, structure, texture and dimensions. With X-ray microscopes, you can see inside your materials in 3D and 4D – non-destructively and in high resolution. Electron microscopes give you additional information on composition and the individual elements present.

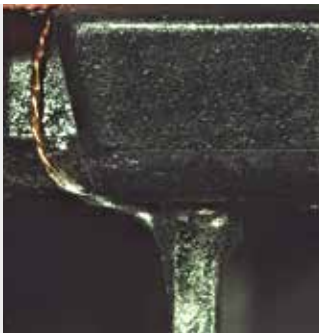


From Micro to Nano – the Most Extensive
Product Portfolio on the Market

Choose the best microscope for your application:
ZEISS systems provide you with information
in the micro to nano ranges.



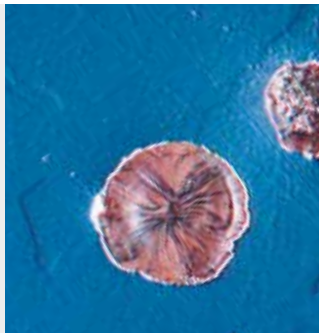
Stereo microscopes



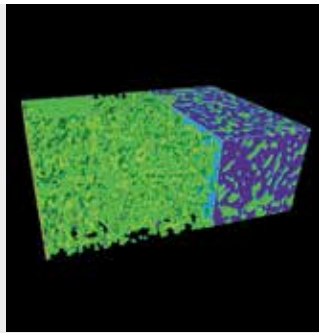
Digital microscopes



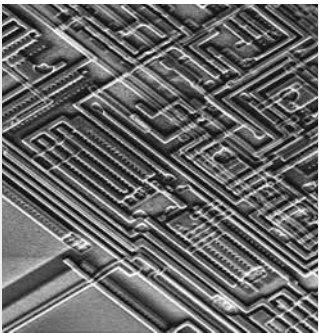
Zoom microscopes



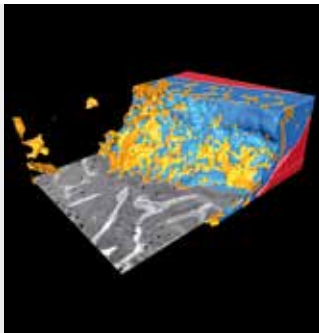
Light microscopes



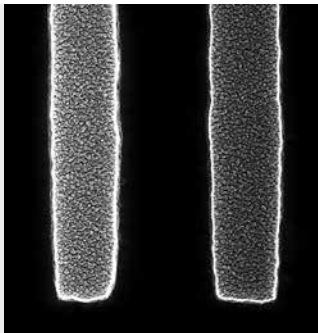
X-ray microscopes



Scanning electron
microscopes



Focused ion beam
electron microscopes



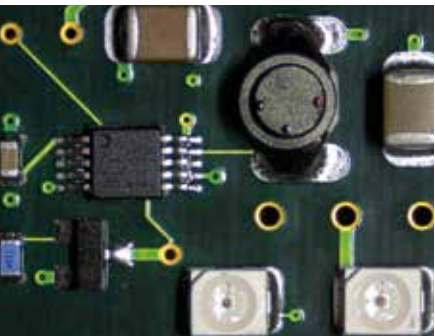
Helium ion microscopes



The Tools to Master Any Task

Investigate metals, non-metals, composite materials, plastics, ceramics and biomaterials. Quantify structures and objects. Analyze microscopic images and document your findings.

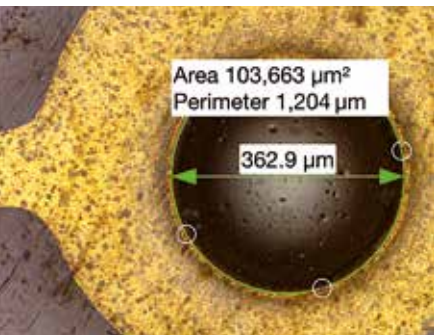
From the moment you select your microscope, you have the advantage of ZEISS experience – with an extensive range of methods and systems for use in production, manufacturing and quality inspections.



Optical Inspection Systems

Produce and inspect minute components with dimensions in the micrometer range. Your dexterity is tested constantly – for instance, when adjusting delicate gears in watch movements or components for medical technology. Inspecting solder points on boards and PCBs or examining metallic structures. Simply, quickly, visually.

Page 10



Digital Image Acquisition and Documentation

Whether your work in quality control or quality assurance, your need for simple, fast imaging and documentation is growing. AxioCam digital microscope cameras from ZEISS let you handle tasks efficiently. Use ZEISS Primotech and Matscope, our iPad imaging app, to digitize your entire test laboratory. Network all your microscopes and share images from your colleagues.

Page 18

Automated Imaging Systems

Microscopic analyses provide you with precise, reproducible results. The motorized components of your microscope and automated workflows simplify the evaluation process. Discover how manufacturing processes and wear influence textures and affect their interaction with other components and materials. Then round out your system with a broad range of software modules.

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Optical Metrology

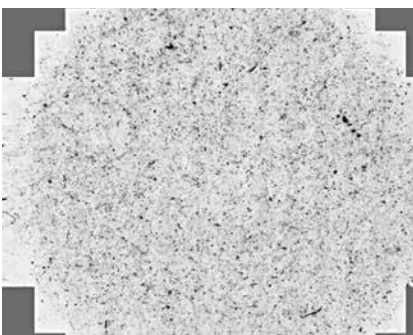
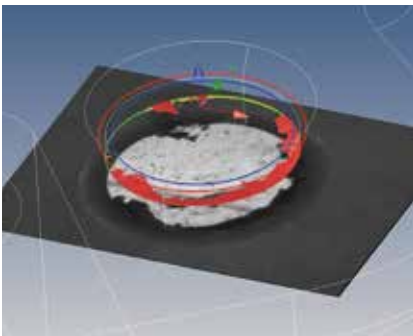
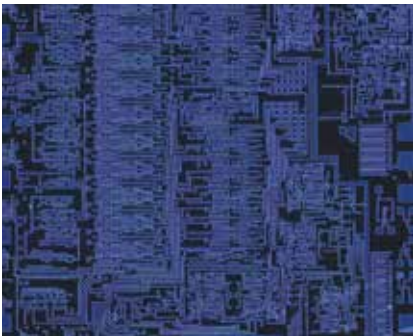
Which optical system you select depends on your application. For measuring complex 3D structures, use the ZEISS O-INSPECT multi-sensor system. ZEISS O-SELECT is your tool of choice for 2D measurements.

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Applications

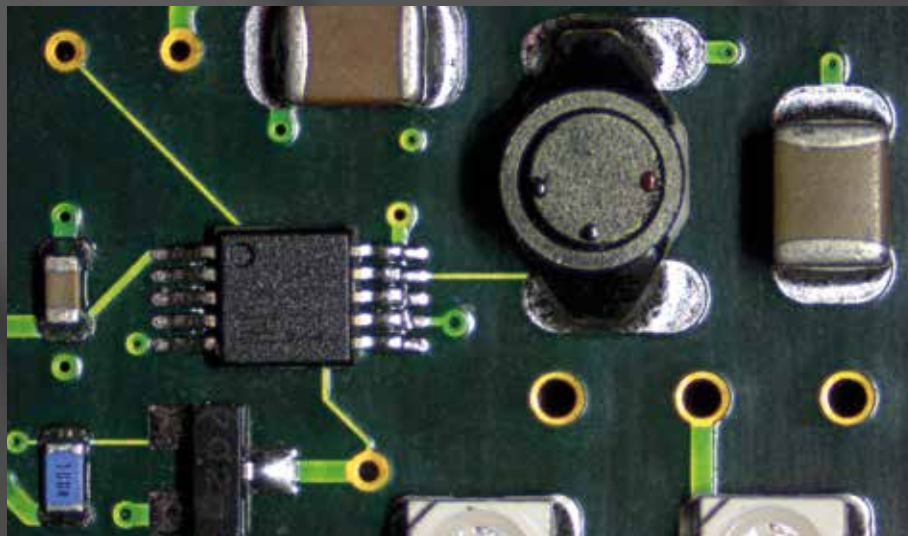
Whether you are analyzing for cleanliness or oils, or detecting non-metallic inclusions, you will find the right system to handle your quality control and quality assurance tasks from the ZEISS portfolio of light, X-ray and electron microscopes.

Page 60



Optical Inspection Systems

See the smallest details
with the highest optical precision.



ZEISS Stemi 305

Compact design, high performance: your stereo microscope with integrated illumination and documentation



Stemi 305 is the compact stereo microscope with 5:1 zoom for production environments. You can observe objects in high contrast and three dimensions without needing to prepare samples. The large working distance leaves you lots of space for assembling, repairing and inspecting your products. Take full advantage of a user-friendly microscope with integrated LED illumination and a wide spectrum of camera and documentation options.

Capture your images with the integrated Wi-Fi camera and document them using Labscope, our iPad imaging app. Or opt for the conventional photo tube to access ZEISS Axiocam cameras and ZEN lite imaging software.

Configured to your requirements

Microscope

Stemi 305

Stemi 305 trino with photo tube (fixed split ratio 50/50)

Stemi 305 cam with integrated Wi-Fi camera

Stands

Stand K, K MAT three-LED stand (ESD-capable), K LAB, K EDU, boom stand A, stand U with tilt arm

Illumination methods

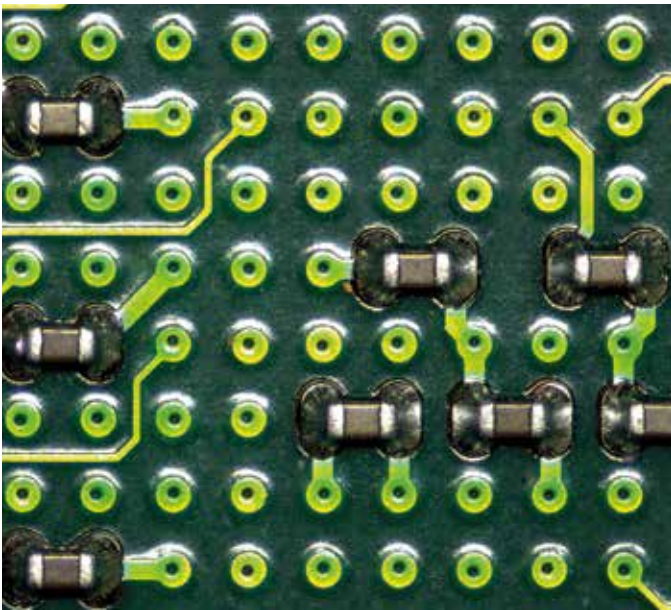
Brightfield, darkfield, oblique illumination and polarization – in reflected light, transmitted light or mixed light

Illumination

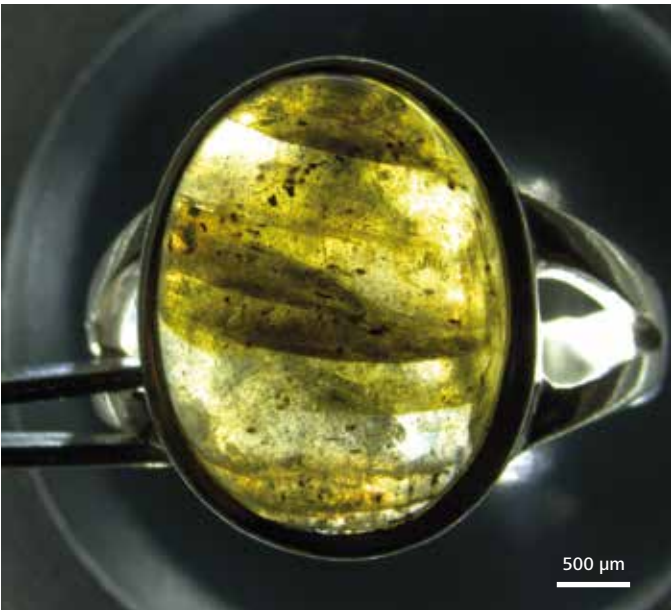
Spot, double spot, segmentable ring light, vertical illumination, flat transmitted light base, transmitted light stand with rotating mirror

Accessories

Eyepieces and interchangeable front lenses, eyepiece reticles, fiber optic cold light sources and light guide, stages, polarization equipment



Printed circuit board, segmentable ring light, quarter-circle illumination



Ring with labradorite, transmitted light darkfield

Simpler. More Intelligent. More Integrated.

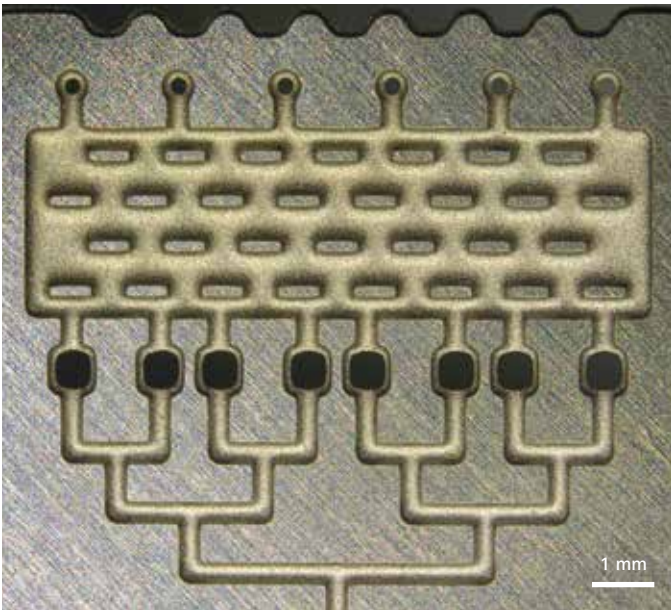
- Stemi 305 is equipped with integrated LED illuminators: combine vertical, oblique or lateral reflected light as well as brightfield and darkfield in transmitted light.
- Even in its basic version, Stemi 305 offers you a working distance of 110 mm and an object field of up to 29 mm.
- By using interchangeable lenses, you can reach all magnifications from 4x to 200x. Double the resolution or object field size and you can achieve working distances of up to 185 mm.
- For large objects or sample chambers, use the tilting-arm stand U. The vertical spotlight integrated in Stemi 305 delivers shadow-free, homogeneous illumination.
- Choose between two documentation options: the conventional photo tube with a 50/50 split ratio or the integrated Wi-Fi camera that transmits your live image wirelessly to Labscope, the iPad imaging app.

Created for your applications

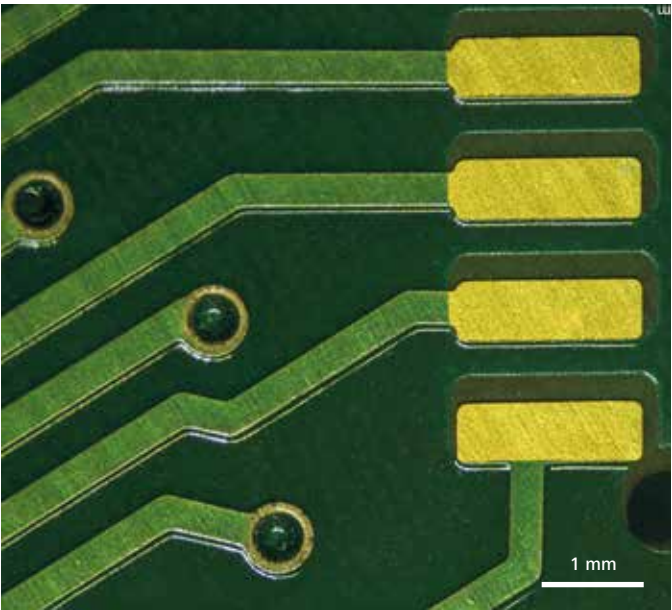
- Assemble micro-optical or micro-mechanical parts to components. Inspect or repair them.
- Inspect PCBs for oxidation, stress corrosion cracking, incorrectly-installed or missing items, or inferior soldering points. In electro-statically-protected areas (EPA), you have the benefit of stand models with ESD functionality.
- Search for and document scratches, corrosion, wear or residues on metallic parts. For this, you will need oblique light from different directions and vertical reflected light to illuminate the interior of bores or threads.
- A dental technician working with all-ceramic crowns can remove casting beads from the structure with great precision.
- Use Stemi 305 to punch, bore and grind delicate jewelry. Engrave the finest contours without tiring.
- A geologist in the oil exploration industry can investigate rock cores. Reconstruct the environmental conditions of earlier times based on micro-fossil findings such as foraminifera or ostracods.

ZEISS Stemi 508

Your apochromatic stereo microscope with 8:1 zoom for outstanding image contrast and color fidelity



Micro-fluid element, zoom: 0.8x



Printed circuit board, segmentable ring light, quarter-circle illumination 1.25x

Stemi 508 is the compact, reliable stereo microscope for industrial inspection. The apochromatic lens offers you razor-sharp images in 3D.

The lenses and mechanics are designed for heavy use. In a 36 mm object field, you can see all of your samples and view fine details with the 8:1 zoom in up to 50x magnification. If you work with particularly large objects, complement your system with interchangeable lenses that give you an object field of up to 122 mm. With its narrow viewing angle of 35°, Stemi 508 is more ergonomic than other Greenough stereo microscopes. Even after hours of work, you can still use your microscope comfortably.

With Stemi 508, you will observe and document your specimens in high contrast and free of distortion and color fringes. Stemi 508 is your robust multi-purpose microscope for daily work in the development laboratory, in manufacturing and in quality control.

Configured to your requirements

Microscope

Stemi 508
Stemi 508 doc with photo tube (100/0 split ratio)

Stands

Compact stand K, LED stands K MAT, K LAB, K EDU, large stand N, boom stand A, SDA dual arm stand SDA, stand U with tilt arm

Illumination methods

Brightfield, darkfield, oblique illumination and polarization – in reflected light, transmitted light or mixed light

Illumination

LED spots, double spots, LED ring lights with segmenting function, LED transmitted light stands, fiber optic cold light sources with spot, ring, linear, vertical, diffusion and surface illumination

Accessories

Eyepieces, eyepiece reticles, interchangeable lenses, stages, polarization equipment

Simpler. More Intelligent. More Integrated.

