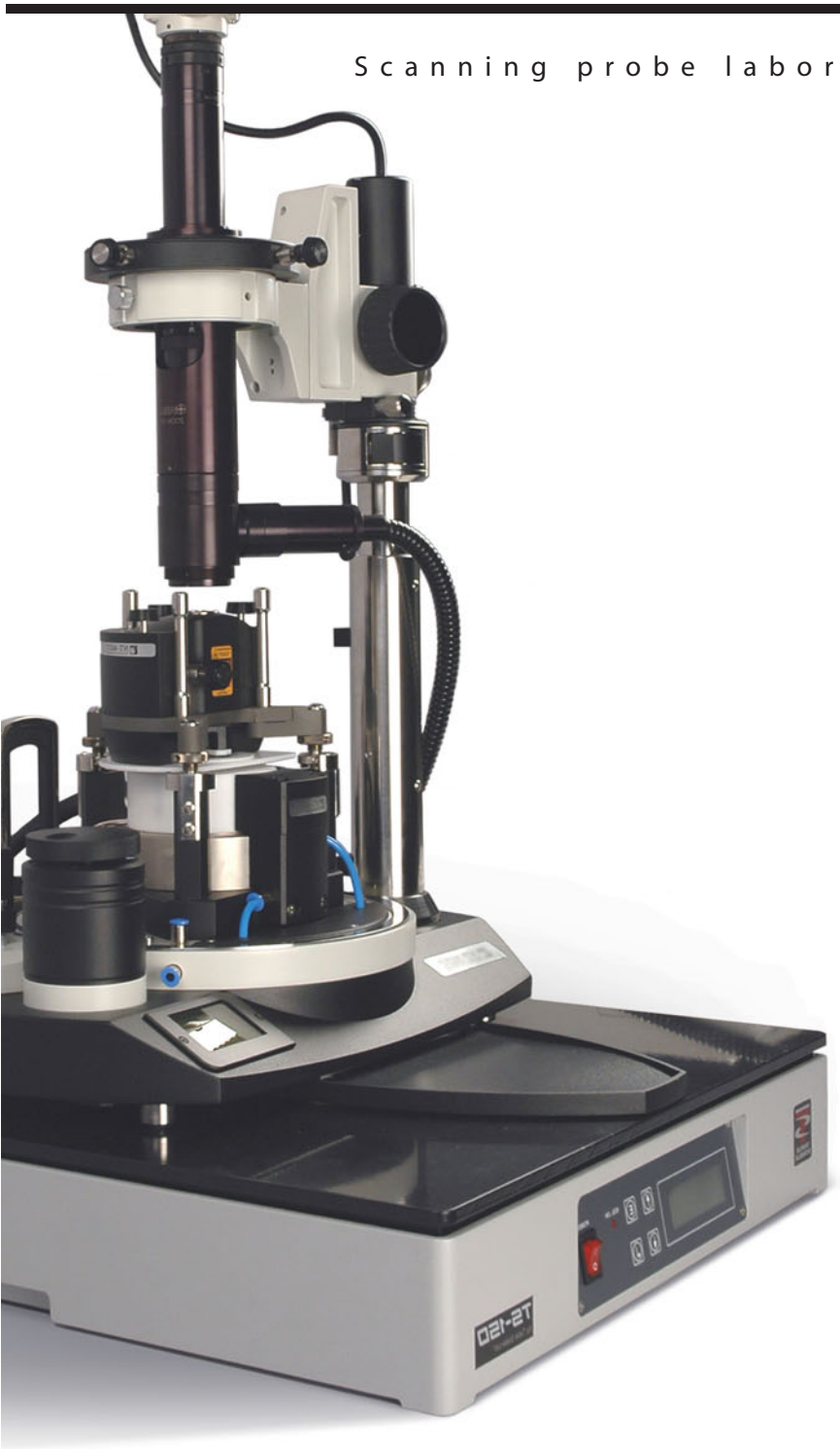
NT-MDT
Molecular Devices and Tools for NanoTechnology

NTEGRA
Scanning probe laboratories

IT'S TIME FOR I**NTEGRA**TION!

