Leica DCM 3D

Dual Core 3D Profiler combines Confocal Imaging and Interferometry

Living up to Life

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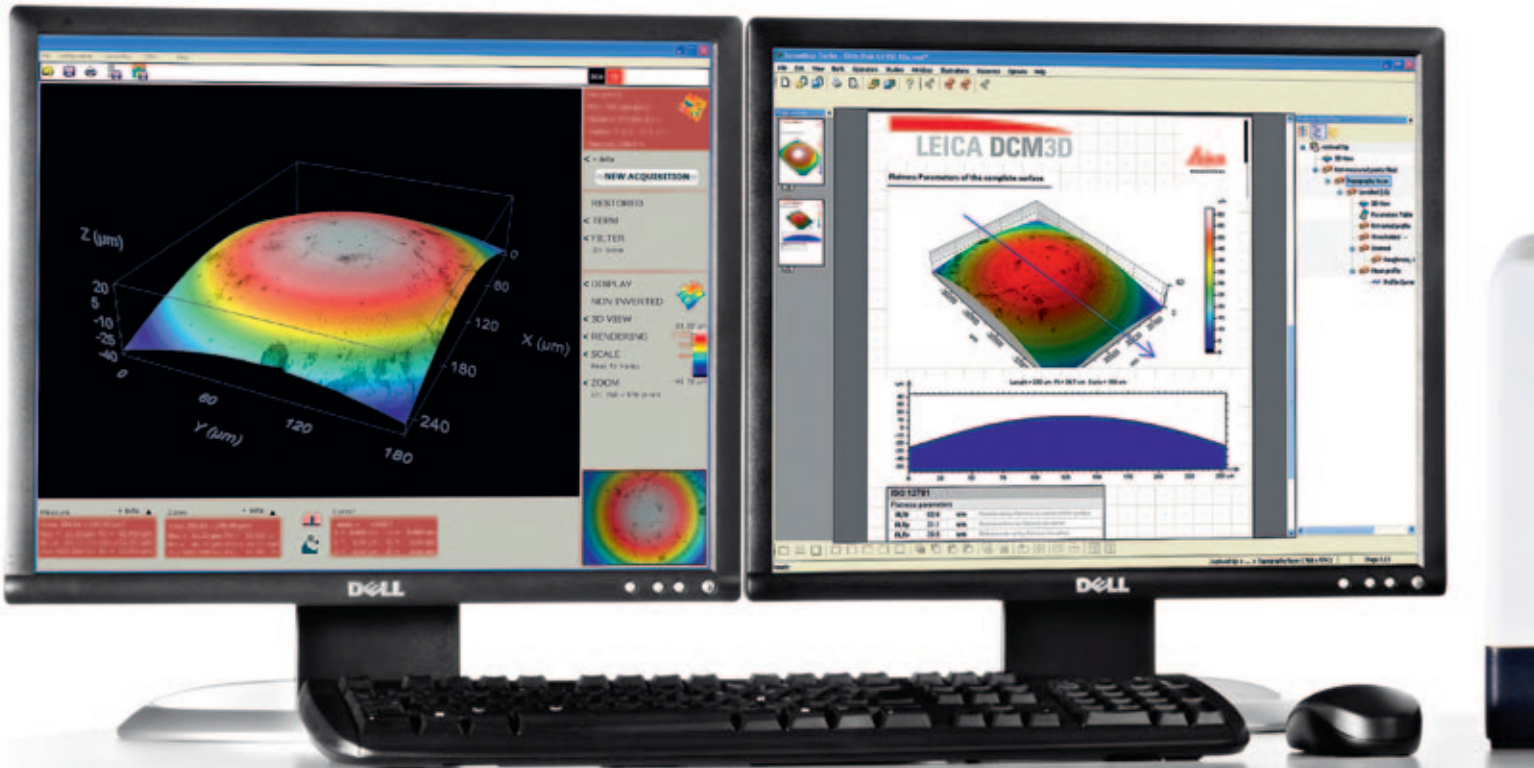
Automated Digital 3D Topography Measurement in High Definition

In recent years, the competing technologies of interferometry and confocal image profiling have been available for non-contact surface metrology. Both types of instrument can accurately and reliably measure surface topography on a scale from millimeters down to nanometers.

Today, Leica Microsystems presents a complete solution, that combines the advantages of both – confocal and interferometry: the Leica DCM 3D dual core 3D measuring microscope. In addition to its compact and robust design, the Leica DCM 3D is the tool of choice when it comes to super fast, non-destructive assessment of the micro- and nano-geometries of critical industrial component surfaces.