- Thanks to the effective reduction in scattered light and the precise adjustability of the zoom's mechanics, Stemi 508 provides you with a high-contrast, razor-sharp stereoscopic image.
- With the large 8:1 zoom, you can enjoy continuous magnification or add ten click stops when needed. The object you are viewing is always in focus.
- In addition to the zoom system, the interchangeable front lenses are also corrected apochromatically. You can capture images that are free of color-fringes over the entire accessible magnification range from 2x to 250x.
- Use interchangeable lenses and extend the application range of your Stemi 508: view samples in the maximum object field of 122 mm and achieve a resolution of 450 Lp/mm, or use a working distance of 287 mm.
- Fiber optic cold light sources with optimized light guides provide high brightness and contrast even with difficult objects.
- Use Stemi 508 with the photo tube for documentation. With Axiocam ERc 5s, you can access your HDMI monitor directly, work with the ZEN imaging software at your PC or capture your images with Labscope, the ZEISS iPad imaging app.

Created for your applications

- Center or adjust optical sensors or fiber optic couplings.
- Evaluate printed circuit boards in true color and reap the benefits of fiber optic cold light sources with a high color-rendering index.
- In forensic work, you can examine ammunition parts and match shells to the weapon that fired them.
- Analyze, restore, clean and preserve works of art such as paintings and sculptures. Layer by layer you can analyze and identify materials.
- A watchmaker can work on tiny gears, springs and drives as well as the screws that hold watch faces, spring cores, latches and collars in place.
- Look inside diamonds to evaluate their quality. Identify inclusions, striations and other impurities. Enjoy the benefits of brilliant contrast and freedom from color fringes in your images.
- Work with and inspect electrodes for cardiac pacemakers.
- Analyze mixed script, the surface of coins or the roughness of paper under laterally grazing lighting.

ZEISS SteREO Discovery.V8

Capture brilliant, high contrast, 3D images



With its modular design, SteREO Discovery.V8 offers you superb flexibility. Choose between ergotubes, coaxial illumination, a second observer bridge and intermediate drawing, photo and fluorescence tubes.

Benefit from the strong 3D impression of your objects. The parfocal capability of the SteREO Discovery.V8's 8:1 zoom ensures razor-sharp images over the entire magnification range. Selectable click stops allow reproducible measurement.

The 450 stand is large, robust and particularly vibration-resistant. Enjoy using a sample chamber that provides plenty of space for working with large stages.

Configured to your requirements

Microscope

SteREO Discovery.V8

Illumination methods

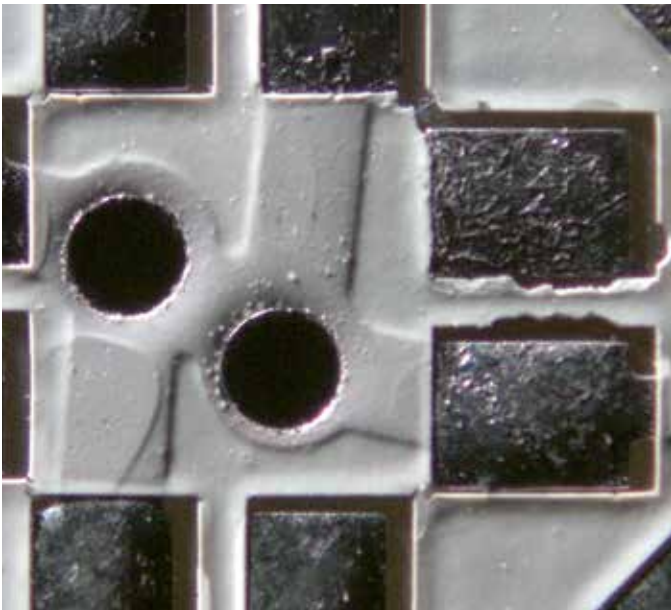
Brightfield, darkfield, oblique light, polarization, fluorescence

Illumination

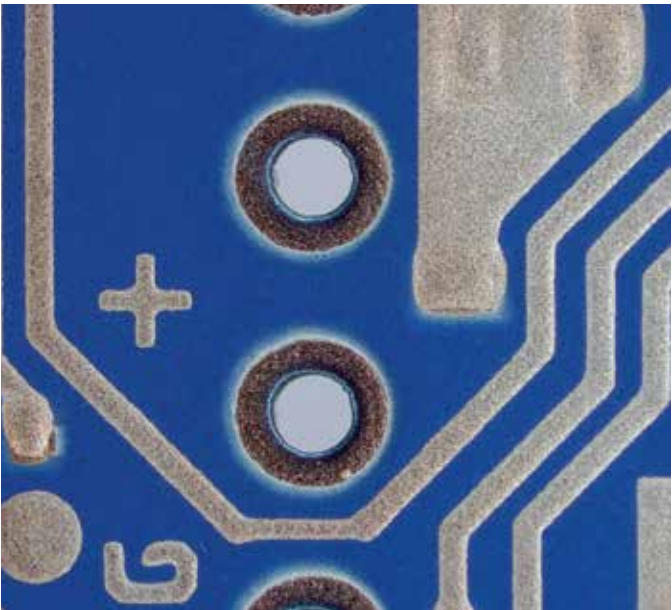
Fiber optic cold light sources with spot, ring, linear, vertical, diffusion, surface and coaxial illumination; LED ring lights with segmenting function; fiber optic and LED transmitted light units

Accessories

Eyeieces, eyepiece reticles, interchangeable lenses, stages, polarization equipment, binocular and trinocular tubes, stage stands and boom stands



SMD circuit board and white solder resist. Linear light for lateral highlighting, Objective: Plan S 1.0x; magnification: 15x



Printed circuit board, fiber optic split-ring illuminator, objective: PlanApo S 1.5x; magnification: 16x

Simpler. More Intelligent. More Integrated.

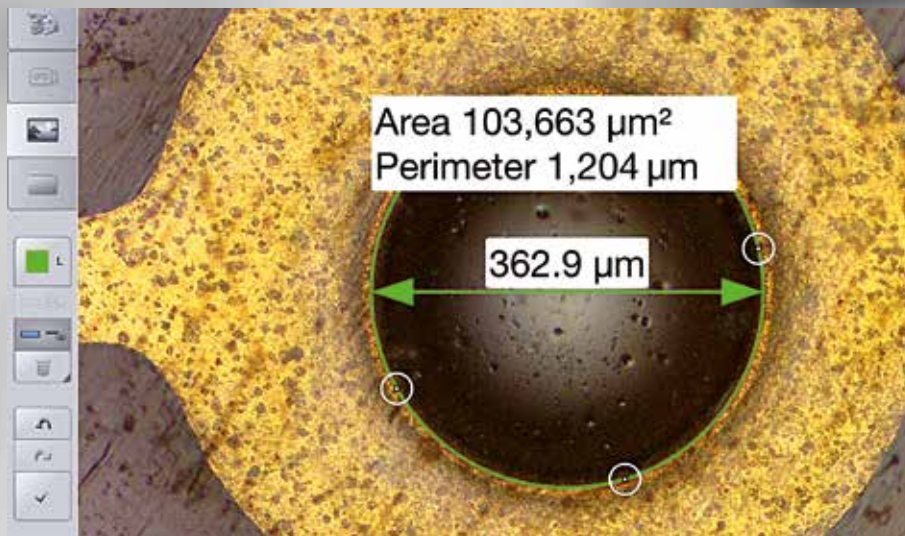
- VisiLED ring lights with segmenting function let you switch from ring light to lateral oblique light at the touch of a button. Rotate the oblique light around your object and twist the light for a spatial impression of the object in your live image.
- The fiber optic cold light sources CL6000 LED and CL9000 LED provide intense cold light along with homogeneous illumination of the object field. Thanks to the long service life of LEDs, changing bulbs is a thing of the past. With the broad range of light guides and accessories, you can highlight your object structures clearly.
- Use different photo tubes for your own digital photo and video cameras or the high-resolution Axiocam microscope cameras from ZEISS.
- You can move your objective under the right stereo channel using the S/doc objective slider or objective turret. This gives you images without parallax error for vertical viewing and acquiring z-stacks.

Created for your applications

- Analyze solder points, particles and artifacts on printed circuit boards.
- Capture valuable forensic evidence by analyzing ammunition parts, tool marks, documents, fibers, coatings, glass, textiles and hair.
- Ensure the quality of medical equipment by producing high-contrast images that show the smallest irregularities on and beneath the surface of catheters and scalpel blades.
- Inspect the surface quality of polished coins with coaxial reflected light and the variable highlighting of the segmentable VisiLED ring lights for darkfield applications.

Digital Image Acquisition and Documentation

Document your results



ZEISS Primotech

Your clever imaging solution: wirelessly controlled and easy to use



Primotech is the smart imaging solution with an attractive price-performance ratio. Control multiple microscopes wirelessly using Matscope, the imaging app from ZEISS. Experience an efficient and smooth workflow, from image acquisition and analysis to report creation, and benefit from rapid results. A choice of stands lets you select the optimal microscope for a wide variety of routine tasks and applications. Primotech combines reflected and transmitted light in a single stand. This flexibility offers big benefits, whether deploying it in the mechanical engineering, automotive and electronics industries, or using it for PCB inspection and powder analysis.

Configured to your requirements

Microscope

- Primotech (reflected light and basic transmitted light)
- Primotech D/A (reflected and transmitted light)
- Primotech D/A POL (reflected and transmitted light, polarization)
- Primotech D/POL (transmitted light, orthoscopy and conoscopy)

Contrasting techniques

Brightfield, oblique light, polarization (orthoscopy and conoscopy)

Illumination

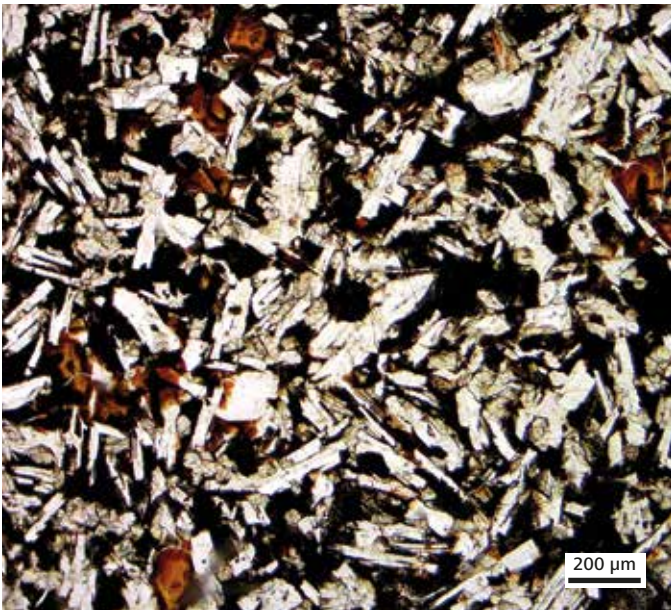
LED 3W 5000 K (brightness equivalent to 50 W halogen illumination) in reflected and transmitted light

Accessories

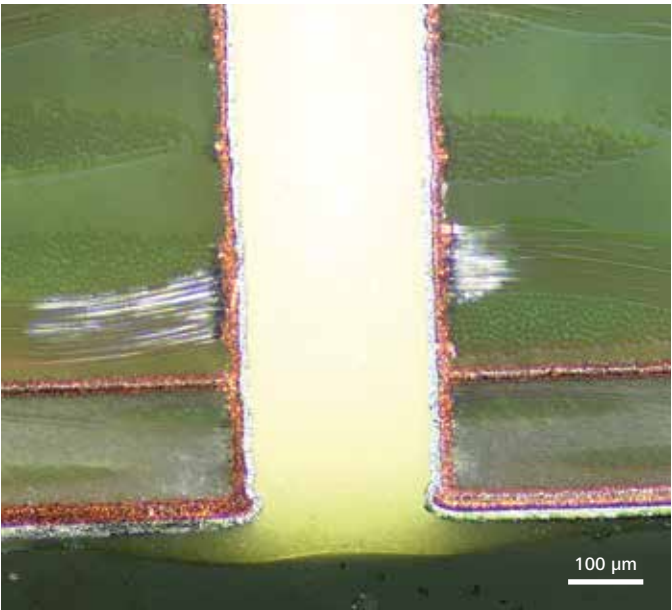
- Polarization: polarizer, analyzer, compensator, object guidance
- Starter kit: leveling press with modeling clay, transport case
- Digital camera tubes: option of three or five megapixels

Software

Matscope



Basalt, brightfield, objective: Epiplan 10×/0.25



Examination of a PCB after galvanizing and solder absorption, polarization, objective: A-Plan 5×/0.12 POL

Simpler. More Intelligent. More Integrated.

- With Primotech, you will get reproducible results quickly. The 5× objective turret is coded and changes in magnification are automatically recorded. This saves you time while minimizing sources of error.
- With Primotech, you can take advantage of the microscope camera integrated into the tube and its numerous interfaces. The camera is always perfectly aligned and protected from contaminants.
- Use the Matscope imaging app to network several microscopes and share images and videos via a Wi-Fi connection. Central control via Matscope leaves you free to move around the room.
- Matscope lets you make measurements in no time at all.
- Metadata are automatically stored and managed together with your images.

Created for your applications

- Investigate samples with a thickness of up to 34 mm. For transparent or opaque surfaces, take advantage of the simultaneous reflected and transmitted light.
- With Primotech D/A, visualize minute depressions and holes with the simultaneous reflected and transmitted light. It comes equipped with an ESD stage that prevents electrostatic discharge of the stand.
- Primotech D/A POL is equipped with a centerable rotary polarization stage. Use this to investigate birefringent structures with brightfield and crossed polars in reflected or transmitted light.
- With Primotech D POL, you can switch from orthoscopic to conoscopic observation.

ZEISS Axio Lab.A1

Your universal solution for materials analysis



Axio Lab.A1 is simply unbeatable when it comes to both performance and optics. Take advantage of its excellent ergonomics, ease of use and outstanding image quality for your applications.

Axio Lab.A1 is small and flexible yet the microscope is extremely robust so you can use it anywhere. All important controls are arranged ergonomically and easy to get to.

The polarization stand lets you capture anisotropic structures such as crystals and fibers.

Configured to your requirements

Microscope

Axio Lab.A1 (integrated reflected light illumination)

Axio Lab.A1 (integrated transmitted light illumination for orthoscopy)

Axio Lab.A1 (integrated transmitted light illumination for conoscopy)

Contrasting techniques

Reflected light: brightfield, darkfield, C-DIC, polarization

Transmitted light: (orthoscopy) linear and circular polarized light;

(conoscopy) brightfield, darkfield, phase contrast

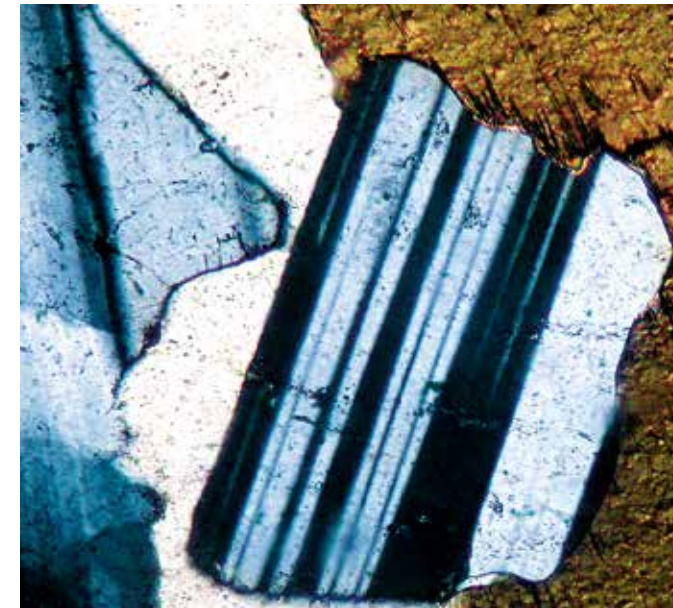
Illumination

Reflected light: 12 V/50 W HAL, optional: LED

Transmitted light: 12 V/35 W HAL, optional: LED

Accessories

XY stage, rotary polarization stage, measuring compensators, photo tubes, ergo photo tube



Plagioclase (feldspar), twin lamination in polarization contrast

Courtesy of: Dr. M. Magnus, Institute for Geology and Paleontology, Freiberg University of Mining and Technology



Steel structure, darkfield, objective: EC-EPIPLAN 20x/0.4

Simpler. More Intelligent. More Integrated.

- With five objective positions, Axio Lab.A1 has enough space for your most important objectives. This gives you quick sample throughput and enhances user-friendliness. When selecting an objective, you can choose between brightfield, bright- and darkfield, and DIC or POL.
- With the 4x reflector turret, you can switch easily between the various contrasting techniques.
- The C-DIC contrast technique translates tiny changes in surface morphology into differences in brightness so that you get excellent image results, even when working with low contrast samples.
- Axio Lab.A1 for conoscopy is particularly easy to operate: the analyzer and Bertrand lens are integrated into the device and coupled to each other in a logical way. Swinging the Bertrand lens into the beam path creates a mechanically-logical coupling that ensures the analyzer also swings into the operating position.
- Store your tools and cable in a flap on the back of Axio Lab.A1.