TEGRA

Scanning probe laboratories



NT-MDT

Molecular Devices and Tools for NanoTechnology

President's word

Nanotechnology is exploding. The world of small sizes has never been as vital for so many directions in science and industry. With this new direction comes a greater need for measurement on the atomic scale and new demands for reliable, precise, and multi-purpose instrumentation.

NT-MDT enjoys a 15-year history in instrumentation created specifically for nanotechnology research, leading the field in originality, quality, and high tech development. Our product lines are constantly expanding. Today, we manufacture accessories and supplies for scanning probe microscopy, simple SPMs for education, and multi-purpose, specialized SPMs for scientific research, industry, and nanotechnology centers.

For advanced research and nanotechnology centers, our multi-purpose **NTEGRA** SPM based systems create a core around which your lab can build a full spectrum of analytical operations, opening new avenues for simultaneously integrating multiple scientific studies such as imaging, metrology, and spectroscopy. And, for micro- and nanoelectronics, our modular "Nanofactories" unite a full arsenal of production and metrology techniques for development, processing, and quality assurance on both chips and devices.

NT-MDT offers expert service and applications development through more than 20 representative offices and distributor centers around the globe. In 2000 and 2002, two key branch offices were opened in Holland and America. In the past five years, our installed base has grown to over 500 instruments, promoting growth of both lab and research programs world-wide.

Victor A. Bykov, Ph.D.
president, NT-MDT Co.

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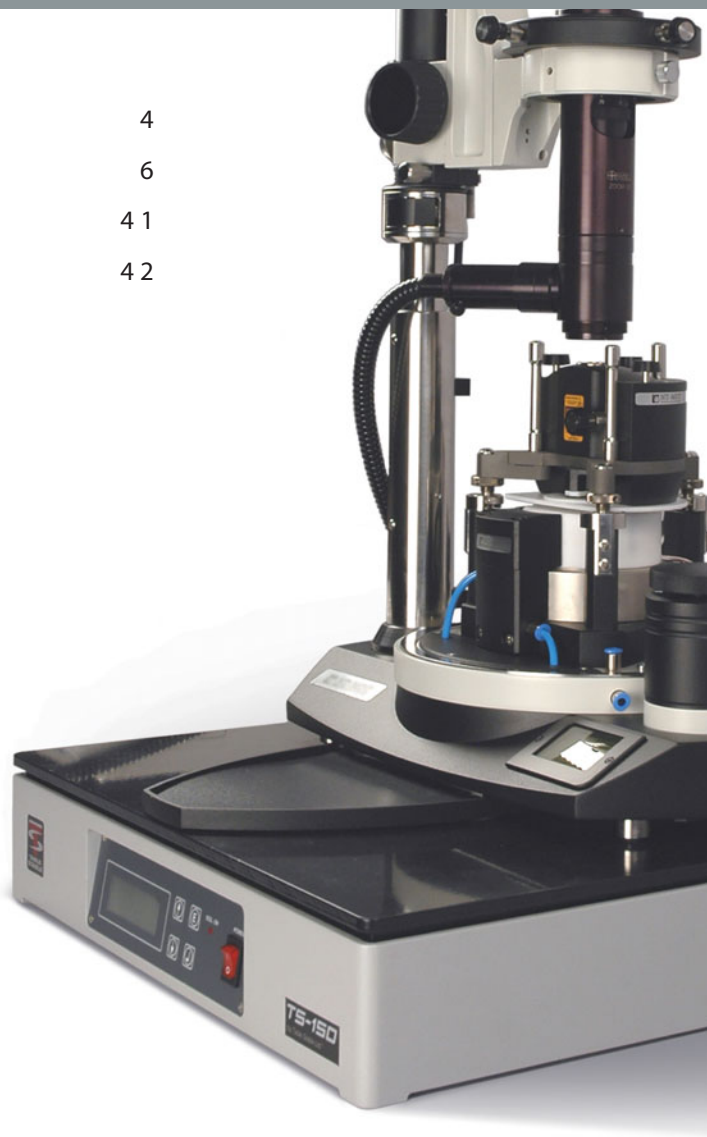


Introducing NTEGRA:

Central to NT-MDT's philosophy of the integrated lab is the **NTEGRA** line.