From R&D and quality inspection laboratories to robotic-driven systems utilized in online process control, the innovative Leica DCM 3D is designed for a wide range of applications where high speed measurements with resolution down to 0.1 nm are needed



3 Systems in one:

- **Brightfield and darkfield color digital microscope**
- **High Resolution Confocal imaging and measuring system**
- **Dual Optical Interferometric Profiler**

3 Simple steps to get highly accurate results

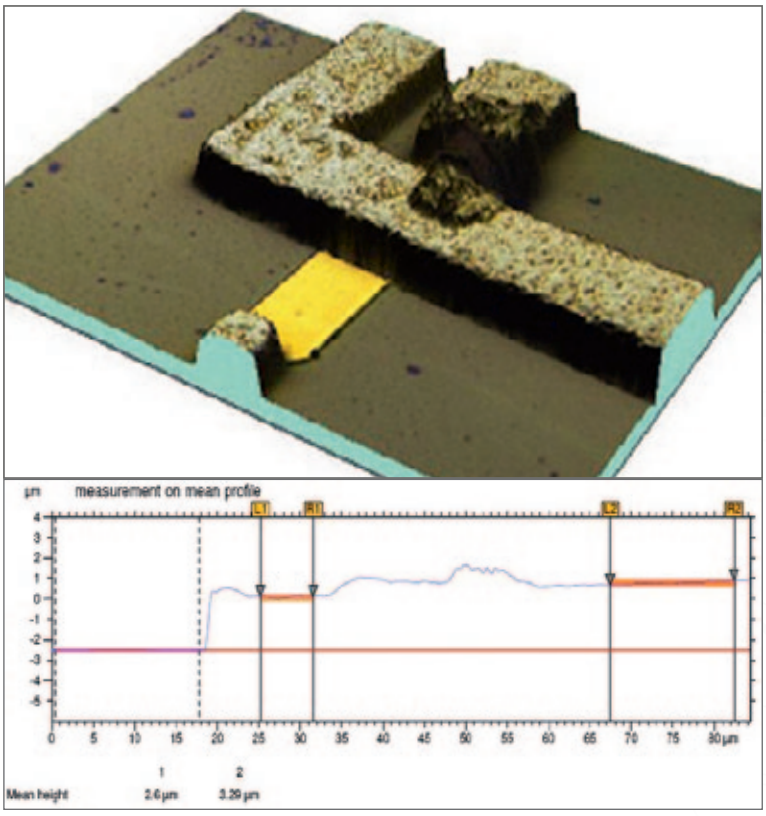
3 Seconds only to obtain 3D topography

Fast and easy measurement – even of complex surfaces

Covers the whole spectra – from super smooth to rough surfaces

Micro optical measurement technology fulfils two important requirements of metrology: non-destructive measurement combined with high accuracy. The measuring capabilities of the Leica DCM 3D range from a few nanometers to several millimeters and therefore serving a wide variety of different applications. Besides the capabilities of adapting to the requirements of the application from super smooth to very rough surfaces, the Leica DCM 3D is specifically designed to carry out measurements at extremely high speed. This does not only save valuable time, but also significantly improves the return of investment.

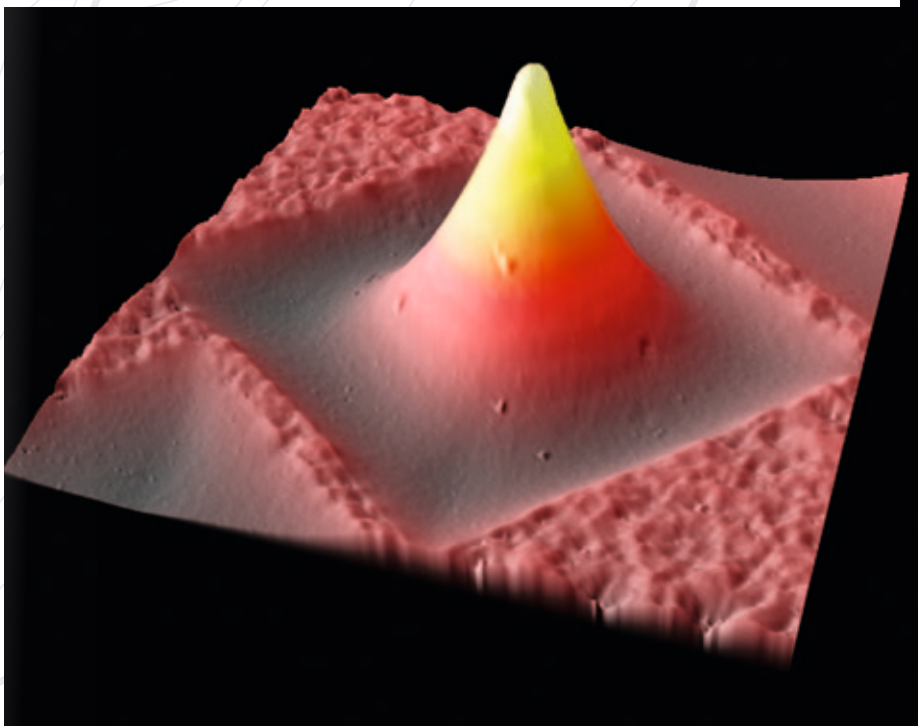
The integrated technologies of the Leica DCM 3D overcome the physical limits of conventional Profiling systems. With a single system it is possible to analyze rough (confocal) as well as smooth (Vertical Scanning Interferometry or VSI) and super smooth (Phase Shift Interferometry or PSI) surfaces. Sub-micron lateral resolution and a vertical resolution in the nm range is obtained in confocal mode, while large fields of view in combination with sub-nanometer Z resolution are acquired in the Interferometry mode.