Created for your applications

- Axio Lab.A1 is the compact microscope for structural examination: use it for determining grain size, structure, distribution and phases, and for quick on-site analyses.
- Analyze the microstructure of metals and acquire information on mechanisms that will lead to material defects such as fatigue, corrosion, creep deformation, stress cracks and fractures.
- Polarization contrast lets you characterize hair, soil samples and fibers for forensic investigations. Analyze paint chips using brightfield, fluorescence and polarization microscopy.
- If you work as a geologist, you can examine rock section and mineral samples – for instance, in oil production.
- In environmental protection, you can identify different types of asbestos fibers.

Digital Image Acquisition and Documentation

ZEISS Axio Scope.A1

Your modular, multi-purpose stand



The manual Axio Scope.A1 microscope is based on a modular concept. Adapt its system to your needs with the aid of five upper sections, three lower sections and two Vario columns. Take your choice of transmitted light or reflected light – or use both.

Axio Scope.A1 is particularly economical. Purchase only the components that you need now. Should your applications change or expand, simply upgrade the system. You can choose from among an extensive range of accessories.

Configured to your requirements

Microscope

Axio Scope.A1

Contrasting techniques

Reflected light: brightfield, darkfield, DIC, C-DIC, polarization, fluorescence

Transmitted light: brightfield, darkfield, DIC, PlasDIC, polarization, fluorescence

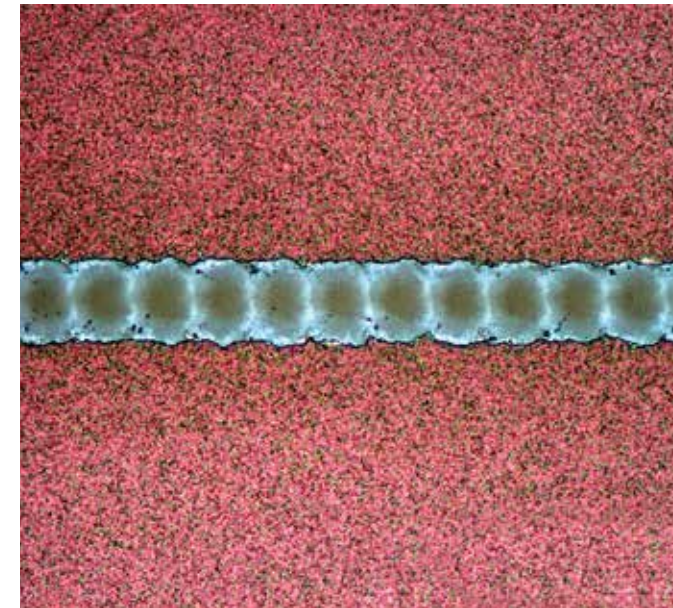
Illumination

Reflected light: 12 V/50 W HAL, 12 V/100 W HAL, 100 W HBO, 75 W XBO, LED

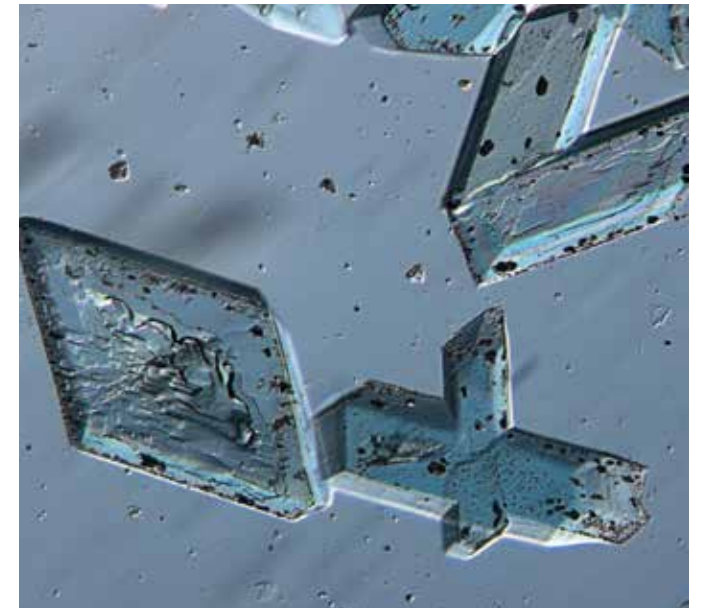
Transmitted light: 12 V/50 W HAL, 12 V/100 W HAL, LED

Accessories

Reflector inserts, spacers, XY stage, ergotubes



Thin-layer solar cells, reflected light, polarization contrast, objective: EC Epiplan-NEOFLUAR 50×/0.80



Copper sulfate crystals, transmitted light, PlasDIC, objective: A-Plan 10×/0.25

Simpler. More Intelligent. More Integrated.

- Examine large samples in one piece, non-destructively: you can use the spacers to vary the size of the sample space. Axio Scope.A1 can handle samples up to 110 mm thick. Using the Vario column, even thicknesses of up to 380 mm are possible.
- With 23 stage configurations and multiple interfaces, you can adapt the microscope to your requirements so that you are always well prepared for challenges.
- The special design of the column meets even the most stringent stability requirements. The metal baseplate ensures low-vibration operation at all times.

Created for your applications

- Investigate the structures of larger components as well as the size, structures, phases and distribution of grains.
- Measure layer thickness and the uniform application of paints.
- Evaluate surface quality and detect inclusions and dirt particles.

ZEISS Axio Vert.A1

Structural analyses: a matter of contrast



Axio Vert.A1 is a compact, inverted microscope that affords you brilliant insights. Investigate large and heavy components with all the usual contrast techniques. Switch easily between brightfield, darkfield, DIC, C-DIC, fluorescent and polarized contrast for reflected light. For transmitted light, use brightfield, polarized light and phase contrast. Simply select the best technique – without ever compromising. You can also combine several contrast types and gain additional insights. The coded 5x objective turret automatically detects an objective change. With the help of the light manager, you can adjust the illumination intensity. Quantify structures efficiently and evaluate the properties and quality of your materials. By understanding your material and optimizing the preparation and production process, you will take the right measures.

Configured to your requirements

Microscope

Axio Vert.A1 (coded)

Contrasting techniques

Reflected light: brightfield, darkfield, DIC, C-DIC, polarization, fluorescence

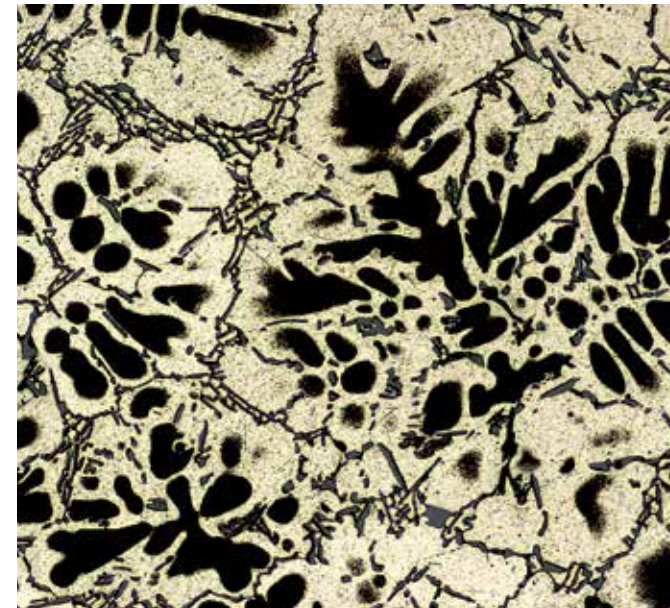
Transmitted light: brightfield, polarization, phase contrast

Illumination

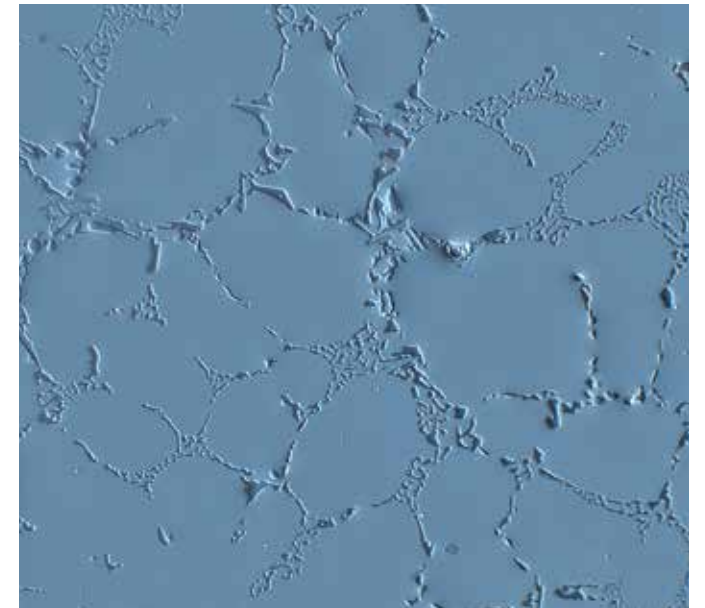
50W HAL, 100W HAL, VisLED

Accessories

Crosshairs for use in measurement, ergotubes, ergo photo tubes, sliding and motorized stages



Aluminum alloy, brightfield, magnification: 100×



Cast aluminum, C-DIC, magnification: 500×; Courtesy of: Allied High Tech Products Inc.

Simpler. More Intelligent. More Integrated.

- Thanks to the 5x objective turret on the Axio Vert.A1, the right magnification is quickly accessible. The turret is coded in such a way that Axio Vert.A1 automatically recognizes your objective.
- The 4x reflector turret lets you switch quickly between the various contrasting techniques.
- With the measuring reticles, you are optimally equipped for taking overview measurements. ZEISS imaging software offers you a powerful range of modules that can be used to analyze grain size, phases and layer thickness, and to make interactive measurements for your investigations.

Created for your applications

- Analyze the microstructure of etched surfaces. By recognizing grain boundaries, you can draw conclusions on grain sizes, phases and structural constituents. Recognize dyes and pigments as well as impurities and structural components – graphite, for example, becomes visible in cast iron prior to etching.
- Mechanical surface defects, cracks, pores and inclusions appear with the same clarity as fissures, scratches and cavities. You can assess the surface quality of machined workpieces with precision.
- Investigate the structure of anisotropic materials such as magnesium, aluminum, bronze and brass. Under polarized light, the colors of the individual grains within the crystal lattice become visible.

ZEISS Axiocam – Microscope Cameras

Documentation that is accurate in every detail is an important part of your daily analysis work.

Document precisely what you see. Quickly, reproducibly and with high quality images. Digital microscope cameras from ZEISS are the perfect tools for handling your images and documentation.

	CMOS	CMOS	CCD	CCD
Microscope camera	Axiocam ERc 5s	Axiocam 105 color	Axiocam ICc 1	Axiocam ICc 5
				
Specification				
Active pixels	5 megapixels	5 megapixels	1.4 megapixels	5 megapixels
Number of pixels (H × V)	2,560 × 1,920	2,560 × 1,920	1,388 × 1,038	2,452 × 2,056
Pixel size	2.2 µm	2.2 µm	4.65 µm	3.45 µm
Sensor format	1/2.5"	1/2.5"	1/2"	2/3"
Sensor diagonal lengths	7 mm	7 mm	8 mm	11 mm
Maximum frame rate at resolution (with ZEN Imaging Software)	20 fps at 800 × 600	15 fps at 2,560 × 1,920	16 fps at 1,388 × 1,038	15 fps at 1,920 × 1,080
PC interface	2× USB 2.0	USB 3.0	FireWire b	FireWire b
Special features	Network access via iPad, HDMI connection, standalone operation, storage on SD card			
Recommended for:				
Documentation	●●●●	●●●●	●●	●●●●
Education	●●●●	●●●	●●	●●
Daily work	●●●●	●●●●	●●●●	●●●●
Quality control	●●●	●●●	●●	●●●
Scientific research	●●	●●	●●	●●

- Less suitable
- Particularly suitable

	CCD	CCD	CCD	CCD
Microscope camera	Axiocam MRc	Axiocam MRc5	Axiocam 503 color	Axiocam 506 color
				
Specification				
Active pixels	1.4 megapixels	5 megapixels	2.8 megapixels	6 megapixels
Number of pixels (H × V)	1,388 × 1,040	2,584 × 1,936	1,936 × 1,460	2,752 × 2,208
Pixel size	6.45 µm	3.4 µm	4.54 µm	4.54 µm
Sensor format	2/3"	2/3"	2/3"	1"
Sensor diagonal lengths	11 mm	11 mm	11 mm	16 mm
Maximum frame rate at resolution (with ZEN Imaging Software)	14 fps at 1,388 × 1,040	4 fps at 1,292 × 9,68	38 fps at 1,936 × 1,460	19 fps at 2,752 × 2,208
PC interface	FireWire a	FireWire a	USB 3.0	USB 3.0
Special features	Active sensor cooling for low noise	Active sensor cooling for low noise	Active sensor cooling for low noise	Active sensor cooling for low noise
Recommended for:				
Documentation	●●	●●●●	●●●	●●●●
Education	●●	●	●	●
Daily work	●●●	●●●	●●	●●
Quality control	●●●●	●●●	●●●●	●●●●
Scientific research	●●●	●●●	●●●●	●●●●

- Less suitable
- Particularly suitable

ZEISS ZEN 2 core

Imaging software made easy



ZEN 2 core combines maximum flexibility with minimum complexity in a single software program. Optimized for your everyday application, ZEN 2 core offers efficient and streamlined workflows that yield reproducible results. When you want to get the highest technical performance out of your microscope, ZEN 2 core gives you the flexibility to optimize all the necessary parameters and functions. When you create task-specific workflows, only those controls that are necessary to the task appear on the screen. Report writing is a very simple process with MS Word® templates, whether they are predefined or created by you. You can adapt user settings to allow individual users access to only those specific settings that they need for their work.

Configured to your requirements

Packages
ZEN 2 core
ZEN 2 starter. Free download at:
www.zeiss.com/zen2starter



All functions are clearly laid out.

Simpler. More Intelligent. More Integrated.

- The user interface is optimized for use in industrial production environments.
- Short familiarization times let you train individual users quickly. User management lets you adapt the software to different users and their level of know-how.
- With ZEN 2 core, you put the emphasis on efficient workflows so you get quick, reliable results that are reproducible at any time.
- Create job templates to ensure efficient work processes.
- You can connect ZEN 2 core to other software platforms.



The archive provides you with an overview of your work.

Created for your applications

The free version ZEN 2 starter offers (selected features):

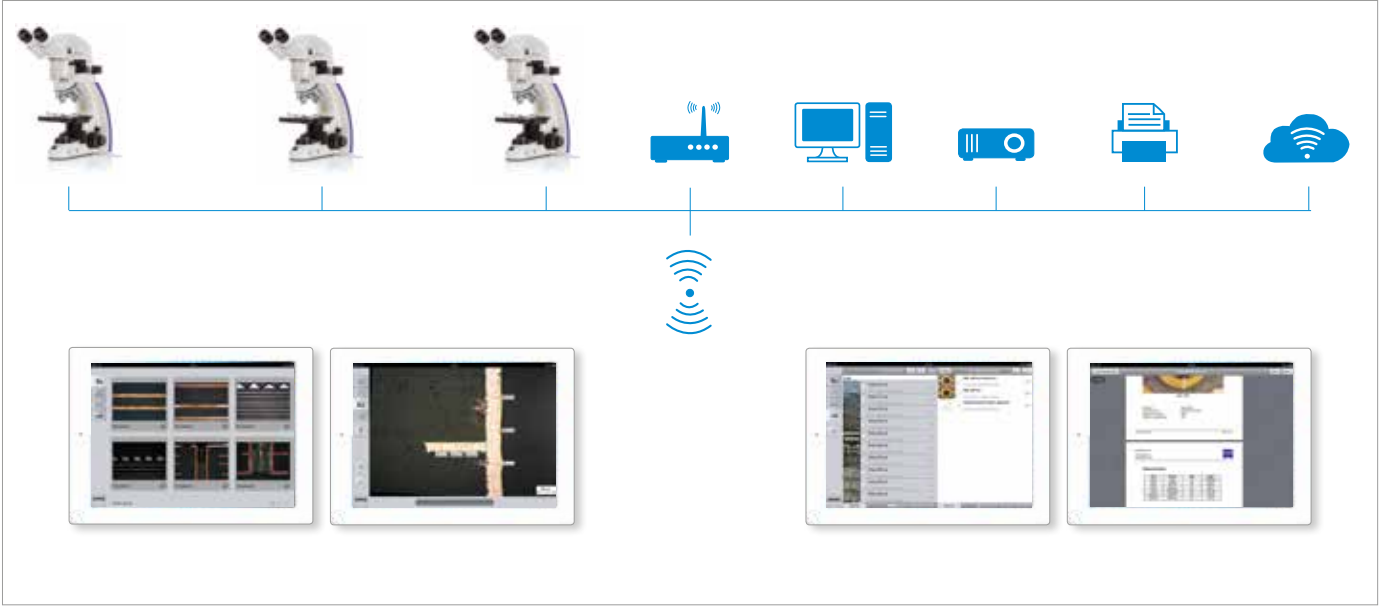
- Simple image acquisition
- Manual extended depth of focus
- Panoramic image acquisition
- Simple image post-processing and measuring functions
- MS Word® report function
- Archive function

ZEN 2 core additionally offers (selected features):

- Automatic tile image acquisition and expanded depth of focus
- Creation of job templates
- User management
- Expanded measurement tasks
- Autofocus
- Integration of heating stages
- Scripting language (Python programming interface).

ZEISS Matscope

Your access into the digital world



ZEISS Matscope imaging app

Matscope, the ZEISS imaging app for iPad, has all the functions you need to perform measurements. Yet it is as easy to use as a smartphone. With this software, you get both reliability and functionality in one package.

Matscope can be integrated into your network seamlessly, regardless of whether you have a Windows, Mac or Linux environment. You can share files with any computer. Download Matscope free in the App Store and test it using the virtual microscope.

