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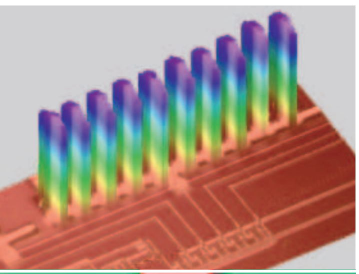
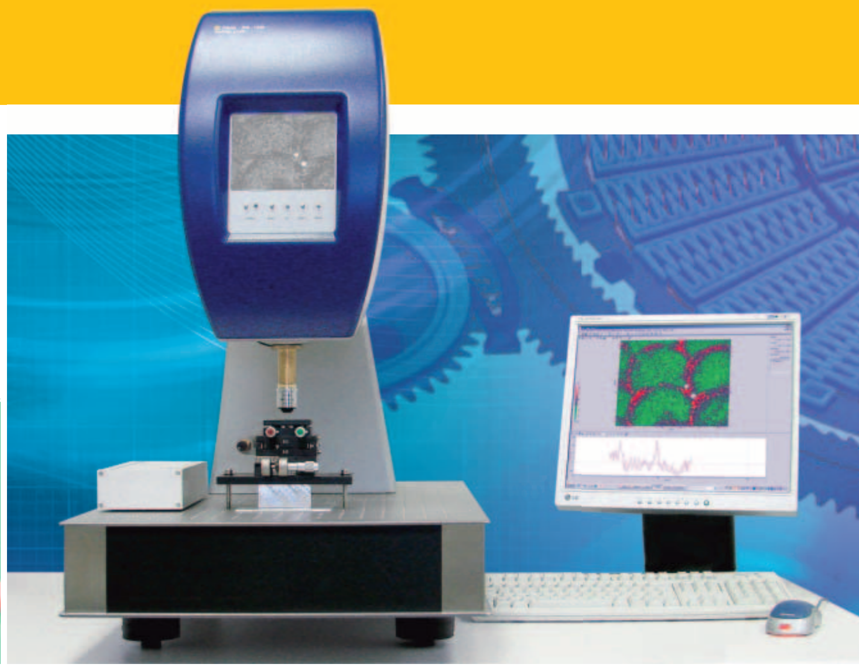
TMS-1200 TopMap µ.Lab





Polytec Surface Metrology

- TopMap Metro.Lab for Benchtop Convenience
- TopMap In.Line for Industrial Environments
- **TopMap µ.Lab for Microscopic Detail**
- TopSens/TopLine Point/Line Sensors

Microscope-Based Non-Contact Topography and Surface Parameter Measurement

With its high spatial resolution, the TMS-1200 TopMap µ.Lab measurement microscope sets new standards in non-contact topography measurement. Simple, quick and precise, it acquires high-resolution topographical maps of functional surfaces and microstructures to determine critical parameters such as flatness, ripple and roughness.

Rapid and High Precision

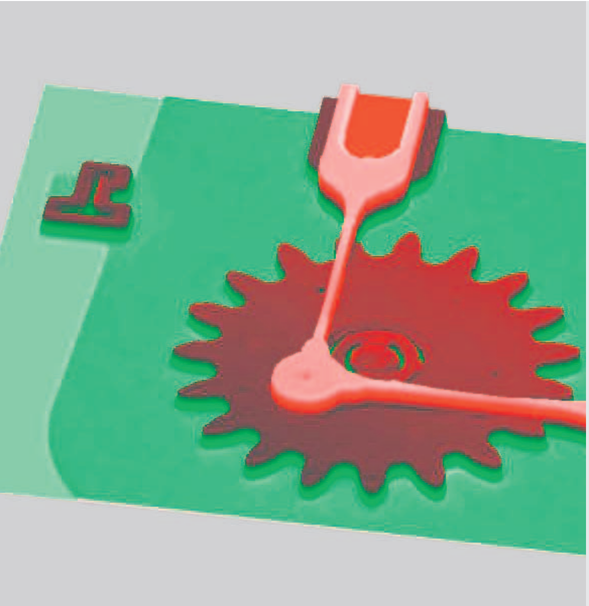
TopMap µ.Lab, with its high lateral resolution, is specifically designed for the micro-topography characterization of functional surfaces and microstructures. Using a scanning white-light interferometer, the µ.Lab rapidly measures flatness, waviness, roughness and general topography with sub-nanometer resolution. It is the perfect solution for products in development or quality control, offering the ability to measure surfaces with different reflectivities by using the Smart Surface Scan technique.