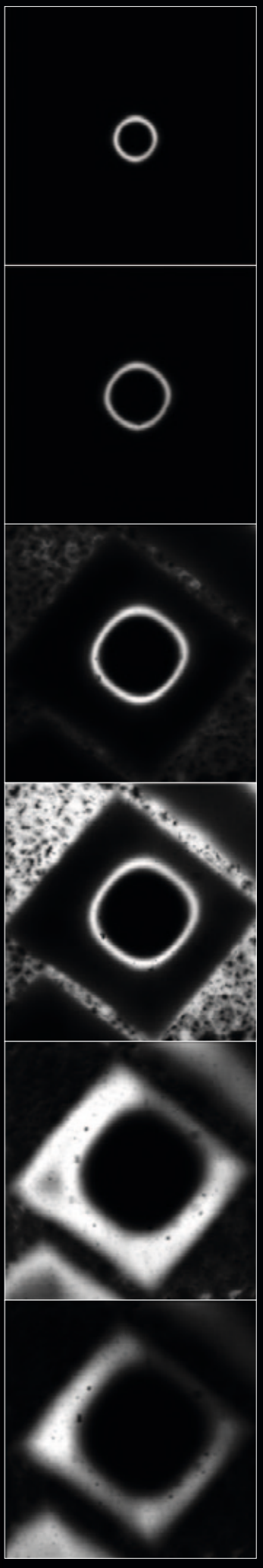


Characteristics of Confocal Profiling

The Confocal mode of the Leica DCM 3D is used to measure the topography of very rough to smooth surfaces. Even fine surface structures become visible without touching the sample surface. Within seconds the sample is scanned vertically in pre-defined steps during which every point on the surface passes through the focus level. All image information that is out of focus is eliminated, and acquired confocal images are providing detailed information of the sample in high resolution and contrast in all three dimensions.

Confocal profiling with the Leica DCM 3D provides the highest lateral resolution within seconds. However, main reason for applying confocal imaging for surface profiling is the possiblity to measure in the Z-dimension. Objectives with high NA (0.95) and high magnification are facilitating the measurement of smooth surfaces that may contain even steep local slopes with more than 70° inclination.

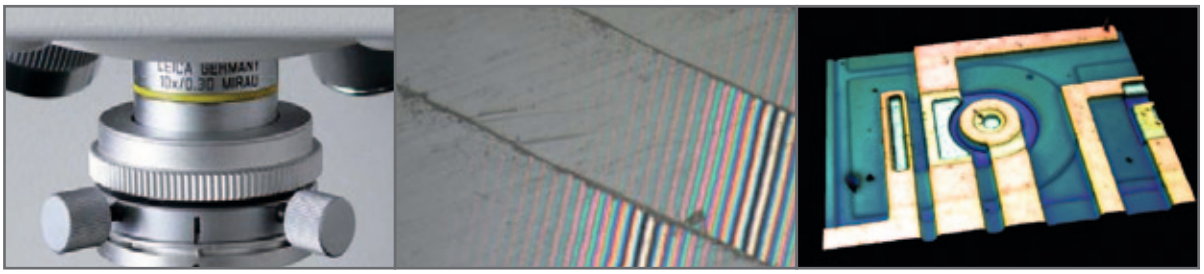




Benefit from a range of measuring principles

Obtain precise height information using interferometry

The Interferometry mode is applied to achieve the highest vertical resolutions. Inside a Leica interferometer objective, the light beam passes through a beam splitter, which simultaneously directs the light to both – the sample surface and an integrated reference mirror. The portion of light that is reflected from both the surface of the sample and the reference mirror recombines into a fringe interference pattern. This pattern provides a measure for the relative vertical position of the observed sample areas and therefore a highly accurate surface information. Depending on the required degree of vertical resolution, the user simply pushes a button to carry out a VSI (Vertical Scanning Interferometry) or a PSI (Phase Shift Interferometry) measurement.



VSI profiling for a variety of surfaces

White light Vertical Scanning Interferometer (VSI) mode is used to measure the surface height of smooth to moderately rough surfaces. Similar to confocal mode, the sample is scanned vertically in steps so that every point on the surface passes through the focus and the maximum fringe contrast occurs at the optimal focus position for each point on its surface. The height of the surface at each pixel location is found by detecting the peak of the narrow fringe envelopes.