Configured to your requirements

Microscope/Camera

Primotech
Stemi 305 cam
Axiocam ERc 5s

Packages

Matscope imaging app (basic functions); free download at: www.zeiss.com/matscope

Primotech basic functions: free functions and an additional selection of magnifications, expanded depth of field and 2D measurement

Advanced Primotech functions: basic functions plus application-specific functions for measuring PCB layer thickness, particles/porosity and grain size, as well as for multiphase analysis

Simpler. More Intelligent. More Integrated.

- View the live image in real time and switch easily back and forth between the microscopes in your network.
- Perform quick checks of the live image by adding a scaled grating or crosshair raster.
- Annotate, measure and edit your images using a wide range of tools.
- Create images in high resolution with shading correction and improved depth of field, then store the scale and other metadata automatically.
- Share images and customizable reports including tables and diagrams via a common network folder or by email.
- Compare images side by side and store them in a variety of formats – CZI, TIF or JPG.

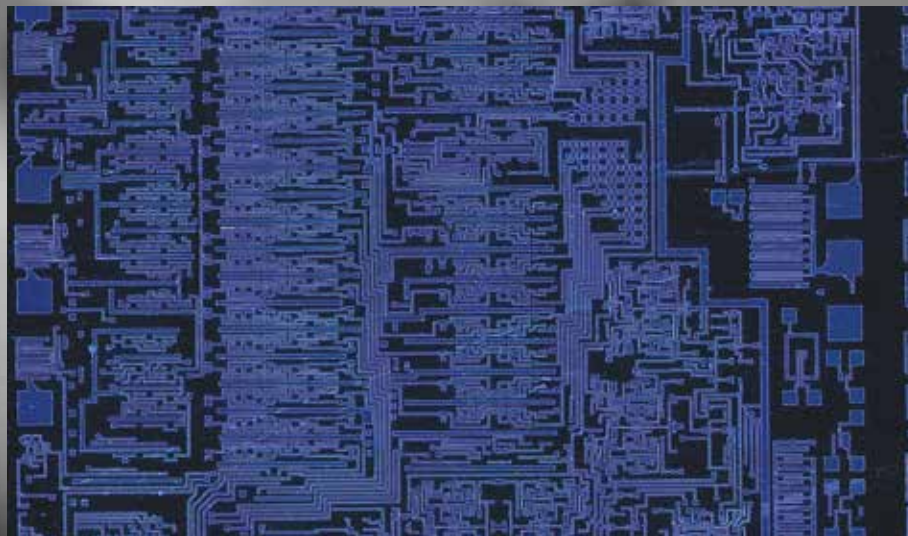
Created for your applications

- Document and measure microscopic details as part of quality control or failure analysis.
- You can share results as soon as you have captured the images and performed the measurements.
- Use the PCB measuring function to determine the minimum thickness and maximum standard deviation of copper layers in cross sections.
- Analyze the size and shape of powder particles or characterize microscopic pores using the particle/porosity measuring function.
- Determine the average grain size of steel and other metals in accordance with ASTM E112, ISO 643, or GB/T 6394-2002.

Please note: Some of these functions are only available in combination with ZEISS Primotech.

Automated Imaging Systems

Microscopic analyses give you precise, reproducible results.



ZEISS Smartzoom 5

Smart Design. Smart Workflow. Smart Output.



With its closed housing and integrated components, Smartzoom 5 is made for industrial environments. Zoom, coaxial illumination, microscope camera and overview camera are combined in a single unit. You can set up your system in just a few minutes – no tools required. The workflow-oriented software was conceived to allow it to operate with minimum familiarization time and rapid results. All steps are automatically stored in the form of an inspection plan.

Smartzoom 5 saves you valuable time. When working with structurally-identical workpieces, simply create an inspection plan for the first specimen, then it will guide your inspection of the others semi-automatically.

Get an overview in an object field of up to 40 mm in size and view details of your sample on the screen using the continuous, motorized 10× zoom. You have the resolution to view structures down to 1 µm.

Configured to your requirements

Microscope

Smartzoom 5: a motorized stand with coded swivel arm, motorized stage, optical unit (with 10× zoom, coaxial illumination, microscope camera and overview camera), up to three objectives with integrated ring illumination, operating unit and an all-in-one PC including application software

Contrasting techniques

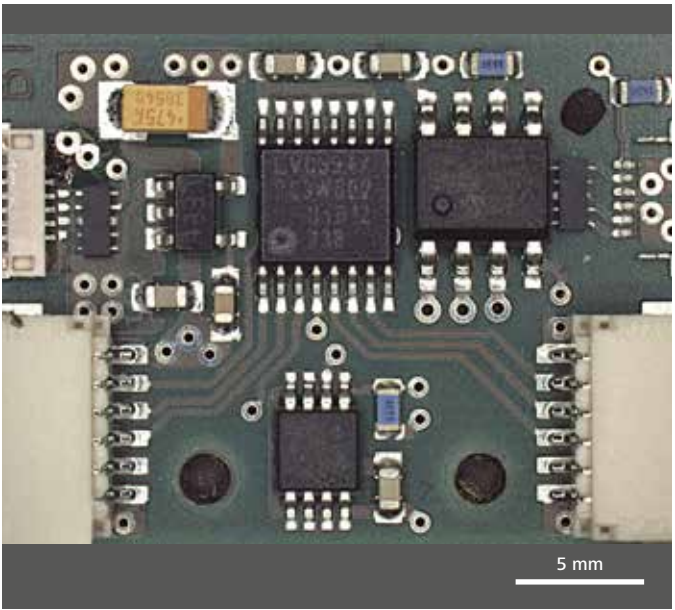
Coaxial brightfield, segmentable ring light, ring light

Illumination

Reflected light: coaxial LED illumination, ring light, LED illumination, mixed light

Accessories

Tablet PC, transport case



Inspection of a circuit board
Objective: 0.5×, LED ring illumination



Laser welds
Objective: 1.6×, expanded depth of field, LED ring illumination

Simpler. More Intelligent. More Integrated.

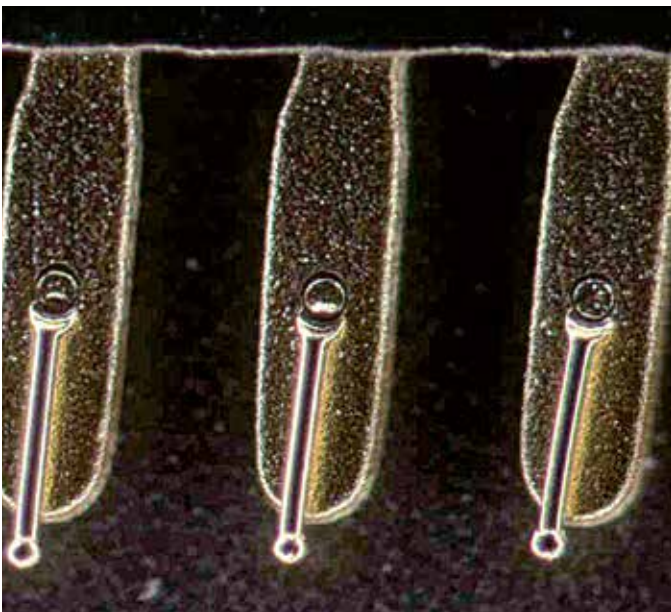
- Three objectives combined with 10× zoom mean you will always have the correct magnification on hand for your application.
- Use the overview camera to keep track of your samples.
- The fully motorized system relocates your workspace away from the microscope to the PC, where you can control all workflows.
- The factory-calibrated components and workflow-oriented software allow user-independent performance of analyses.
- A transport case and tablet PC facilitate mobile use of the system.

Created for your applications

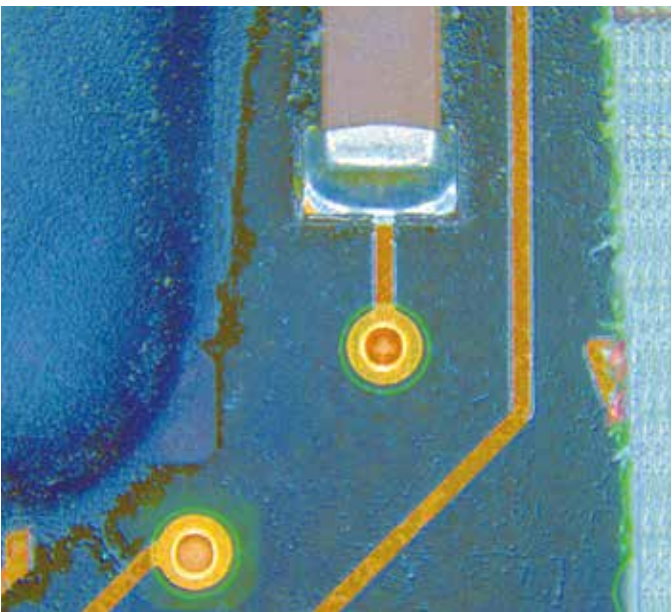
- Perform reliable and reproducible analyses on samples of the same type.
- Inspect solder points on PCBs. Check plastic components for defects or machined metallic parts for dimensional accuracy.
- Smartzoom 5 gives you the capability to perform difficult inspection tasks quickly and reliably.

ZEISS SteREO Discovery.V12 and SteREO Discovery.V20

Brilliant images in 3D



Semiconductor element, darkfield reflected light, objective: PlanApo S 1.5×, magnification: 125×



Semiconductor, darkfield reflected light, objective: PlanApo S 1×, magnification: 7.5×

Both SteREO Discovery.V12 and SteREO Discovery.V20 give you the benefits of motorized microscopes that suit a variety of applications. With an extensive range of accessories, they can be optimally equipped to meet your individual requirements. Choose between ergotubes, a second observer bridge and intermediate photo and fluorescence tubes. The large working distance leaves you plenty of space for handling your samples.

SteREO Discovery.V20 comes with a 20× zoom that gives you greater flexibility so you can switch from overviews to brilliant, high-contrast 3D images of the smallest details.

Configured to your requirements

Microscope

SteREO Discovery.V12 (motorized zoom)

SteREO Discovery.V20 (motorized zoom)

Illumination methods

Brightfield, darkfield, oblique light, polarization, fluorescence

Illumination

Fiber optic cold light sources with spot, ring, linear, vertical, diffusion, surface and coaxial illumination. LED ring lights with segmenting function, fiber optic and LED transmitted light units

Accessories

Eyepieces, eyepiece reticles, interchangeable lenses, stages, polarization equipment, binocular and trinocular tubes, stands for stages, boom stands

Simpler. More Intelligent. More Integrated.

- Both SteREO Discovery.V12 and SteREO Discovery.V20 work with an electronically-generated zoom curve that lets you take precise control of freely-selectable magnification positions. That gives you the advantage of reproducing your image scale with an accuracy of more than 99 %.
- With SteREO Discovery.V20, the large zoom range of the microscope body achieves high magnification with smaller objectives. Because of the narrower stereo angle, the spatial impression of the microscopic image lets you see even the smallest details much more quickly.
- Both models come with a wide range of modules and accessories so you are always free to extend you system later as your needs change – right up to the most powerful imaging system that stereo microscopy has to offer.
- Use the SyCoP control panel to handle all the most important functions of the microscope without ever looking away from the eyepiece. Quickly, precisely and reproducibly

Created for your applications

- Analyze solder points, particles and artifacts on printed circuit boards.
- Capture valuable forensic evidence by analyzing ammunition parts, tool marks, documents, fibers, coatings, glass, textiles and hair.
- Working in the pharmaceutical industry, you can test therapeutic products and analyze their composition and quality.

ZEISS Axio Zoom.V16

High resolution and high speed: your zoom microscope for large object fields



Axio Zoom.V16 is the high resolution, apochromatically corrected on-axis zoom microscope from ZEISS. With a magnification range of 16:1, you can zoom from a large overview (33 mm) down to the smallest detail (0.7 μm).

Use Axio Zoom.V16 to achieve a maximum resolution of up to 0.3 μm in a 1.6 mm field. This is a particularly advantageous for automated etching of large tile images. It reduces image acquisition times and thus significantly speeds up your analysis tasks.

Configured to your requirements

Microscope

Axio Zoom.V16 (manual focus)

Axio Zoom.V16 (focus motor)

Illumination methods

Transmitted light: brightfield, darkfield, oblique light

Reflected light: brightfield, darkfield, oblique light, fluorescence

Illumination

Cold light sources CL 1500 Eco, CL 6000 LED, CL 9000 LED CAN with fiber optic spot; ring, linear, vertical, diffusion, surface and coaxial illuminators; VisiLED ring illuminators with segmenting function, fiber optic and LED transmitted light units

Accessories

Eyepieces, eyepiece reticles, interchangeable lenses, stages, polarization equipment, binocular and trinocular tubes, stands for stages, boom stands



Spark plug: inspection of functional ceramic parts; analysis of different types of material structure such as pore formation in ceramics for insulators, conductive composite materials, and steel and copper pins



Carbon brush: extensive views of structural homogeneity; distribution of conductive phases such as Cu particles and hard phases; visualization of manufacturing effects

Simpler. More Intelligent. More Integrated.

- Axio Zoom.V16 combines a 16 $\times$ zoom with a 0.25 numerical aperture. This gives you up to 2.5 times higher resolution as compared to CMO stereo microscopes in comparable fields.
- The eZoom principle of your Axio Zoom.V16 combines the zoom drive with an electronically-controlled iris diaphragm. Select your zoom mode at the touch of a button: the overview provides maximum resolution at higher magnifications and with greater depth of field.
- The EpiRel contrast makes even minor differences in height visible in brightfield: you can illuminate your sample from a slight lateral angle, even for coaxial reflected light. This creates shadows on the sides of the structures which lend your object considerably more plasticity than in conventional brightfield.

Created for your applications

- Analyze the structural elements of your components such as phases, grain size, textures and excretions – also structural defects such as inclusions, pores, cavities, cracks and inhomogeneities.
- Create overview images of entire components and zoom in on the smallest details without changing the objective.
- Capture the morphology and inner structure of wafers.

ZEISS Axio Imager 2

Your open microscope system for automated materials analysis



Take advantage of the full flexibility of your microscope platform when performing material research and quality control tasks. Choose a microscope that you can adapt to your growing requirements. You can apply all the usual contrast techniques for reflected and transmitted light. With C-DIC you contrast different surface structures. Get precise and reproducible results: the contrast and light manager stores your hardware and software settings, thus ensuring you keep replicable settings and image capture conditions.

Configured to your requirements

Microscope

- Axio Imager.A2m (manual, coded)
- Axio Imager.D2m (manual, partly motorized: reflector turret)
- Axio Imager.M2m (motorized, transmitted light, manual)
- Axio Imager.Z2m (motorized)

Illumination methods

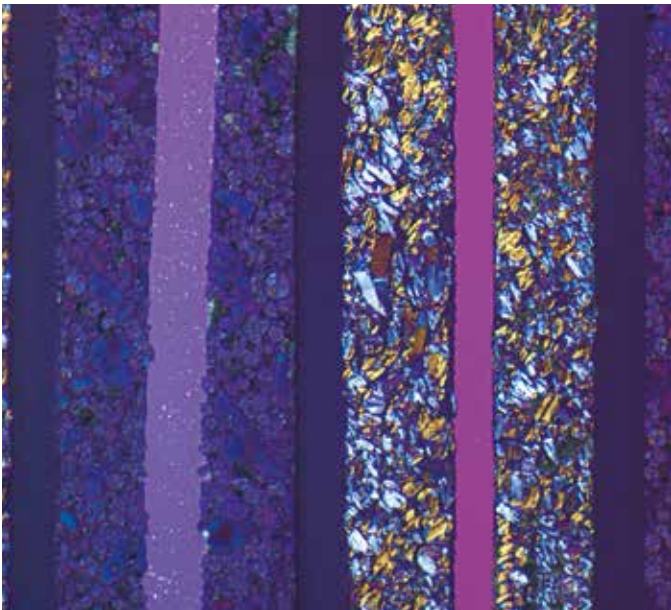
- Reflected light: brightfield, darkfield, DIC, C-DIC, polarization, fluorescence
- Transmitted light: brightfield, darkfield, DIC, PlasDIC, polarization, phase contrast

Illumination

- Reflected light: LED, halogen, HBO, XBO
- Transmitted light: LED, halogen

Accessories

- 6× or 10× reflector turret, automatic component recognition (ACR), contrast manager, light manager, Autofocus, manual and motorized stages, heating stages



Lithium-ion battery, polarization contrast
Courtesy of: the Materials Research Institute at Aalen University



Biotite in granite; pleochroism made visible by rotating the stage; brightfield

Simpler. More Intelligent. More Integrated.