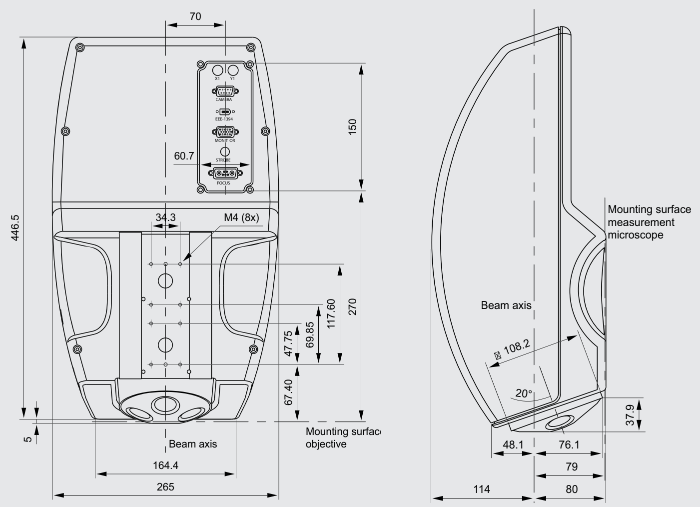
Sophisticated Design

The TopMap µ.Lab is a complete white-light interferometric measurement microscope workstation for micro-topography measurement on almost any surface. A special objective lens generates an interference pattern of the test sample. This interference pattern is imaged by a digital camera. By scanning the interference objective with nanometer precision, a series of interference patterns are generated and then recorded by the camera.

Features

- Rapid, non-contact 3-D topography measurement with sub-nanometer resolution
- Determination of structure heights and shape on both rough and specular surfaces
- Smart Surface Scan technique copes with different contrast levels
- Powerful TMS software for topography and surface characterization
- 2-D and 3-D presentation with video overlay
- Optional stitching for extending the field-of-view





Dimensions of the TopMap µ.Lab Measurement Microscope (in mm)

The result is an X-Y-Z topography measurement of the test object with high spatial resolution and precise Z values. The powerful analysis software uses the data set to determine shape, curvature, flatness and roughness. Its open software architecture allows for custom programming of routinely repeated measurement tasks using C# add-ins and for the customization of the user interface. The user can process the data using envelope or phase evaluation, as well as various filtering and masking techniques. For enhanced capabilities, a report software package is available. Objects larger than the optical field-of-view can be measured by translating the object and stitching the topography measurements. This enhancement is available with translation shifts of 50 mm in both the X and Y directions. The total surface is then assembled from the individual measurements by the TMS software, allowing significantly larger measurement areas.

TMS Software

- User interface for measurement and data evaluation
- Live video for placement and adjustment of the measurement sample
- Linear and areal surface parameters, form parameters like step height and flatness
- 2-D and 3-D data presentation
- Profile cuts, angle measurements, high pass and low pass filters
- Add-in programming in C# ®
- Direct data export as ASCII file
- Optional software expansions: customer-specific C# add-ins
- Additional software packages for special analysis tasks available

TopMap µ.Lab Specifications

Hardware	Controller	Measurement Microscope
Dimensions [L x W x H]	244 mm x 108 mm x 50 mm	Refer to figure
Weight	0.9 kg	10.4 kg (1)
Power	100 ... 240 VAC ±10 %, 50/60 Hz; max. 30 W	
Operating temperature	+5 °C ... +40 °C (41 °F ... 104 °F)	
Storage temperature	–10 °C ... +65 °C (14 °F ... 149 °F)	
Relative humidity	max. 80 %, non-condensing	

(1) Without objectives and focus block

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Specialists in Micro-Topography of Fine Structures

By using short-coherent white light, the TopMap µ.Lab Microscope System features a very high lateral resolution, enabling topography measurements on microstructures. It offers high performance analysis options for characterizing micro-sensors, micro-actuators, structured plates and bearing surfaces. Large surfaces can be characterized by stitching several measurements together.

Microstructured Surfaces

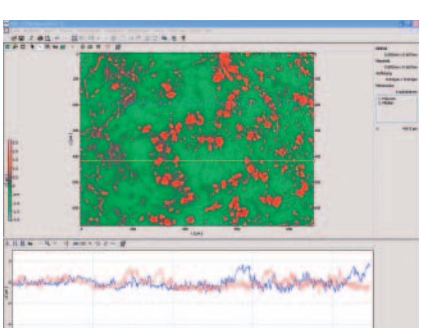
Functional surfaces often require the presence or absence of certain structural characteristics. For example, the type and frequency of pores is an important characteristic for determining the lubricant choice for a frictional surface. Additionally, in the automotive industry, engine surfaces or connecting rod eyes must match the right lubricant to avoid premature part failure; the same applies to structures for improved adhesion of coatings in the steel industry. In contrast to verifying designed structures, there are also unwanted structures which must be found and eliminated to avoid harmful frictional forces or unwelcome vibrations.