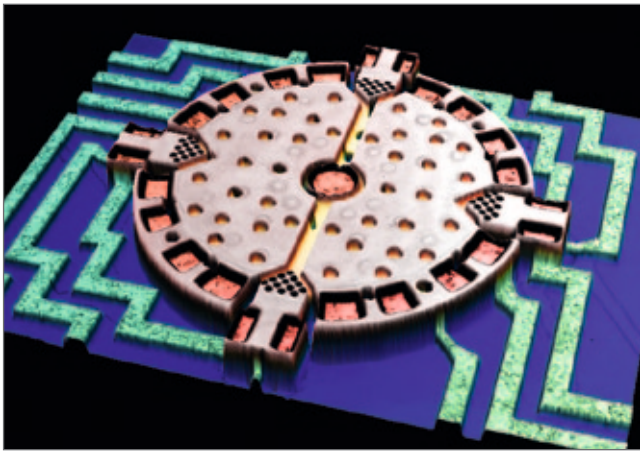
PSI Measurement of sub-nanometer height profiles

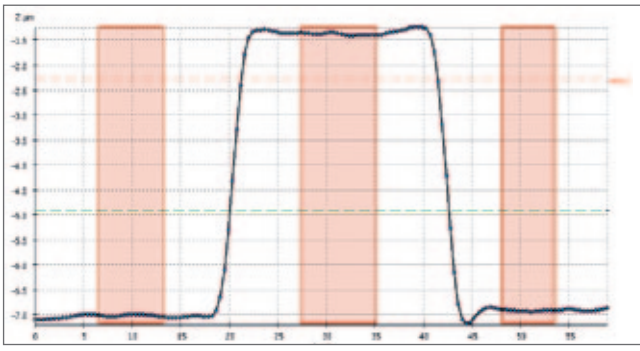
Phase Shift Interferometer (PSI) mode is used to achieve the highest resolution measurements of very smooth, continuous surfaces. In less than 3 seconds texture parameters of a super smooth surface such as a mirror-like bare wafer are measured with sub-nanometer resolution. To achieve this extreme level of resolution, the focused sample is scanned vertically in steps that are very accurate fractions of the wavelength. The profiling algorithms produce a phase map of the surface, which is converted to the corresponding height map via an unwrapping procedure

Double your advantages with Dual Core

Benefit from the Dual Core Technology

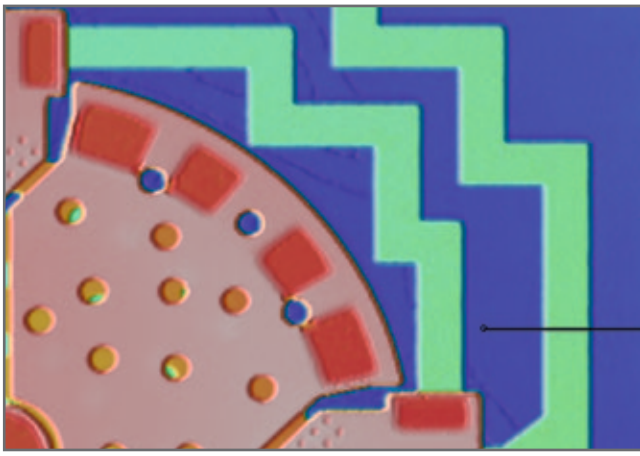
White light Optical Interferometric Profilers are often used because contact profilometers tend to be destructive to delicate surfaces and surface structures. Using the interferometry technology of the Leica DCM 3D sub-nanometer vertical resolutions are achieved, therefore even smoothest surfaces can be measured with high accuracy at an extreme speed. However in case of a measurement of rough surfaces the maximum slope that can be measured is limited by the comparably low numerical aperture (NA) of the interferometry objective. To allow the measurement even of steep slopes the Leica DCM 3D Dual Dore measuring microscope uses dedicated confocal objectives with an NA of up to 0.95 and high light efficiency. This results in its ability to measure from moderate smooth up to rough surfaces with highest repeatability and more than 70° of local slope.





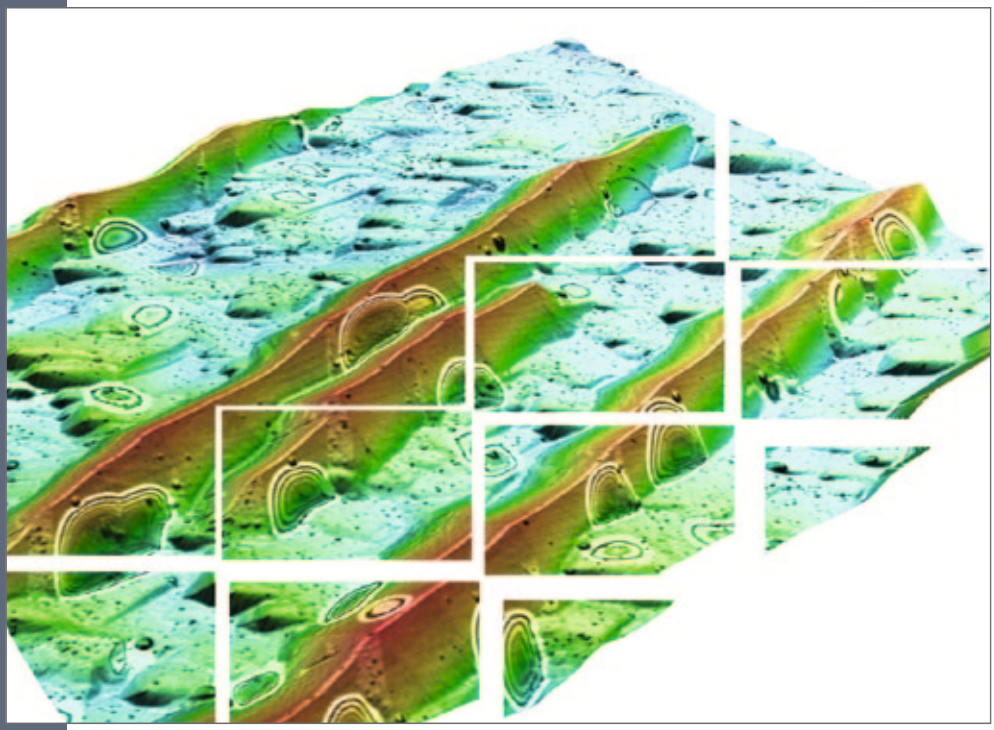
Surface texture characterization is easy