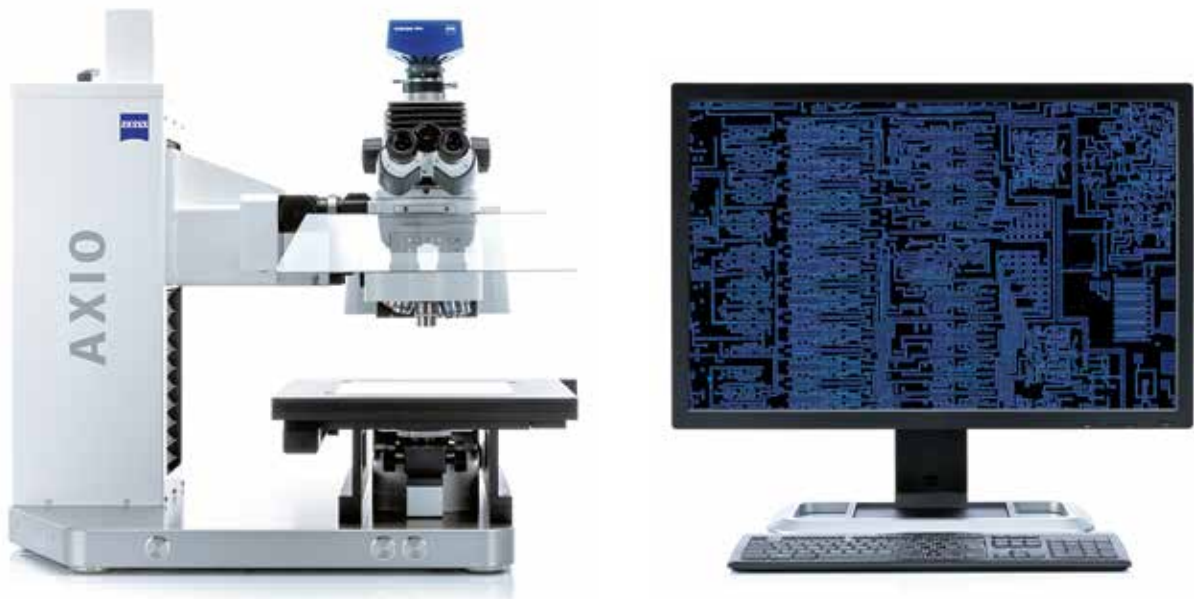
- Axio Imager 2 gives you quick results and reproducible analyses. The light and contrast managers ensure correct automatic setting of all parameters and components – even when you change magnification.
- For examining the surface of reflective, low contrast specimens, you can equip Axio Imager 2 with the fast and efficient Autofocus system.
- Use C-DIC to make sample structures that formerly could be seen only in a certain direction; they are now visible in their entirety, regardless of their orientation and without rotating the sample.
- The Shuttle & Find software module makes Axio Imager 2 the foundation for correlative microscopy work. This enables you to complement your light microscope structure analyses with material analyses from your electron microscope.
- Combined with the laser scanning microscope LSM 700, you can complement classic light microscope contrast techniques with the possibilities that come with fluorescence microscopy while achieving high resolution topography.

Created for your applications

- Examine the surface of solar cells for homogeneity and micro-cracks.
- Use the Autofocus system to capture particles, scratches and defects on wafers.
- Examine hard magnetic phases and draw conclusions as to the magnetic properties of your materials using polarization contrast.
- Use the Particle Analyzer to examine the morphology and distribution of particles on the basis of color, brightness, shape and orientation.
- In forensic work, you can use polarization contrast to examine hair, dirt and fibers. Analyze paint residues using brightfield, fluorescence and polarization.
- As a geologist searching for new deposits, you can use polarization to analyze thin sections.
- Working in environmental protection, you can identify a variety of asbestos fibers.

ZEISS Axio Imager Vario

Examine large specimens with automated processes – compatible with clean rooms.



Examine tiny MEMS sensors, XXL wafers and everything in between. With a maximum specimen size of 300×300 mm and an impressive maximum specimen thickness of 254 mm, this is the non-destructive way to analyze large specimens. The column design ensures stability.

Examine wafers in your clean room: Axio Imager Vario is DIN EN ISO 14644-1-certified and meets the requirements of clean room class ISO 5. With the motorized Z-axis drive and the Autofocus system, you can bring low contrast, reflective specimens into perfect focus. This produces optimum results every time.

Configured to your requirements

Microscope

Axio Imager.A2 Vario (manual, coded)
Axio Imager.Z2 Vario (capable of being fully motorized)
Axio Imager.Z2 Vario (without turret focus)

Illumination methods

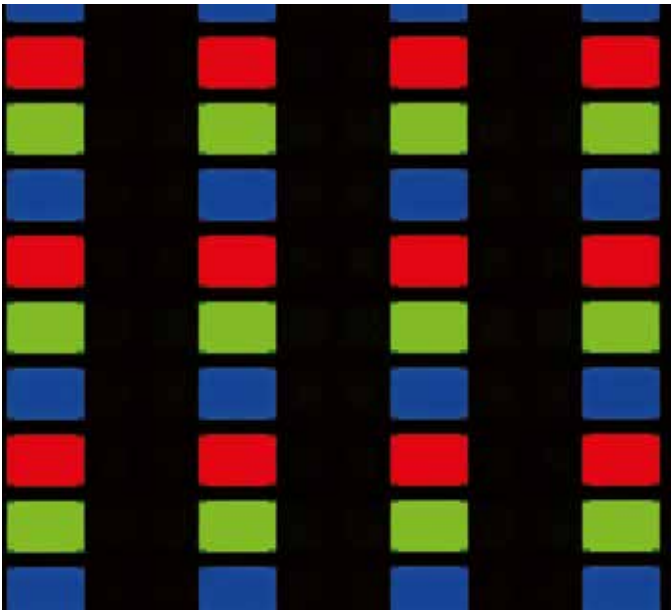
Reflected light: brightfield, darkfield, DIC, C-DIC, polarization, fluorescence
Transmitted light: brightfield, darkfield, DIC, PlasDIC, polarization, phase contrast

Illumination

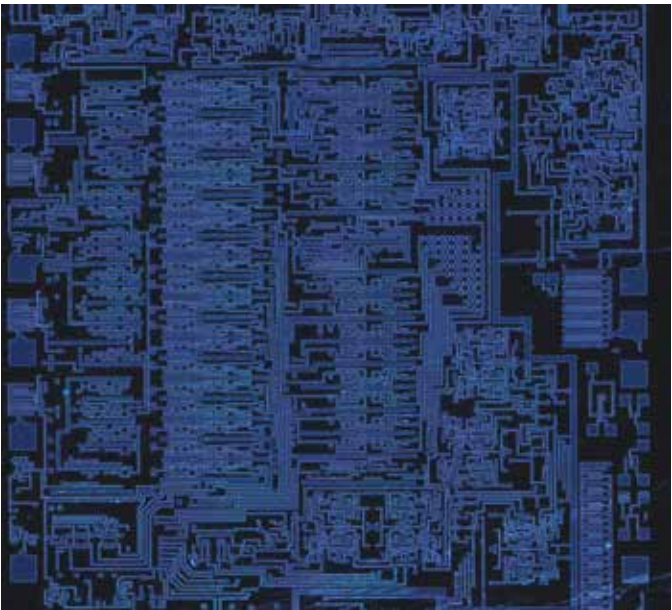
Reflected light: LED, halogen, HBO, XBO
Transmitted light: LED, halogen

Accessories

Autofocus, linear sensor, manual and motorized stages



TFT display; brightfield; transmitted light; red, green and blue sub-pixels



Wafers, 200 mm diameter, darkfield, reflected light in combination with Autofocus in the clean room

Simpler. More Intelligent. More Integrated.

- Take advantage of a maximum specimen size of 300×300 mm and an impressive maximum specimen thickness of 254 mm for non-destructive analysis.
- Whether dealing with heavy specimens or working in combination with the LSM 700 laser scanning microscope, the sturdy column design provides stability you can rely on and prevents vibration.
- Axio Imager Vario is DIN EN ISO 14644-1-certified and, together with a clean room kit, meets the requirements of clean room class ISO 5.
- For examining the surface of reflective, low contrast specimens, equip Axio Imager Vario with the fast and efficient Autofocus system. Then even your largest specimens will remain in perfect focus when moved along the X- and Y-axis.

Created for your applications

- Thanks to the extensive travel range, you can examine the surface of solar cells for homogeneity and micro-cracks.
- Use the clean room kit and Autofocus to identify particles, scratches and defects on wafers.
- Recognize pixel defects in TFT displays under reflected and transmitted light.
- Examine photomasks for excess chromium film and particles with the photomask holder.

ZEISS Axio Observer

Your inverted microscope system for metallography



Axio Observer, the inverse material microscope from ZEISS, provides almost unlimited sample space. That means you will save all that time and needless effort on extensive sample preparation – a big advantage.

You will get a flexible platform, perfectly adapted to the requirements of your work in metallography. Use all the contrast methods to produce brilliant images of your structures.

Axio Observer is future-proof: simply adapt the microscope to meet your changing requirements.

Configured to your requirements

Microscope

Axio Observer 3 materials (coded)
Axio Observer 5 materials (coded, partly motorized)
Axio Observer 7 materials (motorized)

Contrasting techniques

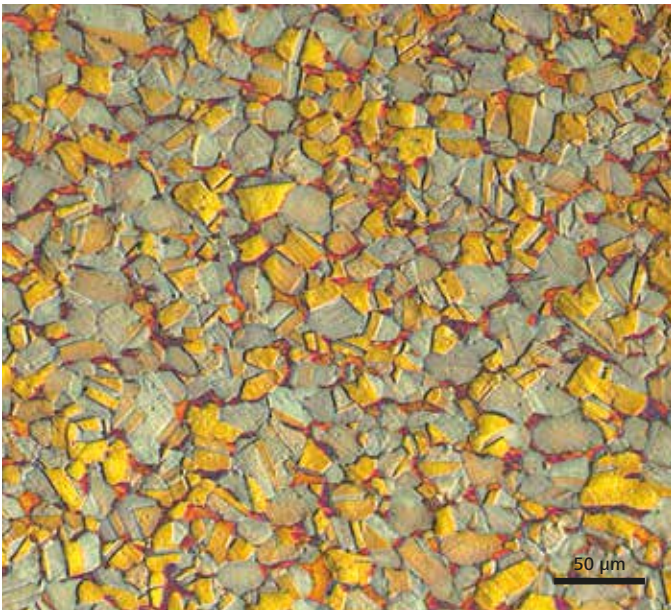
Reflected light: brightfield, darkfield, DIC, C-DIC, polarization, fluorescence
Transmitted light: brightfield, DIC, PlasDIC, polarization, phase contrast

Illumination

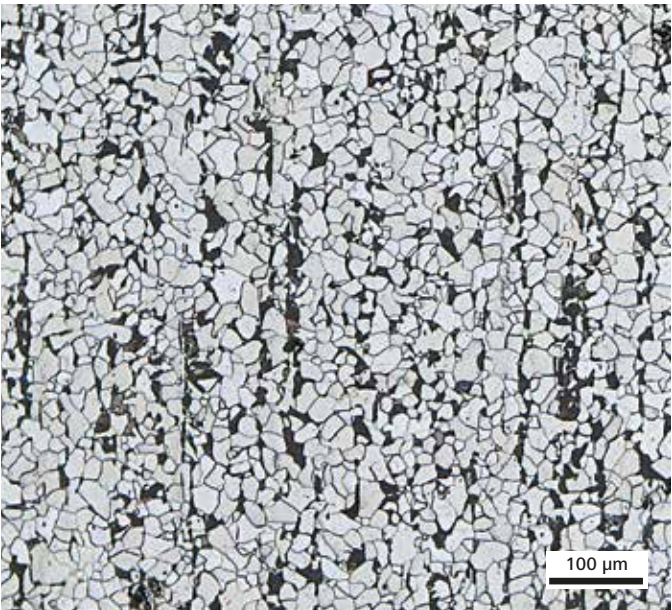
Reflected light: halogen, HBO, LED, XBO
Transmitted light: halogen, LED

Accessories

6× reflector turret, automatic component recognition (ACR), contrast manager and light manager for automatic microscope settings



Brass structure
Objective: EC-Epiplan NEOFLUAR 20×/0.50, brightfield
Courtesy of: the Materials Research Institute at Aalen University



Steel, tempered structure
Objective: EC-Epiplan NEOFLUAR 50×/0.80, bright field
Courtesy of: the Materials Research Institute at Aalen University

Simpler. More Intelligent. More Integrated.

- Automated components give you reproducible results. The contrast and light managers automatically control your microscope settings.
- Take advantage of the numerous analysis options for investigating structures, grain boundaries and phases.
- Choose between three different types of stand – from manual to fully motorized.
- Navigate and control your Axio Observer in comfort by using either the operating buttons on the stand or the touch screen, or via the software.

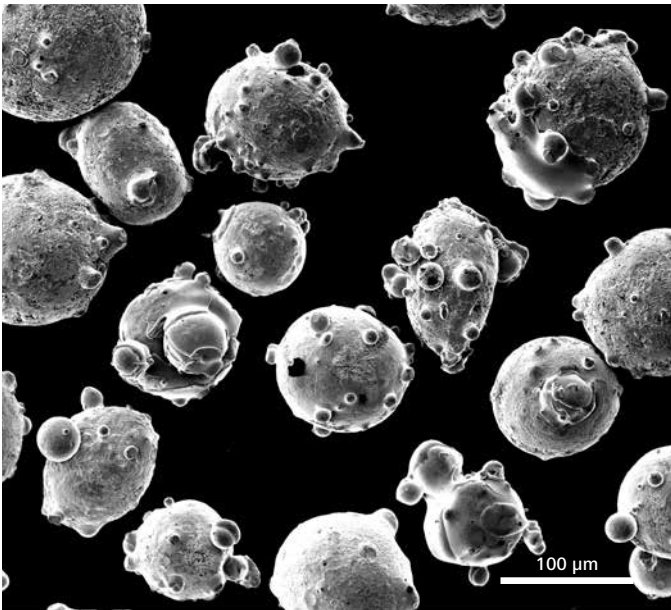
Created for your applications

- Investigate the structure and determine grain size, distribution and phases with the aid of optional software modules.
- Examine steel for purity and identify non-metallic inclusions on the basis of color, contrast, shape and orientation.
- Measure the layer thickness and geometric properties of electrodes.
- Using polarized light, analyze anisotropic structures such as Barker-etched aluminum alloys, zinc alloys, graphite, titanium alloys.

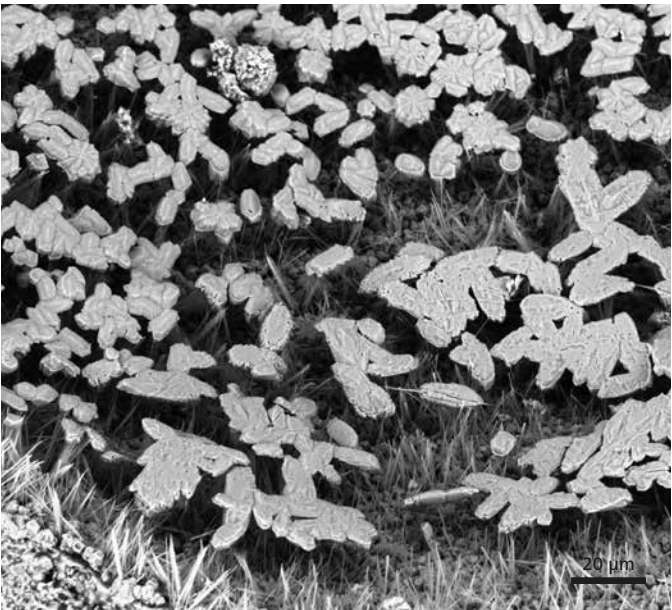
Automated Imaging Systems

ZEISS EVO MA and EVO HD

The scanning electron microscope for your most demanding samples



Carbide, depicted at 1 kV with the EVO HD SE detector



The C2D detector in variable pressure mode shows the structure of self-healing concrete

With EVO you can capture and analyze images better than ever before. Use the HD detector technology to capture high contrast surface details of fractures, composites, machined surfaces and particles. With EVO 25, you can view large samples from the aerospace and automotive industries in its large 420 mm chamber.

EVO increases your productivity in quality control and failure analysis. Put Automated Intelligent Imaging to work on your tasks and it will quickly deliver reproducible results. What's more, SmartBrowse has interactive image templates, letting you display your sample images in context and significantly speeding up the creation of reports.

Configured to your requirements

Resolution

1.9 nm, 2 nm, 3 nm at 30 kV SE with HD, LaB₆, W
4.0 nm at 30 kV BSD (in VP mode)
5 nm, 10 nm, 3 nm at 3 kV SE with HD, W
8 nm, 15 nm, 20 nm at 1 kV SE with HD, LaB₆, W

Magnification

<7–1,000,000×/ <5–1,000,000×

X-ray parameters

8.5 mm WD/35° TOA

Pressure range

10–400 Pa

Simpler. More Intelligent. More Integrated.

- The robust stand and variety of chamber sizes allow you to work with large, heavy or complex samples.
- EasyVP lets you switch seamlessly between high vacuum and variable pressure modes.
- The user-friendly image navigation and selection of sample types let you capture images quickly.
- Its high stability and its geometry ensure precise element analyses in high vacuum and variable pressure modes.
- Your system is future-proof and can be expanded at any time. Simply equip it with new detectors or with an extended pressure or wet mode when your application requirements so demand.

Created for your applications

- Analyze the thickness, composition and structure of automobile paints.
- Ensure the cleanliness of your production processes.
- Conduct analyses on the composition of non-metallic inclusions in steel.
- Conduct forensic investigations on gunshot residue and firing pin indentations on cartridge cases.
- Perform quick and reproducible particle analyses.
- Analyze the distribution of pharmaceutical agents on tablet sections.
- View slip bands, cavities and fractures caused by pore formation in metals and alloys.

ZEISS Sigma

Your field emission SEMs for imaging and analysis



The Sigma product family combines field emission and scanning electron microscope technology (FE-SEM). Its most salient feature is its excellent performance in imaging and analysis. With Sigma, you will increase productivity by using functions such as the integrated airlock, first-rate EDS geometry and an intuitive workflow in only four steps.

Sigma offers you detector technology for imaging with high resolution. The microscope is designed to handle different operating conditions and can be adapted to suit your application precisely. Sigma produces high quality, sharp, high contrast images – from nano particles and nano fibers to semiconductors and MEMS components, and all the way on to solar cells. It gives you information on topography, composition, crystallography and element distribution for use in comprehensive sample characterization.