Microstructure Technology

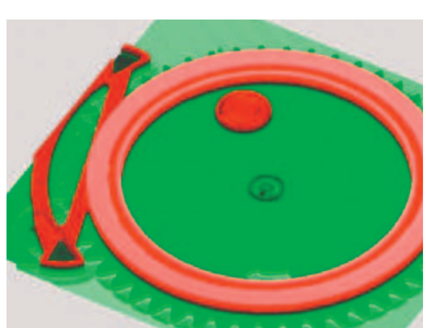
The topography of small components contained in microsystems must be verified to check that the components are within the required dimensions. Microelectromechanical systems (MEMS) and their subcomponents, such as miniature cogwheels and gears, are examples of critical next generation technologies that depend on precision metrology.

Micro Material Processing

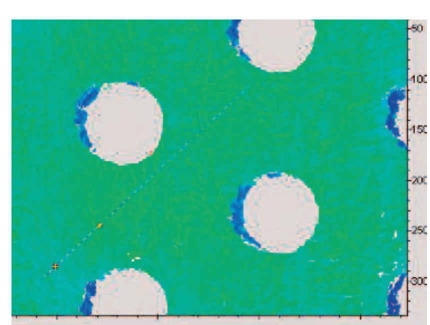
Topography measurements with high lateral resolution are also important when determining the material ejected or distorted during lift-off or deposition processes or while laser machining or etching critical features. Other examples are selective surface texturing to produce predefined frictional surfaces, and the preparation of very small drill holes.



Microstructure of an AluSil cylinder surface



Micro gearwheel



Atomizer membrane with holes and ejecta

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Specifications

Optics					
Measurement method		Scanning white-light interferometry (Michelson/Mirau objectives)			
Light source		Long-lifetime LED, 525 nm wavelength			
Camera		Progressive scan CCD camera, 1392 (H) x 1040 (V) pixels			
Piezo travel range		Max. 250 µm			
Objective	**Magnification**	**Stand-off distance (1) (mm)**	**Field of view (mm x mm)**	**Pixel resolution (µm)**	**Numerical aperture NA(2)**
Standard (Mirau)	10X	7.40	0.90 x 0.67	0.65	0.30
Optional					
Michelson objectives	2.5X 4X 5X	10.3 >30 9.3	3.59 x 2.68 2.24 x 1.68 1.8 x 1.34	2.58 1.61 1.29	0.075 0.10 0.13
Mirau objectives	20X 50X 100X	4.7 3.7 2.0	0.45 x 0.335 0.18 x 0.134 0.09 x 0.067	0.323 0.129 0.065	0.40 0.55 0.7

(1) The stand-off distance results from the parfocal length (95 mm) minus the length of the objective mounted. For the exact values please ask your local Polytec sales/application engineer.

(2) Optical resolution can be calculated by 0.61 · λ/NA (Rayleigh criterion)

Measurement Performance				
Sampling increment	10 nm		87 nm	
Evaluation procedure (1)	Smooth surface	Rough surface	Smooth surface	Rough surface
Resolution (RMS) (2)	35 pm	350 pm	45 pm	1.2 nm
Resolution$_{single}$ (RMS)	195 pm	3.65 nm	300 pm	14 nm
Repeatability (3)	250 pm	2.5 nm	500 pm	20 nm
Average flatness deviation (4)	550 pm	7.5 nm	2 nm	50 nm
Measurement performance on a traceable calibrated standard, PTB Type A1 (ISO 5436-1)				
Repeatability (5)				0.07%
Expanded uncertainty of measurement (6)				0.35%
Measurement time				
Calculation	Measurement time = (Z range + 6 µm) / (sampling increment x frame rate)			
Examples (7)	~1.2 min (10 nm sampling increment)		~8 s (87 nm sampling increment)	

(1) “Smooth surface”: Evaluation of the correlogram phase. “Rough surface”: Evaluation of the correlogram envelope

(2) Root mean square (RMS) of the signal amplitude at an averaging number of 50 measurements on a silver coated, parallel aligned plane mirror, measured under vibration-damped, temperature controlled conditions. Values for Resolution$_{single}$ correspond to single measurements

(3) Standard deviation of the measured flatness in a series of 100 measurements on an optical flat (λ/20) slightly tilted

(4) Mean value of the flatness (according to ISO 1101), see (3)

(5) RMS deviation of 30 step height measurements, referred to a calibrated step height of nominal 50 µm

(6) 3x combined standard uncertainty + deviation of the nominal value at 30 consecutive measurements under repeating conditions. The combined standard uncertainty is the quadratic mean out of the uncertainty of the normal and the standard deviation of the measurement values.

(7) Conditions: Z range 15 µm, frame rate 30/s, without averaging

You can find more information at **www.topmap.info**, or ask for advice from one of our product specialists: **info@polytec.com** (US), **oms@polytec.de** (all other regions).

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