For quality control and production control e.g. of solar cells, the Leica DCM 3D confocal profiler can control within seconds the silicon surface texture, roughness, pyramid statistical characterization, and metal contact. Non-destructive 3D measurements of larger scanned regions are achieved in less than 10 seconds in comparison to lengthy time consuming measurements with conventional systems. The high local slope of a pyramid face requires the use of high NA objectives, which are mainly available with confocal technology. Typically a Leica objective with a magnification of 150× and an NA of 0.95 is used. The surface is scanned a few microns along the focus position of the objective, collecting the confocal images plane by plane. The result is an image with infinite focus and 3D information about the pyramid heights, which can automatically integrate into pre-defined reports.



See More of a Sample –

The quality control of microelectronic components may require the measurement of a small section of the sample as well as a fast overview of a larger scanning area. In addition, maximizing the throughput of a production line is often a critical factor for success. Typically an objective with a high numerical aperture (NA) is related to higher magnification, which reduces the field of view to a few microns only. To overcome this limitation of conventional systems, the Leica DCM 3D features an ultra fast topography stitching. By using the highly efficient XY-stitching mode, sections of acquired 3D models are composed together – in an area far larger than a single field of view. The final surface data shows a seamless, highly precise model of a large surface area of the sample including the perfectly in focus texture while keeping the original properties of a single field.



within a fraction of time

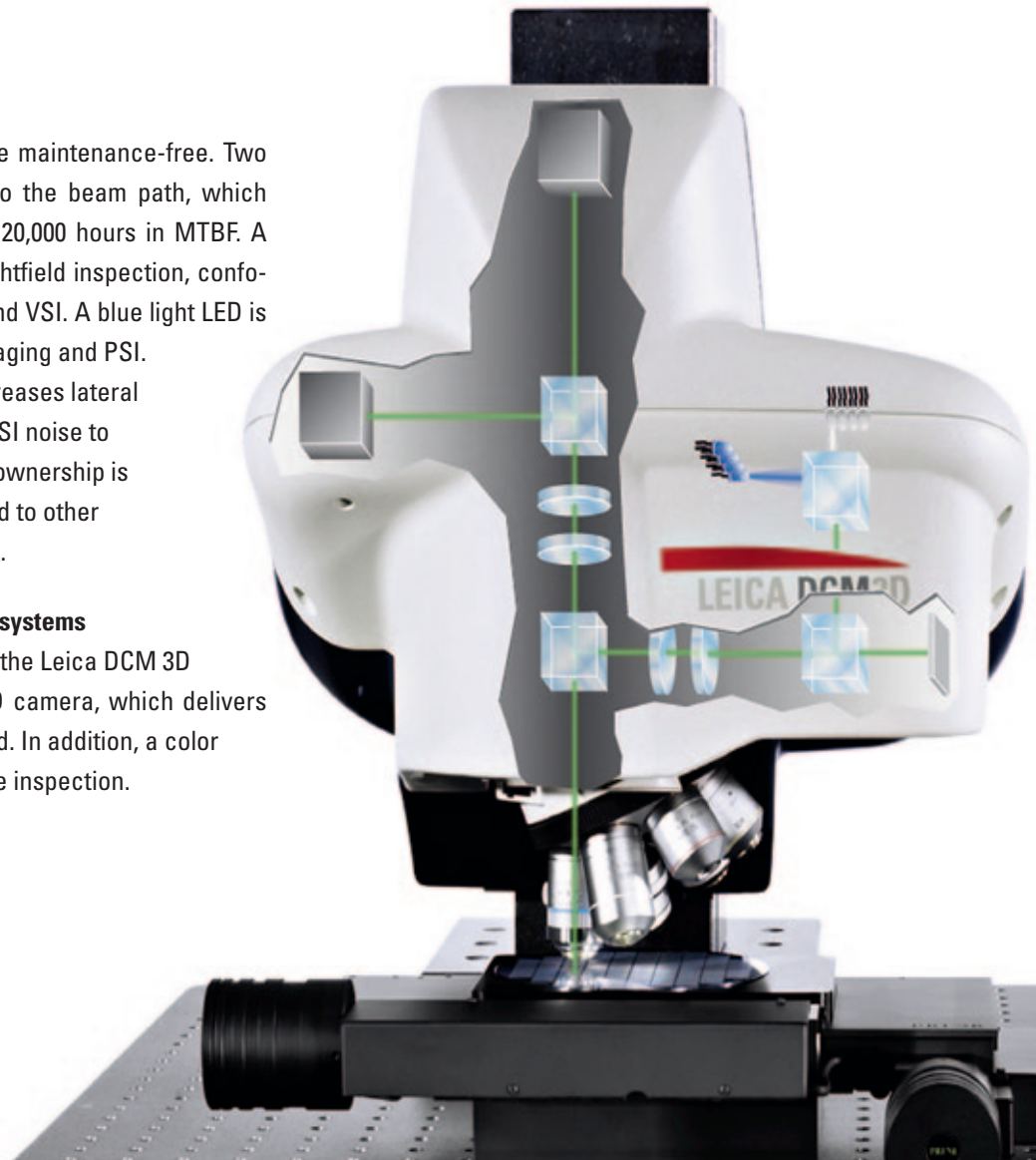
Little or no maintenance and better results