Configured to your requirements

- Resolution**
- 0.8 nm at 30 kV (STEM)
 - 0.8 nm at 15 kV
 - 1.6 nm at 1 kV
 - 2.0 nm at 30 kV (in VP mode)

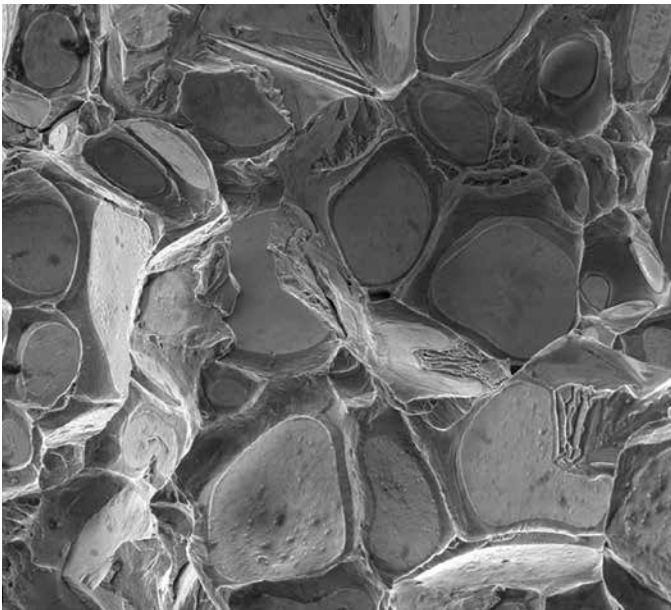
- Acceleration voltage**
- 0.02–30 kV

- Sample current**
- 4 pA–20 nA (100 nA optional)

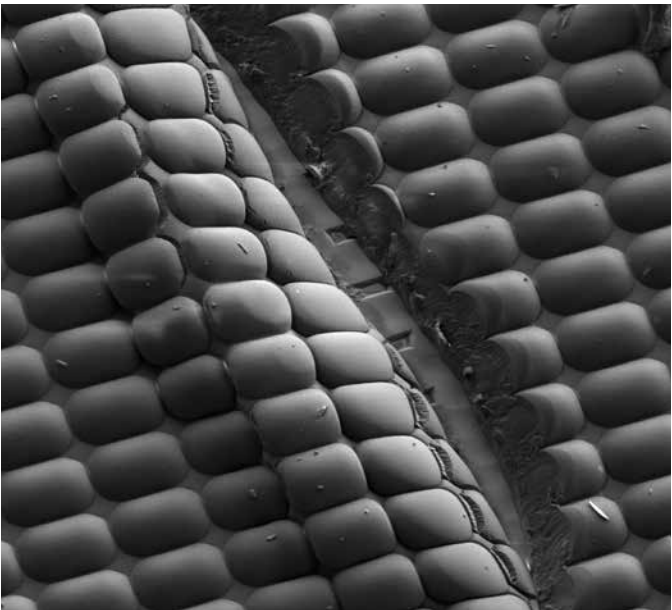
- Magnification**
- 10–1,000,000×

- Electron emitter**
- Schottky field emitter

- Standard detector**
- Inlens SE, ETSE detector, VPSE-G4 (in VP mode)



Alloy and tungsten core, surrounded by a steel matrix; Inlens Duo, BSE mode, low voltage



The SE detector shows damage to the non-conductive micro-objective of a CCD.

Simpler. More Intelligent. More Integrated.

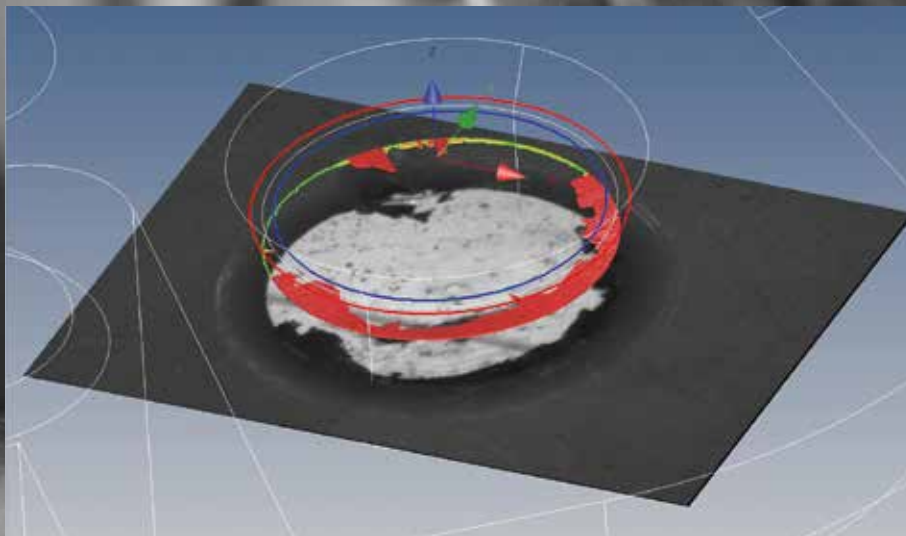
- The automated workflow leads you step by step, increasing your productivity.
- Sigma offers you first-rate analysis performance, particularly when working with beam-sensitive samples.
- The integrated airlock lets you achieve high sample throughput for wafers up to 5" in size.
- Combined electrostatic and magnetic fields optimize optical performance while reducing field effects on the sample at the same time.
- The Inlens Duo detector for SE and BSE signals lets you acquire information on topography and composition in a single detector.
- Gemini beam booster technology allows small beam diameter and high signal-to-noise ratio even under extremely low acceleration voltages.

Created for your applications

- Analyze materials and manufactured components to acquire topographic information in high resolution on damaged micro-structures and MEMS parts.
- Create a 3D surface metrology of precision-machined components in real time to determine the cause of fractures and defects.
- Use an extensive range of detectors to create high resolution images and analyses of nano materials.
- Analyze coatings and thin films to reveal hidden surface details of non-conductive particles.
- Handle large metal samples in the chamber with the Cartesian motorized stage and use for in situ plasma cleaning to maintain high image quality and get crystallographic and channeling contrasts.
- Sigma's large airlock lets you change wafers quickly on semiconductor and electronic samples. Capture topographic images of element layers in high magnification.

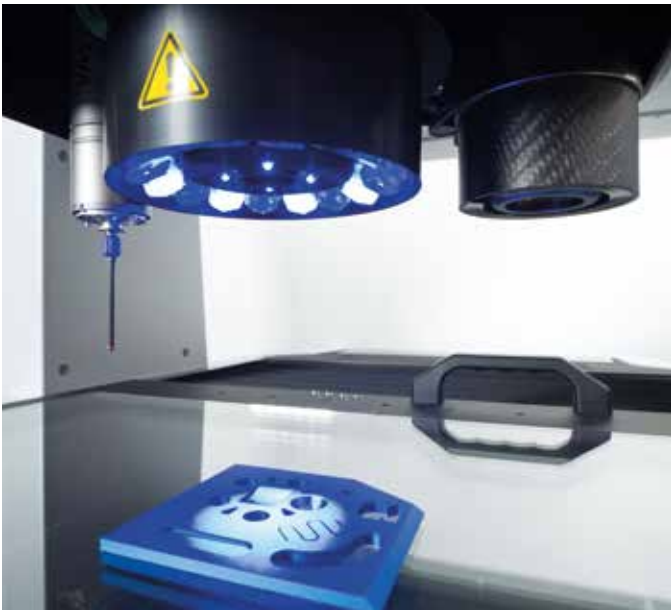
Optical Metrology

Use optical metrology for contact-free quality control.



ZEISS O-INSPECT

Your multi-sensor measuring instrument for 3D measurements



With O-INSPECT multi-sensor measuring instruments from ZEISS, you can make optimum measurements of each property – optically or physically.



And the star key makes key changing a thing of the past

O-INSPECT measuring instruments combine optical and physical measurement technology in one device. You can cover a broad range of particles and extensive evaluation options. Choose between sizes 322, 543 and 863, and enjoy the benefits of optical and physical sensing technology in proven ZEISS quality. These devices are equipped with the VAST XXT scanning sensor and provide you with genuine 3D measurements.

Configured to your requirements

Measuring instruments

- O-INSPECT 322
- O-INSPECT 543
- O-INSPECT 863

Features

Discovery telecentric zoom objective, adaptive illumination system, VAST XXT scanning probe, probe turret, reference sample for measuring ranges up to 800×600×300 mm

Accessories

Loading system with glass palette and mesh palette, reference palette, white-light distance sensor, rotating stage

Software

CALYPSO

Simpler. More Intelligent. More Integrated.

- O-INSPECT measuring instruments are equipped for use in near-factory conditions: you will get reliable measurement results over a wide range of temperatures.
- You can use the optical sensor to measure objects quickly and contact-free.
- O-INSPECT lets you switch from optical to physical measurement within the same measuring process. Even if you switch manually, the probe settings are recognized automatically. No need for time-consuming recalibration.
- With its adaptive illumination system, O-INSPECT gives you precise optical measurement results. The two LED colors and the array of illumination angles can be optimally adapted to suit the measuring element. Capture perforations and contours using transmitted light.
- Use the O-INSPECT optional white-light distance sensor to measure 3D structures efficiently and contact-free.
- Scanning technology lets you not only inspect individual points, but also predict shapes accurately.

Created for your applications

- O-INSPECT is the ideal solution for inspection tasks in the fields of the medical technology, plastics, electronics and precision mechanics.
- With the white-light distance sensor, you can inspect both reflective and transparent objects such as glass and strongly absorbent matte surfaces.
- Solve complex inspection tasks precisely, flexibly and with a high degree of automation.
- Determine the geometry of workpieces point by point across their surface and access parameters such as dimension, distance, angle, shape deviation and spatial relationship.

ZEISS O-SELECT

The digital measuring projector for 2D measurement



The O-SELECT measurement system works automatically and thinks collaboratively – both in creating measurement programs and carrying out the measurement itself. It only takes the touch of a button: simply place the workpiece on the measurement field and start the program. Within seconds, the lenses capture contours, automatically evaluate all inspection characteristics and then record them in the ZEISS PiWeb evaluation and statistics software. This means that the optical 2D measurement of workpieces is traceable, reproducible and therefore reliable.

Configured to your requirements

Measuring instrument

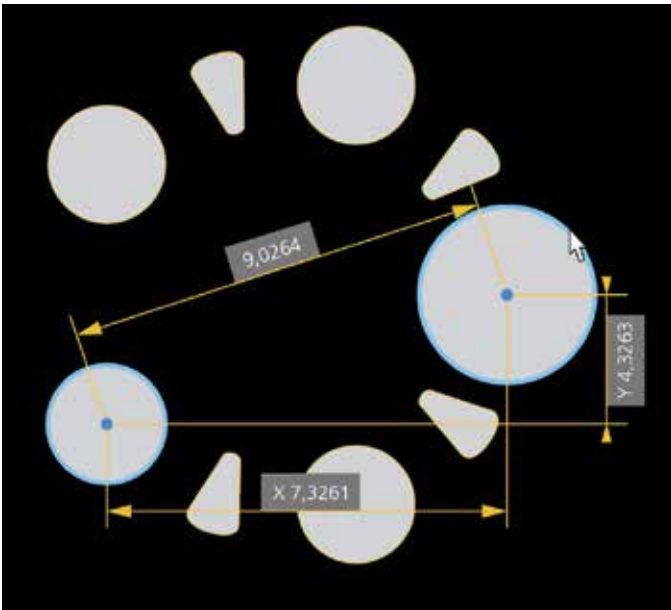
O-SELECT

Features

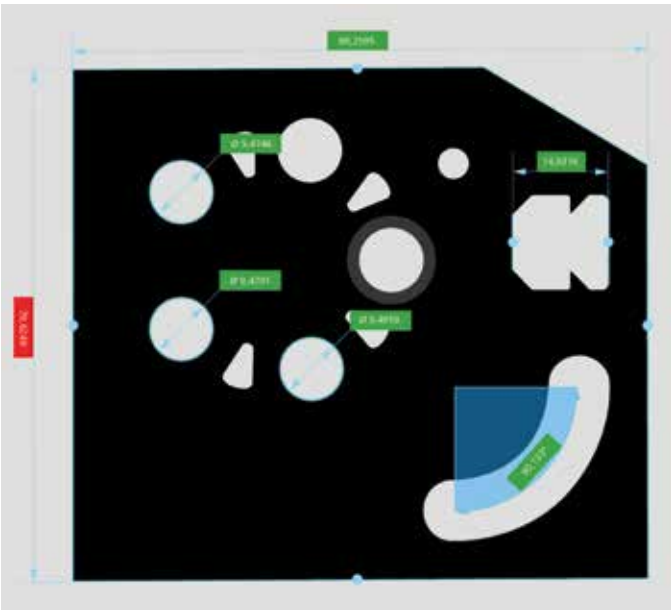
- Camera for high resolution digital images
- Autofocus for sharp images of samples at different heights
- Telecentric ZEISS lenses for index-free images
- Ring light with individually-controllable segments for measuring tasks with reflected light
- Transmitted light for measuring contours and perforations

Accessories

Coaxial light for measuring deep structures



Once you have clicked on the elements, the software offers you a range of inspection characteristics for selection in the image.



Results are superimposed directly at the dimensioning arrows on the image. Color coding immediately indicates that values are within tolerance.

Simpler. More Intelligent. More Integrated.

- Achieve sharp edges automatically: O-SELECT corrects blur at the edges even when it's not directly visible.
- With Autofocus, you can rely on the measurement system to select the right distance between camera and sample, bringing the workpiece edge into focus and maximizing contrast.
- O-SELECT automatically calculates the right illumination for every workpiece: you always work under optimal light intensity.
- With automatic workpiece recognition, you can select the elements you need with just a few clicks. These are then converted into a measurement program.
- It also recognizes the elements being measured, independently identifying elements such as circles or lines on an unknown work-piece.

Created for your applications

- O-SELECT works simply and reliably in a wide variety of fields, from the automotive and electronics industries to plastics processing.
- Check the dimensional accuracy of distances, radii or angles on standard sample types such as stamped and bent parts, injection-molded workpieces or laser-cut workpieces. It's quick and reliable.
- Perform measurements in a field of view approximately 100×90 mm in size.
- O-SELECT software was specially developed to meet your requirements for digital measurement projectors.
- Both hardware and software are coordinated to optimize the measurement process

Specifications

Find the microscope system that best suits your application.

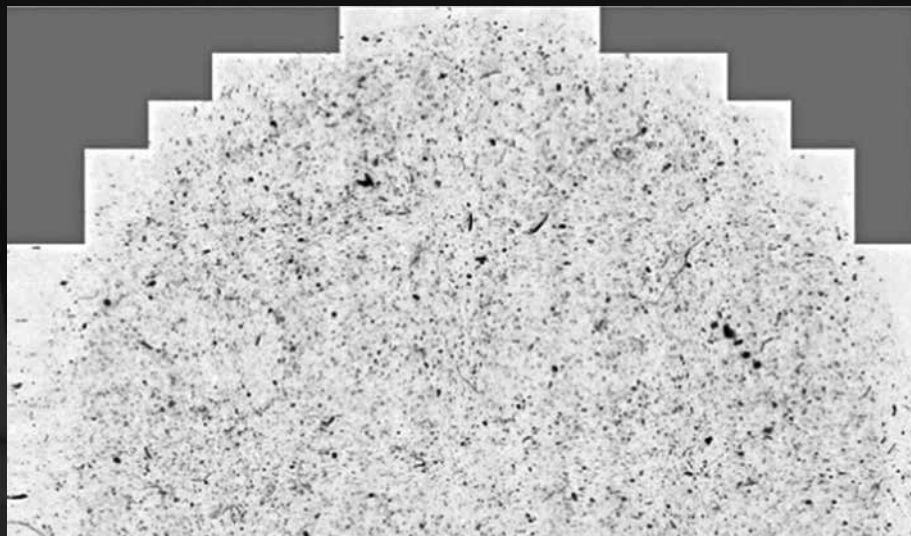
Sample	Stemi 305	Stemi 508	SteREO Discovery.V8	Primotech	Axio Vert.A1	Axio Lab.A1	Axio Scope.A1	Smartzoom 5	SteREO Discovery. V12/V20	Axio Zoom.V16
Use of unprepared samples	●●●●●	●●●●●	●●●●●	●●●	●●●	●●●	●●●	●●●●●	●●●●●	●●●●●
Large samples	●●●	●●●	●●●		●●●●●		●●●●●	●●●	●●●	●●●
High sample throughput								●●●●●	●●●	
Analyze sample composition										
Job to be done										
2D measurement functionality				●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Resolution	●●	●●	●●	●●●●●	●●●●●	●●●●●	●●●●●	●●	●●	●●●
Live 3D impression	●●●●●	●●●●●							●●●●●	●●●
3D image				●●●	●●●	●●●	●●●	●●●●	●●●	●●●
Image acquisition and documentation	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●
Creation of reports					●●●●	●●●●	●●●●	●●●●●	●●●●	●●●●
● Less suitable ●●●●● Particularly suitable										

Sample	Axio Imager 2	Axio Imager Vario	Axio Observer	EVO	SIGMA	Shuttle & Find	NMI	Particle Analyzer	CAPA	O-INSPECT	O-SELECT
Use of unprepared samples	●●●	●●●●	●●●			●		●●●	●	●●●●●	●●●●●
Large samples		●●●●●	●●●●●							●●●●●	●●●●
High sample throughput	●●●	●●●	●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●●
Analyze sample composition				●●●●●	●●●●●	●●●	●●●	●●●	●●●		
Job to be done											
2D measurement functionality	●●●●	●●●●	●●●●							●●●●●	●●●●●
Resolution	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●	●●●	●●●●●	●●●●●*)	●●●●●*)
Live 3D impression											
3D image	●●●	●●●	●●●	●●●	●●●					●●●●	
Image acquisition											
Documentation	●●●●●	●●●●●	●●●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●●●	●●●●●
Creation of reports	●●●●	●●●●	●●●●				●●●●●	●●●●●	●●●●●	●●●●●	●●●●●
● Less suitable ●●●●● Particularly suitable											
*) Maximum permissible error (MPE)											