NTEGRA's *name (pronounced as in-'te-gr&) is derived from three sources:*

1) *In Latin, "integre" means perfect, absolute, or complete. For ages these ancient languages have been associated with "pure" and"absolute" scientific character. NTEGRA's Latin and Greek roots are reiterated in the naming for its models, from Solaris and Prima to Vita and Spectra.*
2) *The concept of "completeness" reflects the NanoLaboratory concept: Each specialized system serves as a core for the whole laboratory.*
3) *"NT," the first two letters in NTEGRA reflect key letters in both NanoTechnology and our company name, NT-MDT...*

The NTEGRA concept

NTEGRA is a revolutionary technological concept. It was designed specifically to form an SPM-based platform within which cutting-edge methods from other scientific analyses such as spectroscopy and sample preparation could be integrated. All the systems assembled on the **NTEGRA** platform share the same SPM core, electronic controllers and software. As a result, any **NTEGRA** base unit built for one particular application can easily be modified into a system suitable for another, very different application. The result: a complete solution for research, industry, and nanotechnology.

One integrated concept, many built-for-purpose models

Currently NT-MDT offers eight versions of the systems assembled on the NTEGRA platform. For superior performance, each system has its own application specialization.

NTEGRA Prima is a high-resolution, low-noise SPM ideal for the multi-user labs. Integrated optics coupled to the SPM provides imaging of samples with almost continuous zoom from the millimeter to angstrom range.

NTEGRA Therma performs SPM measurements either at constant temperatures from -30 °C to 300 °C or with changing temperature. Our low-drift THead maintains a drift of less than 15nm/°C.

NTEGRA Aura performs measurements in vacuums down to 10-2 torr or under controlled atmosphere environments.

NTEGRA Maximus, unique in the industry, performs high throughput screening of multiple samples as well as measurements on large samples.

NTEGRA Solaris uses Scanning Near-Field Optical Microscopy (SNOM) to investigate optical properties beyond the conventional limits imposed by diffraction.

NTEGRA Vita combines the strengths of SPM with an inverted optical microscope for biological and medical applications.

NTEGRA Tomo, another industry-leading NT-MDT invention, integrates a Scanning Probe Microscope with an ultramicrotome to perform AFM tomography and 3D reconstruction of biological and materials ultrastructure never seen before.

NTEGRA Spectra integrates SPM with Raman spectrometry and laser confocal microscopy to study the distribution of chemical properties with molecular resolution.