The Leica DCM 3D features vibration-free, long-lifetime scanning using microdisplay technology. Conventional confocal microscopes use movable mechanic parts inside scanning heads (scanning mirrors and spinning discs) that limit the instrument's lifetime, need a periodic re-adjustment to maintain optimum performance, and introduce mechanical vibrations that increase noise on the measurement. The Leica DCM 3D uses advanced microdisplay technology, a fast switching device with no moving parts inside that makes the scanning of confocal or interferometry images fast and stable with an extensive lifetime.

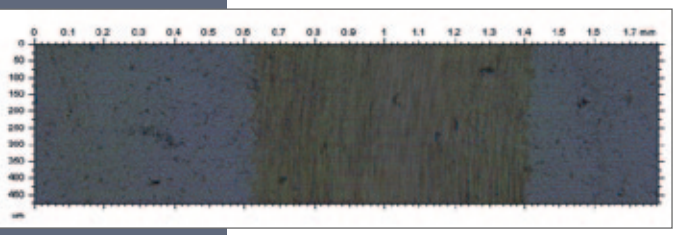
The Leica DCM 3D is designed to be maintenance-free. Two high-power LEDs are integrated into the beam path, which provides a long average lifetime of 20,000 hours in MTBF. A white light LED is used for color brightfield inspection, confocal images with real color texture, and VSI. A blue light LED is used for high-resolution confocal imaging and PSI.
The blue LED's short wavelength increases lateral resolution to 0.15 µm and improves PSI noise to 0.1 nm of vertical resolution. Cost of ownership is significantly reduced when compared to other spinning disk or laser-based systems.

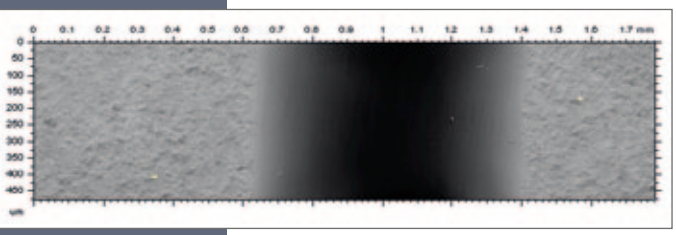
Make use of two integrated camera systems

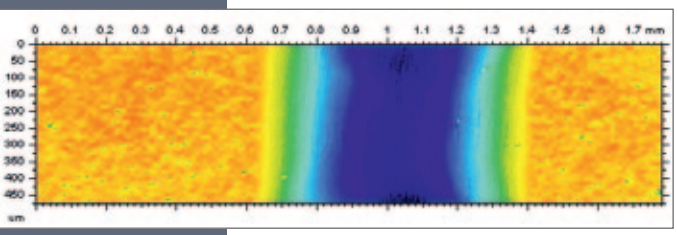
The main metrology image sensor of the Leica DCM 3D is an integrated high-resolution CCD camera, which delivers black and white images at high speed. In addition, a color camera is used for brightfield surface inspection.