Applications



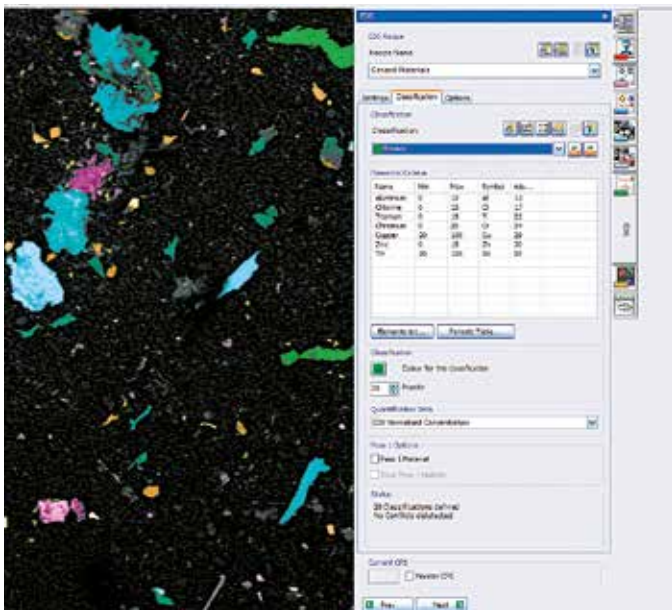
Find the right system
for your quality control needs



Technical cleanliness



Metallic, non-metallic particles and fibers on filter membrane microscope: ZEISS Axio Imager.Z2m
Objective: EC Epiplan-NEOFLUAR 10x/0.25
Camera: ZEISS AxioCam MRC

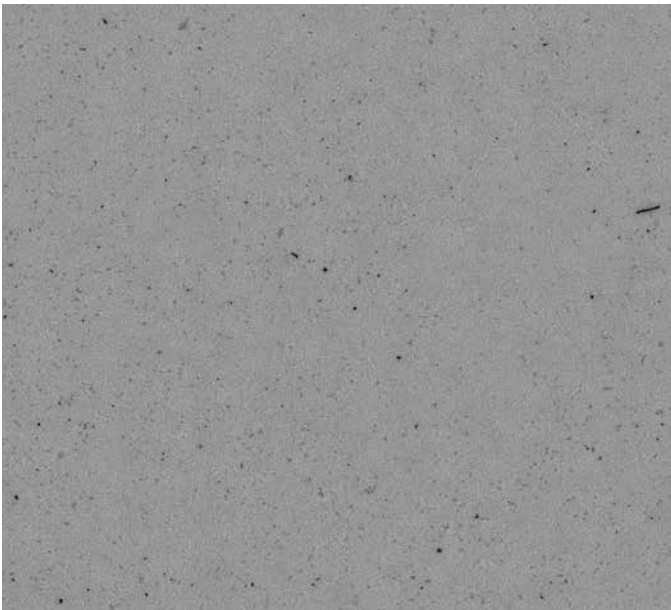


Classification of particles according to elemental composition with the ZEISS SmartPI

Technical cleanliness is an essential aspect of quality assurance in the automotive industry. The degree of particulate contamination has far-reaching effects on the functionality and service life of your products. The quantitative and qualitative detection of particle contamination improves your manufacturing process and saves you money. Work precisely and efficiently with the ZEISS system solutions for standard and advanced analyses combined with particle thickness measurement. With SteREO Discovery.V8, you can identify particles down to 25 µm in size. Use the Axio Zoom.V16 fully motorized zoom microscope to analyze particles as small as 5 µm. ZEISS systems for technical cleanliness conform to ISO 16232 and VDA 19 as well as internal company standards.

Make sure your products meet quality requirements by monitoring the technical cleanliness in your production process. With ZEISS SmartPI for automated analysis of nano particles, you can analyze up to 200,000 particles on your filter with the electron microscope and produce results on the chemical composition of the particles examined. With the correlative particle analysis function, you will be using both light and electron microscopy measure and analyze up to 200 particles – quickly and effectively. In combination with electron dispersive spectroscopy (EDS), correlative particle analysis provides you with comprehensive material characterization and specifically supports you in identifying potential killer particles.

Oil purity



Membrane with residual soil particles from fresh oil
Microscope: ZEISS Axio Imager.Z2m
Objective: EC Epiplan-NEOFLUAR 10x/0.25
Camera: ZEISS AxioCam MRC5

Nearly 80 % of all machine downtime occurs in connection with oil contamination. That’s why analysis is so critical in the oil and lubrication industry as well as the automotive and aerospace industries, power supply and many other branches of industry. Using oil analysis, you can determine the degree of contamination caused by wear and corrosion of integral components such as housings, pumps and valves. Minimize your maintenance costs and maximize availability.

ZEISS systems are the ideal solution for quantifying particulate contamination. Use the Axio Imager 2 to measure particles down to 2 µm. ZEISS systems for oil analysis comply with ISO 4406, ISO 4407, SAE AS 4059, DIN 51455 and internal company standards.

Steel purity



Non-metallic inclusions in steel
Microscope: ZEISS Axio Imager.Z2m
Objective: EC Epiplan-NEOFLUAR 10x/0.25
Camera: ZEISS AxioCam MRC

Metallurgical purity is essential to the quality as well as to the processing and use characteristics of steel products. Non-metallic inclusions are often the incubation points for fatigue cracking. For this reason, the quantity, size and distribution of non-metallic inclusions have a significant effect on the strength and corrosion resistance of your steels and steel products over time. Use ZEISS systems for analyzing non-metallic inclusions within manufacturing and receiving, or when investigating instances of damage.

Axio Imager 2 and Axio Observer are the optimal choice for determining steel purity. ZEISS systems support EN 10247, ASTM E45, ISO 4968, DIN 50602 and other international standards.

ZEISS Particle Analyzer

Investigate minute particles on a large scale

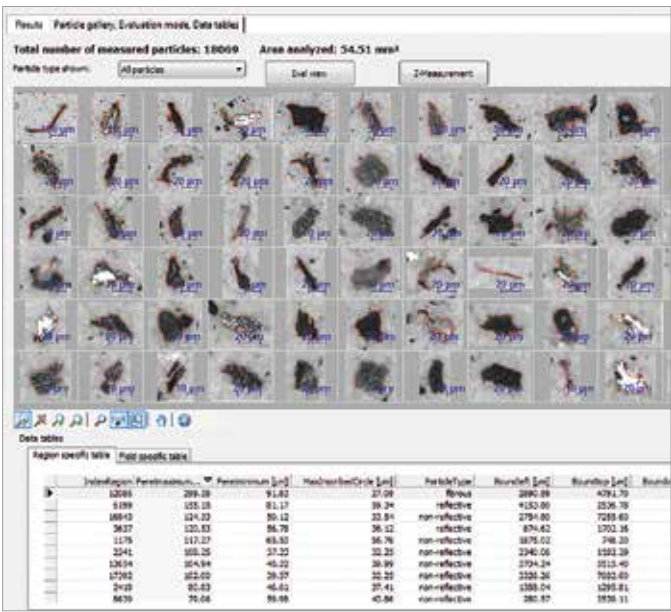


The ZEISS Particle Analyzer is made for practical use, performing everyday industrial quality control tasks. Use it to investigate the size distribution of residual dirt particles and classify them as metallic or non-metallic particles or fibers. The ZEISS solution complies with ISO 16232 and VDA 19.

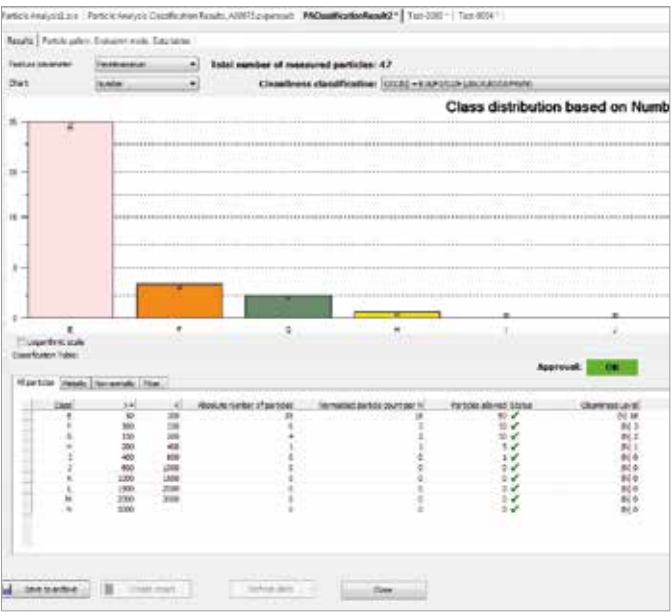
Stereo Discovery.V8 is the system of choice for your standard analyses in accordance with VDA 19. You can perform advanced analyses starting at 5 µm with Axio Zoom.V16. With Axio Imager 2, you are optimally equipped to measure particle heights as part of advanced analysis.

Configured to your requirements

- Microscope**
 - Standard analysis:
 - Stereo Discovery.V8
 - Advanced analysis:
 - Axio Imager 2
 - Axio Zoom.V16
- Software**
 - Light microscope:
 - Particle Analyzer Projects
 - AxioVision Mosaic
 - AxioVision Autofocus
 - Correlative microscopy:
 - Correlative Particle Analyzer (CAPA)
- Accessories**
 - Filter holder
 - Correlative filter holder



Gallery view, AxioVision Particle Analyzer



Classification view, AxioVision Particle Analyzer

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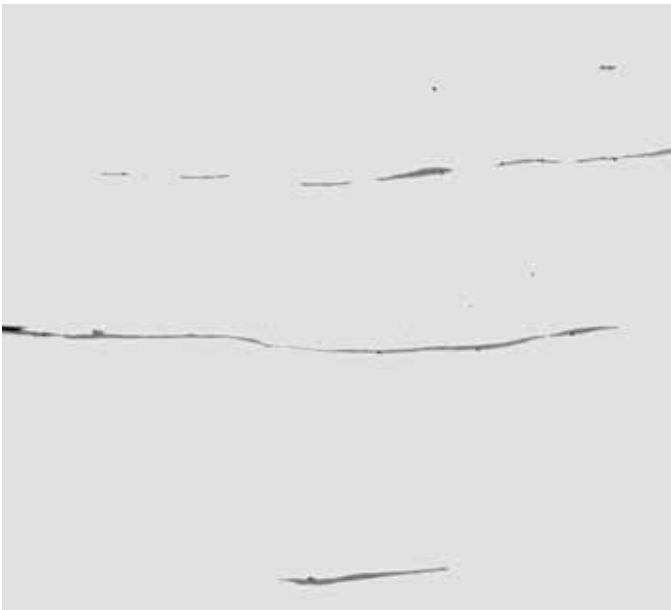
- From the contrasting processes and your choice of objective to the exposure time of the camera and the illumination settings: your motorized light microscope systems make sure that all of your settings have been correctly selected. Together with the fully automatic image analysis provided by AxioVision, you will get reproducible results at all times – safely and reliably.
- Use the gallery view for a quick overview of both shiny metallic and non-metallic particles and fibers. This allows you to relocate particles of interest quickly.
- The combination of light and electron microscopes with EDS lets you measure, classify and document the size distribution, particle type and chemical composition of residual dirt particles.

Created for your applications

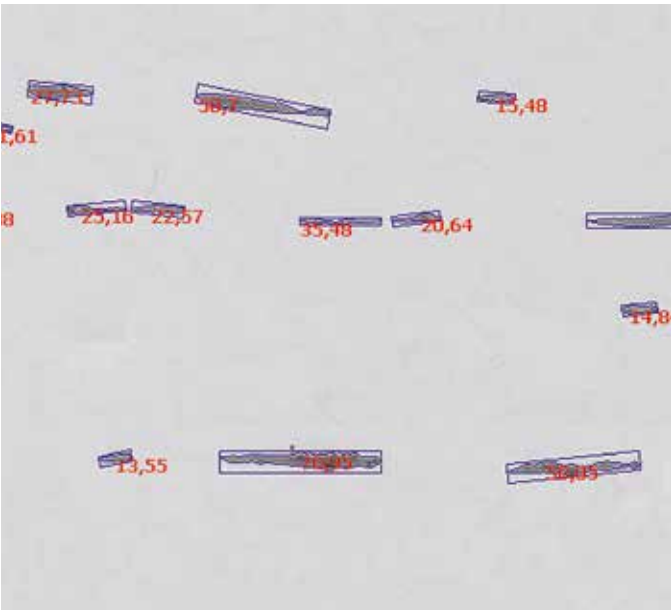
- Inspecting for component cleanliness: determine the residual dirt content of your components automatically in terms of quantity, size, distribution and particle type (metallic and non-metallic as well as fibers). You can evaluate samples in accordance with ISO 16232 and VDA 19 as well as internal company standards.
- Specify the particulate content of fresh and used oil as well as lubricants in terms of quantity, size and distribution – it's automatic. You can evaluate samples in accordance with ISO 4406, ISO 4407, SAE AS 4059 and DIN 51455 as well as internal company standards.
- Working in the chemical industry you can detect objects and structures fully automatically in terms of quantity, size, color and morphology.

ZEISS NMI

Analyze non-metallic inclusions automatically. In compliance with standards.



The images provided by MosaiX enable the full depiction of large inclusions.
Courtesy of: SKF GmbH, Schweinfurt



Sulfide inclusions in steel

Non-metallic inclusions affect the mechanical properties of steel. Knowing the structure and identification of inclusions provides you with important information for product development and quality assurance.

The European standard EN 10247 on automatic and manual specification of microscopic purity replaces various national standards. By setting parameters clearly, you can carry out precise and user-independent evaluations of non-metallic inclusions.

Together with international experts on steel purity, ZEISS has developed a fully automated image analysis system. NMI gives you results that are reproducible at any time.

Configured to your requirements

Microscope

Axio Imager.Z2m
Axio Observer 7 materials

Software

AxioVision NMI, MosaiX, Autofocus
Optional: comparative diagrams, grain-size analysis, multi-phase analysis, cast iron analysis

Cameras

Axiocam MRc
Axiocam MRm

Accessories

Sample holder

Simpler. More Intelligent. More Integrated.

- Get precise, reproducible results. Axio Imager.Z2m and Axio Observer.Z1m stands are motorized: automatic image analysis and storable parameter settings ensure precise reproducibility.
- Evaluate your samples on the basis of all relevant standards in parallel: AxioVision NMI supports DIN 50602, EN 10247, ASTM E45, ISO 4967, GB/T 10561 and JIS G 0555 standards.
- Get quick, precise information on your samples. The NMI system adapts to your daily workflow. With just a few clicks, you can begin the analysis, create your report and archive your test results. NMI software lets you view your parameters at a glance. Standard-specific techniques are clearly displayed. The gallery gives you a quick overview of various types of inclusion: sulfide, oxide and globular inclusions. Relocate interesting inclusions at the click of the mouse.

Created for your applications

- Perform qualitative and quantitative analyses of the microstructure of steel to determine its purity.
- Investigate the content and distribution of non-metallic inclusions on the basis of size, shape, orientation and color.
- Evaluate inclusions based on the images in a comparative diagram.
- Identify sulfide, oxide and nitride non-metallic inclusions precisely and in compliance with standards.

ZEISS Shuttle & Find

Bring together the best of light and electron microscopy in one package



Combine the optical contrasting techniques of a light microscope with the analytical methods of an electron microscope. You'll get additional information on both the structure and function of your samples.

The Shuttle & Find software module enables an easy-to-use, productive workflow between your light microscope and electron microscope.

Use your light microscope to capture and mark points of interest on the sample. Then, use Shuttle & Find and its special sample holder to locate the points again in your electron microscope. Now you can depict your sample at several times the resolution and continue examining it in further detail. And it's all absolutely reproducible.

Configured to your requirements

Microscopes

Light microscopes: Axio Scope.A1, Axio Zoom.V16, Axio Imager.M2m, Axio Imager.Z2m, Axio Observer.Z1, SteREO Discovery
Electron microscopes: EVO, Sigma, Crossbeam, GeminiSEM

Software

AxioVision
Shuttle & Find software module
SmartSEM

Accessories

Sample holders for correlative microscopy
Adapter plate
Calibration marker
Optional adapter frame

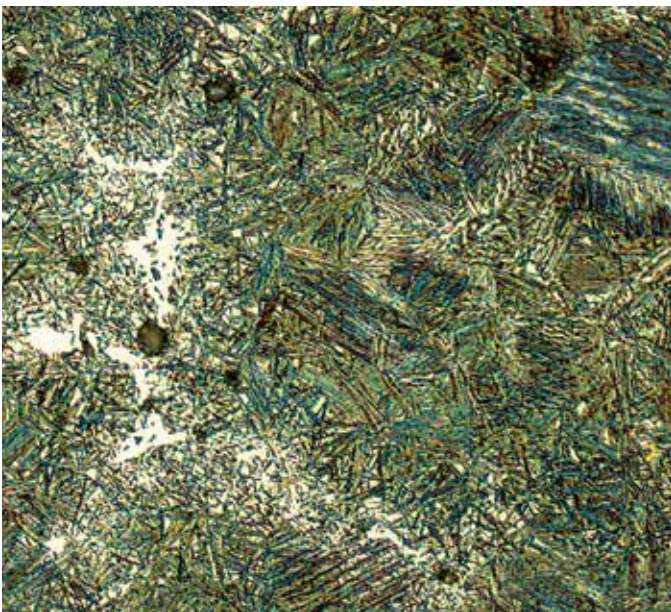
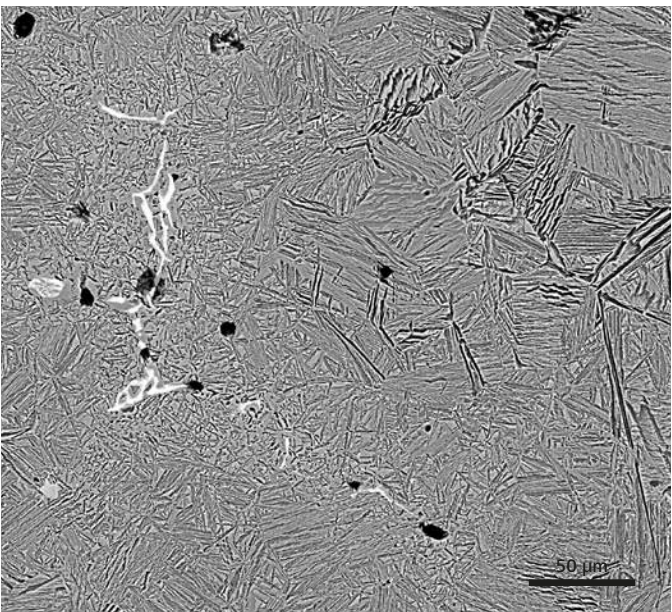


Image of an ADI sample from a light microscope
Magnification: 400:1



BSE image of the same sample area;
the microstructure is clearly visible.