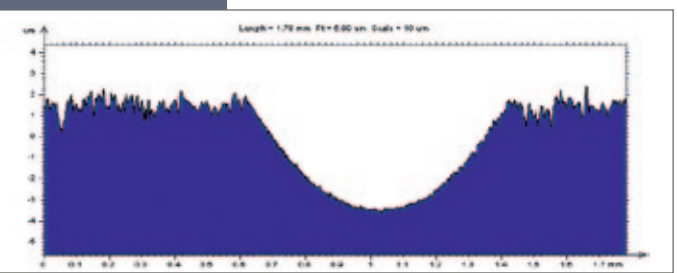


Customized, Easy-to-use System







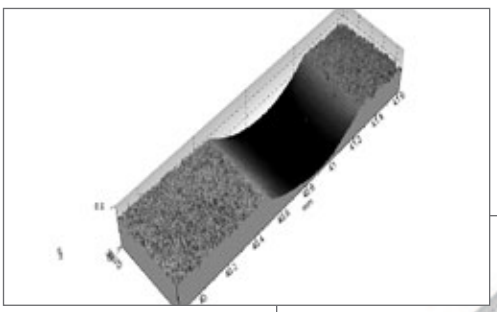


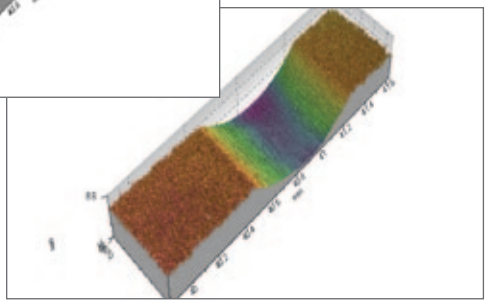
Create your own result standards

The acquistion software controls the automated functions of the Leica DCM 3D Dual Core profiler.

This software takes all measurements easily, and a basic set of tools for displaying and analyzing data is an integral part of the package. A few mouse clicks is all it takes to automatically make changes between techniques, illumination methods, and settings. For example a single button click reveals the measuring result: Just pressing the button “2D“ is enough to get the hight profile together with the 2 dimensional image of the sample, or pressing “3D“ to get the 3D result.

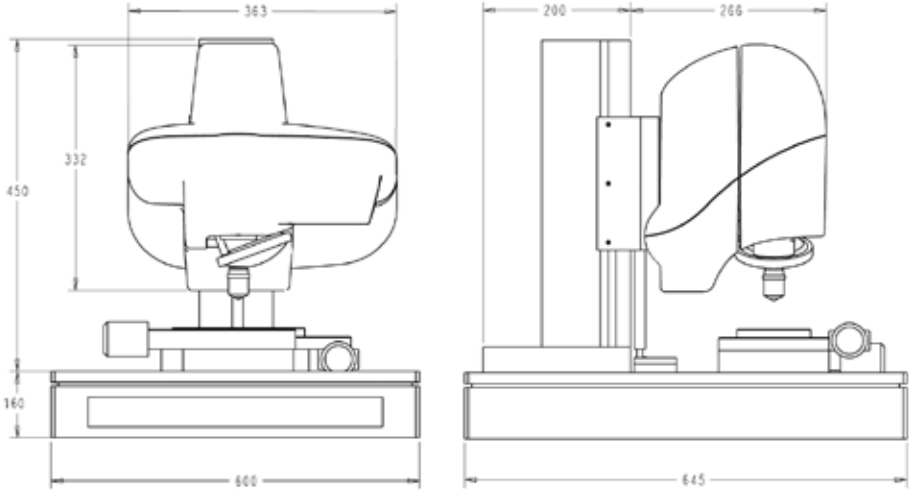
Automated measurements are obtained with the integrated Recipes tool, which further simplifies the user interface. Once a decision on a fully personalized report standard is made, all future results will be created using this report format. Several security measures and account based access levels are protecting methods and results.





General Specifications

Measuring principle	Dual Core Optical Imaging Profilometry (Confocal and Interferometry) non-contact, 3 dimensional				
Maintenance	Maintenance free				
Sample preparation	No specific sample preperation required				
Capabilities	Imaging, 3D-Topography, Profiles, Coordinates, Thickness, Roughness, Volume,				
	Surface Texture, etc .				
Contrasting modes	Confocal, Interferometry (PSI, ePSI, VSI), Brightfield Color,				
	Brightfield Greyscale (high resolution), Darkfield.				
Objectives	from 2.5× up to 150× in confocal				
	from 5× up to 50× in interferometry				
Nosepiece	6-fold objective revolver manual / 6-fold objective revolver motorized				
Stage travel range (x,y)	Manual: 200 × 100 mm (others on request). Manual stitching available				
	Motorized: From 114 × 75 mm to 302 × 302 mm (others on request).				
	Automatic stitching available over the full scanning range				
	Closed loop encoded stages for high precision stiching				
Illumination	High power white LED 530 nm for coaxial light, controllable				
	High power blue LED 460 nm for coaxial light, controllable				
Image Acquisition	2 Sensors: Metrology Sensor (B&W), Color Sensor (both high resolution CCD)				
Vertical Scanning Range	40 mm				
Sample Reflectivity	From 0.1% up to 100%				
Operating temperature	5ºC to 40ºC				
Ambient humidity	< 80% relative humidity				
Vibration Isolation	active or passive (recommended for Interferometry)				
Confocal mode					
Objective magnification	5×	10×	20×	50×	150×
Numerical Aperture	0.15	0.30	0.50	0.90	0.95
FOV (µm)	2550×1910	1270×950	636.61×477.25	254.64×190.90	84.83×63.60
Optical Resolution (X / Y) (µm)	0.94	0.47	0.28	0.16	0.14
Vertical resolution (nm)	<150	<30	<15	<3	<2
Vertical Scanning speed (µm/s)	20 – 320	10 – 160	5 – 80	1 – 16	0.5 – 8
Full Resolution Confocal Frame Rate	12.5 fps				
Typical measurement time	3 – 5 seconds				
Interferometry mode					
Objective magnification	5×	10×	20×	50×	
Numerical Aperture	0.15	0.30	0.40	0.50	
FOV (µm)	2550×1910	1270×950	630×460	254.64×190.90	
Optical Resolution Blue (X / Y) (µm)	0.94	0.47		0.28	
Optical Resolution White (X / Y) (µm)	1.08	0.56		0.34	
Vertical Resolution (nm)	PSI < 0.1 / ePSI < 1.0 / VSI < 4.0				
Vertical Range	PSI: 5 µm; ePSI 100 µm; VSI 10 mm				
Vertical Scanning speed (µm/s)	VSI/ePSI: 4 – 18 µm/s				
Typical measurement time	PSI:3 – 6s; VSI: 10s; ePSI: 30s				