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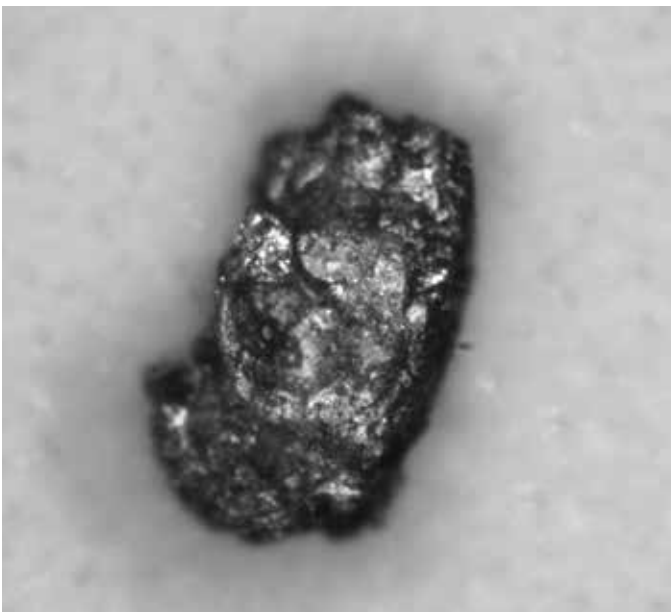
- Use Shuttle & Find to link interesting sample areas in both light and electronic microscope systems. It stores sample areas marked in the light microscope together with their coordinates so you can then find these areas in the electron microscope – in just seconds.
- Get more information from your sample. Use the numerous optical contrast techniques in the light microscope for information on size, morphology and color. The electron microscope expands your knowledge with details of its structure and chemical materials composition. All that with resolution down to the nanometer range.
- With fully automated image analysis, you can be confident of reliable, reproducible results.

Created for your applications

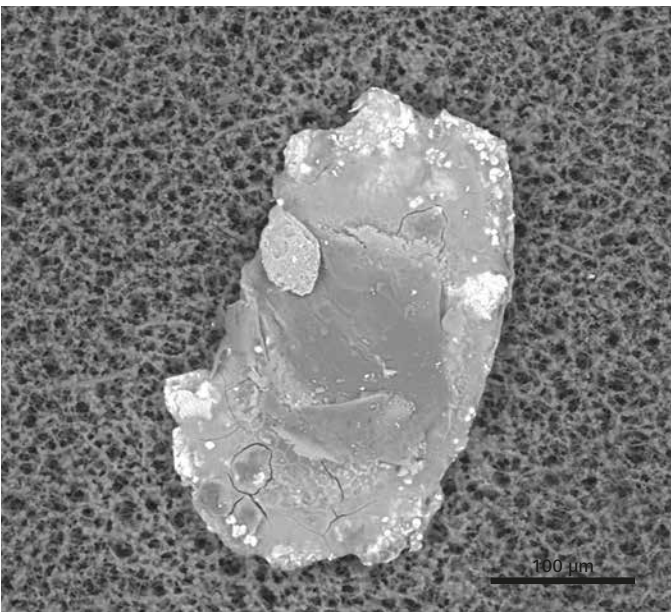
- Analyzing for residual dirt in the automotive industry. First classify metallic and non-metallic particles in the light microscope. Then perform a comprehensive examination and identification of particles in the electron microscope.
- Use the light microscope to determine the purity of steel and identify sulfides, oxides and silicates on the basis of shape and color. With the electron microscope, you can then characterize atypical inclusions based on their chemical composition with the aid of X-ray spectroscopy.
- Take advantage of this precise, quick and reliable workflow to boost your productivity in nano-fabrication. Working with both microscope systems in a highly automated and effective manner, you will reduce cycle times and significantly increase throughput.

ZEISS Correlative Cleanliness Analysis

Combine light and electron microscopy to characterize and classify particles.



Light microscopy image of a metallic particle



Electron microscopy image of the same particle

Acquire more information in less time with correlative particle analysis (CAPA). By combining light and electron microscopy you unleash the full performance of both systems.

Analyze particles using your motorized light microscope: Axio Zoom.V16 and Axio Imager.Z2m provide information on the quantity, size distribution, morphology and color of particles. With polarization contrast, you can differentiate between metallic and non-metallic particles.

Then identify critical particles and relocate them in your electron microscope. The material composition of the particles is automatically determined by means of energy dispersive X-ray spectroscopy (EDS). The results of both light and electron microscope analyses will be consolidated in a single report.

Configured to your requirements

Microscope

Light microscopes: Axio Zoom.V16, Axio Imager.Z2m
Electron microscopes: EVO, Sigma, MERLIN, GeminiSEM

Software

AxioVision
Software module: ZEISS Correlative Particle Analyzer (CAPA) and MosaIX
SmartSEM
SmartPI

Accessories

Sample holder for 47 mm or 50 mm particle filters
Adapter plate
Calibration marker
Optional adapter frame

Simpler. More Intelligent. More Integrated.

- Characterize process-critical particles and identify killer particles. First capture particles with your light microscope, then find them again with your electron microscope and EDS analysis to get information on their material composition.
- CAPA automatically supplies you with a report that integrates your results from both light and electron microscopic analyses.
- The gallery and evaluation view provide a quick overview of all particle types: reflective, non-reflective and fibrous. See all classifications and ISO codes at a glance.
- Select and relocate interesting particles with the touch of a button.
- Your results are available up to ten times faster than when performing light and electron microscope analyses back to back.

Created for your applications

- Cleanliness analysis ensures the proper function and verifies the cleanliness of parts.
- Analyze particles in oils and brake fluids from 2 µm in size to prevent the fouling of filters, nozzles and valves – as well as oil aging, cracks, leaks or pump failure.
- Use EDS analysis and automatically determine the chemical composition of up to 200 of the largest particles or up to 200 particles in a selected size range.

ZEISS ParticleSCAN VP

The robust SEM with a SmartPI user interface



ParticleSCAN VP offers a completely integrated solution for industrial applications that you can use wherever you need it to increase productivity and quality. The integrated SmartPI technology makes particle analysis automatic.

Designed for field use, ParticleSCAN VP is very user-friendly; this means that deploying the microscope in industrial environments poses no hazards to the equipment. The scanning electron microscope system offers variable pressure and a tungsten source. The robust housing makes it easy to pack up and transport the system, and put it into operation on-site in just a few hours.

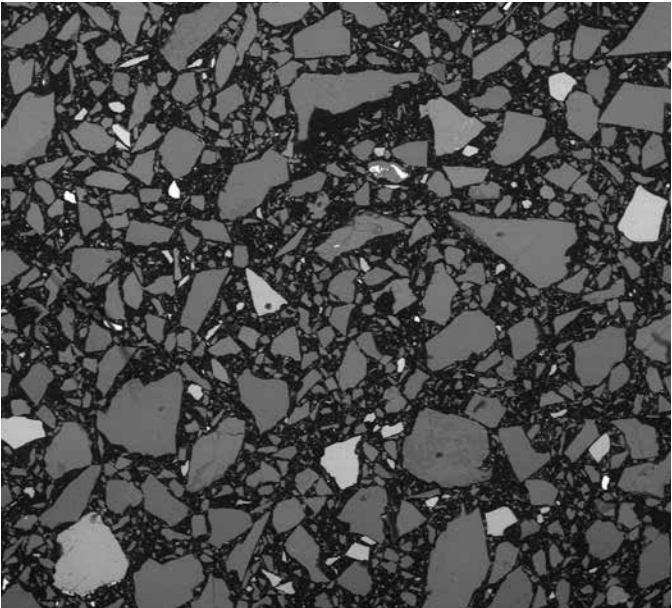
Configured to your requirements

- A selection of sample holders for pins and filters
- Up to four EDS detectors
- Detector for backscattered electrons
- Internal chamber: 267 × 193 × 300 mm
- Power supply: 208–230 V, 50/60 Hz (single phase)
- Integrated PC
- Dust filter system
- Robust transport case and cover
- Lifting recesses for forklift trucks
- Dimensions in operation: 770 × 770 × 1,720 mm
- Dimensions in transport: 770 × 770 × 1,740 mm
- Weight: 475 kg *

* Approximate weight: the exact weight depends on the configuration.



A selection of 2D particle sections captured with the BSE detector



Choose between a selection of sample holders or use your own.

Simpler. More Intelligent. More Integrated.

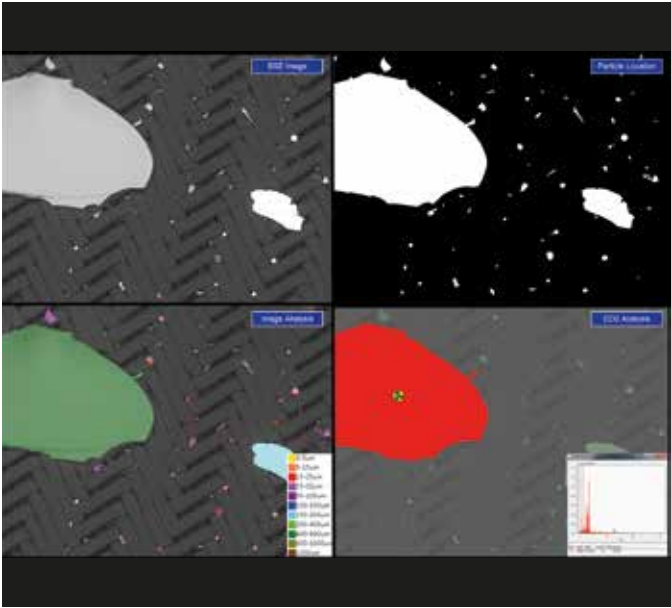
- Capitalize on greater flexibility with rapid system deployment at different locations.
- Reap the benefits of automatic self-calibration.
- With reproducible results, you are free to concentrate on interpreting information – not just acquiring data.
- The robust portable housing has proven itself across the globe in applications for the military as well as in the mining, and oil and gas drilling industries.
- Integrated SmartPI technology is standard, offering you automated particle analyses whenever they are needed.
- Take advantage of up to four EDS detectors for quick chemical analysis.
- Measure particles on pin samples or use the optional filter holders.

Created for your applications

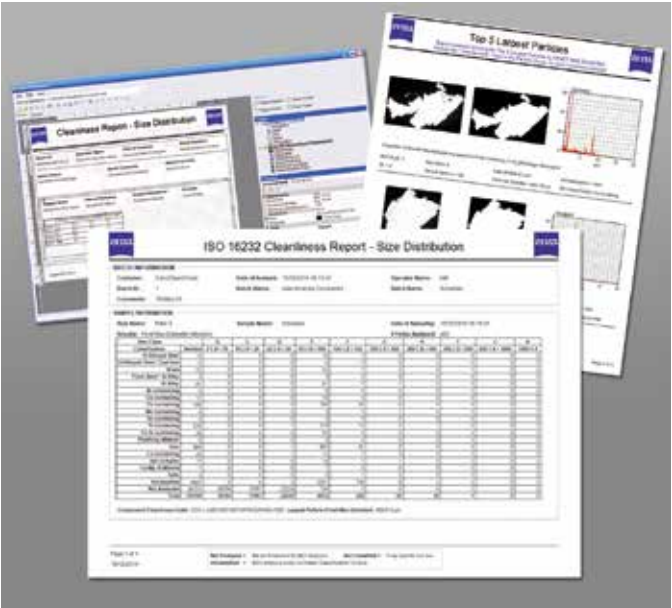
The ParticleSCAN VP system is based on an SEM platform already proven many times for on-site use. It gives you access to critical data everywhere: carry out projects for process optimization, then move on to the next site to work on projects there. This provides you with quicker access to critical data from those responsible for project management. The range of sample holders suits most sample types customarily used in industry, including filters. Or use your own holder and configure it quickly with the aid of the user-friendly interface for routine tasks.

ZEISS SmartPI

Your SEM software for particle analysis



Completely automated, simple workflow for localization, imaging and identification of particles



Integrated, automatic particle analysis for industrial applications such as cleanliness technology

Smart Particle Investigator (SmartPI) is a software package designed for particle analysis in the field of cleanliness technology. SmartPI transforms conventional and FE-SEM microscopes from ZEISS into powerful tools for the automatic characterization of particles of interest in a single application.

Use this software for routine analyses – it lets you perform standard tasks and calibration automatically and without user input. Advanced users have the benefit of a variety of measurement parameters and classification types. Reporting options allow access to more information than ever before.

With SmartPI, you get more out of your SEM: data acquisition is accelerated and processes can run overnight and on weekends with no need for monitoring.

Configured to your requirements

- Sample holders for particles on pins, filters and embedding resins
- Simple workflow and user-friendly interface
- Automated system calibration on start-up and at intervals during measurement
- Measure several samples in a row with without monitoring the process.

SmartPI performs these tasks automatically:

- Localization of particles in every field of view
- Advanced image analysis for characterizing morphology (size and shape)
- EDS analyses for identifying particle composition
- Correlation of all data for grouping the particles according to type using a classification database
- Storage of particle images and data in a database for use in studies and reports
- Provision of various tools for data acquisition and creating reports

Simpler. More Intelligent. More Integrated.

- SmartPI offers you all the features of SEM control, image processing and EDS analysis for analyzing and characterizing particles.
- The system allows you to automate repetitive analyses.
- Reap the benefits of continuous, unmonitored operation.
- Get objective results, thanks to minimal operator input.
- Perform analyses such as particle counting, determination of size and particle identification.

Created for your applications

Automate routine tasks and leave yourself free to concentrate on important things like examination, characterization and reporting. You can set up fully automatic analyses quickly. Since you are freed up from the manual task of data acquisition, you can use the time you save to gather important information from your data and make well-informed decisions.

SmartPI is designed particularly for technical cleanliness. It can automatically create reports in accordance with ISO 16232/VDA 19 and in line with user specifications. Or use it in the dynamic evaluation of results.

In correlative particle analysis (CAPA), you can increase the productivity and depth of information in your work by using SmartPI correlative workflows between light and electron microscopes.



Service and Support for Your ZEISS Microscope System

ZEISS Moments are about passion. The same passion that drives us to support and accompany you and your ZEISS microscope over its life cycle ensures that your work will lead systematically to success.

You work hard. We make sure your microscope keeps pace with you.

High imaging quality, reliable results and instrument availability are the parameters of your day-to-day working life. Your ZEISS microscope integrates seamlessly into this demanding workflow. It provides you with insights and results that you can trust: thorough, comprehensive and reproducible. With our Life Cycle Management we help you keep your microscope in optimum condition to get these optimum results.

Life Cycle Management comes with your microscope.

Life Cycle Management from ZEISS backs up our solutions throughout the working life of your ZEISS microscope system. From the procurement phase onward, you can count on our support with site surveys to optimize the location for your microscope system. Throughout the operational phase we will complement our service with support for relocations and upgrade opportunities that enhance or expand your possibilities. As soon as you think about replacing your long-serving microscope with a new one, we will take care of the disassembly and disposal of systems that are no longer needed. Rely on our service features: our employees analyze the status of your system and solve problems via remote maintenance or directly at your location.

From expert to expert

Never hesitate to ask our application specialists to support your specific tasks. Take advantage of our training sessions for any colleagues or employees who will be working with your ZEISS microscope.

Peace of mind and availability with regular maintenance

Your service plan is tailor-made for you. Make sure you take advantage of all the opportunities your ZEISS microscope system offers. Get optimized performance, instrument reliability and availability, all at predictable costs. Choose from different service levels of our Protect-Service Plans, ranging from Protect preventive, via Protect advanced, to Protect premium. We look forward to discussing your ideal Service Plan personally.





The moment you see something that has been hidden from you until now.
This is the moment we work for.

How will doctors treat their patients in the future? How far can we go with the miniaturization of semiconductor structures? What role will photographs and videos play in the way we communicate in years to come? These and many other questions are what drive us every day at ZEISS. Only those who ask will find the answers.

As pioneers in the industry and one of today's worldwide leaders in the field of optics and optoelectronics, we have always pushed the limits of the imagination at ZEISS.

The questions for medicine in the future are already being worked on by our people – with boldness, passion and innovation. From this impetus will come medical instruments that optimize the success of treatments and laboratory devices that will underpin medical advances.

The many challenges that industry faces also motivate us to continue setting new standards in technology. As we do, quality in all components is being safeguarded by ZEISS. Just as it will be in the smaller, higher-performance and low-priced microchip of the future.

ZEISS researchers and developers are working with equal determination to realize their quality standards for moving and fixed images. Whether in the largest planetarium in the world or in the smallest smartphone that has ever been built, it's going to happen and you will see it. This passion for topmost performance links all business areas at ZEISS. That's how we create advantages for our customers and inspire the world to look for things that have been hidden until now.





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