Dimensions in mm

“With the user, for the user”
Leica Microsystems

Leica Microsystems operates globally in four divisions, where we rank with the market leaders.

• Life Science Division

The Leica Microsystems Life Science Division supports the imaging needs of the scientific community with advanced innovation and technical expertise for the visualization, measurement, and analysis of microstructures. Our strong focus on understanding scientific applications puts Leica Microsystems’ customers at the leading edge of science.

• Industry Division

The Leica Microsystems Industry Division’s focus is to support customers’ pursuit of the highest quality end result. Leica Microsystems provide the best and most innovative imaging systems to see, measure, and analyze the microstructures in routine and research industrial applications, materials science, quality control, forensic science investigation, and educational applications.

• Biosystems Division

The Leica Microsystems Biosystems Division brings histopathology labs and researchers the highest-quality, most comprehensive product range. From patient to pathologist, the range includes the ideal product for each histology step and high-productivity workflow solutions for the entire lab. With complete histology systems featuring innovative automation and Novocastra™ reagents, Leica Microsystems creates better patient care through rapid turnaround, diagnostic confidence, and close customer collaboration.

• Surgical Division

The Leica Microsystems Surgical Division’s focus is to partner with and support surgeons and their care of patients with the highest-quality, most innovative surgical microscope technology today and into the future.

The statement by Ernst Leitz in 1907, “with the user, for the user,” describes the fruitful collaboration with end users and driving force of innovation at Leica Microsystems. We have developed five brand values to live up to this tradition: Pioneering, High-end Quality, Team Spirit, Dedication to Science, and Continuous Improvement. For us, living up to these values means: **Living up to Life**.

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Australia:	North Ryde	Tel. +61 2 8870 3500	Fax +61 2 9878 1055
Austria:	Vienna	Tel. +43 1 486 80 50 0	Fax +43 1 486 80 50 30
Belgium:	Groot Bijgaarden	Tel. +32 2 790 98 50	Fax +32 2 790 98 68
Canada:	Richmond Hill/Ontario	Tel. +1 905 762 2000	Fax +1 905 762 8937
Denmark:	Ballerup	Tel. +45 4454 0101	Fax +45 4454 0111
France:	Nanterre Cedex	Tel. +33 811 000 664	Fax +33 1 56 05 23 23
Germany:	Wetzlar	Tel. +49 64 41 29 40 00	Fax +49 64 41 29 41 55
Italy:	Milan	Tel. +39 02 574 861	Fax +39 02 574 03392
Japan:	Tokyo	Tel. +81 3 5421 2800	Fax +81 3 5421 2896
Korea:	Seoul	Tel. +82 2 514 65 43	Fax +82 2 514 65 48
Netherlands:	Rijswijk	Tel. +31 70 4132 100	Fax +31 70 4132 109
People’s Rep. of China:	Hong Kong	Tel. +852 2564 6699	Fax +852 2564 4163
Portugal:	Lisbon	Tel. +351 21 388 9112	Fax +351 21 385 4668
Singapore		Tel. +65 6779 7823	Fax +65 6773 0628
Spain:	Barcelona	Tel. +34 93 494 95 30	Fax +34 93 494 95 32
Sweden:	Kista	Tel. +46 8 625 45 45	Fax +46 8 625 45 10
Switzerland:	Heerbrugg	Tel. +41 71 726 34 34	Fax +41 71 726 34 44
United Kingdom:	Milton Keynes	Tel. +44 1908 246 246	Fax +44 1908 609 992
USA:	Bannockburn/Illinois	Tel. +1 847 405 0123	Fax +1 847 405 0164

and representatives in more than 100 countries

In accordance with the ISO 9001 certificate, Leica Microsystems (Switzerland) Ltd, Industry Division, has at its disposal a management system that meets the requirements of the international standard for quality management. In addition, production meets the requirements of the international standard ISO 14001 for environmental management.

www.leica-microsystems.com

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