Model line

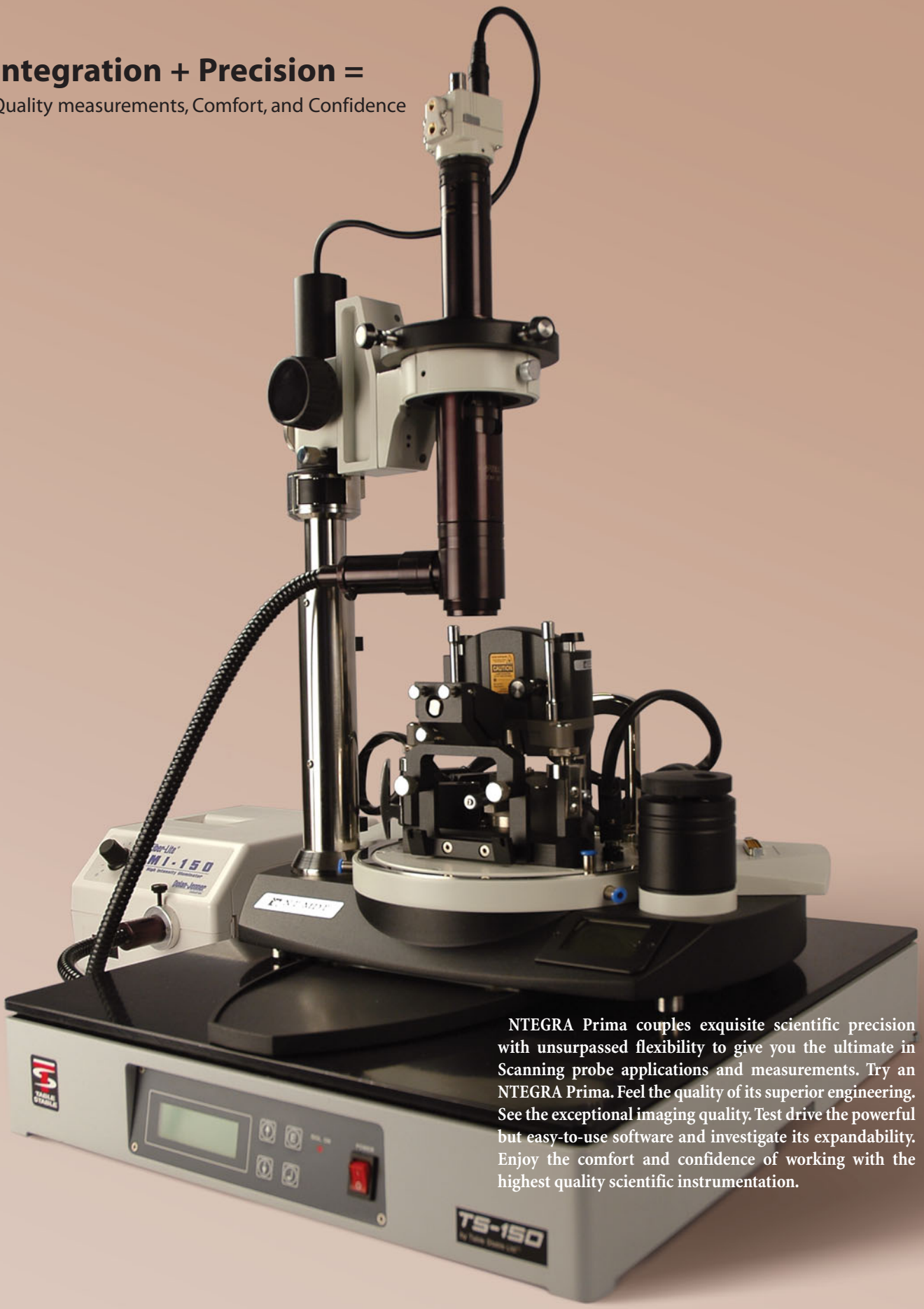
NTEGRA Prima 7
NTEGRA Therma 11
NTEGRA Aura 15
NTEGRA Maximus 19
NTEGRA Solaris 23
NTEGRA Vita 27
NTEGRA Tomo 31
NTEGRA Spectra 35

Benefit from precise motion

NTEGRA Prima

Integration + Precision =

Quality measurements, Comfort, and Confidence



NTEGRA Prima couples exquisite scientific precision with unsurpassed flexibility to give you the ultimate in Scanning probe applications and measurements. Try an NTEGRA Prima. Feel the quality of its superior engineering. See the exceptional imaging quality. Test drive the powerful but easy-to-use software and investigate its expandability. Enjoy the comfort and confidence of working with the highest quality scientific instrumentation.

One core, unlimited functionality

NTEGRA Prima brings extraordinary freedom to your research. Now, one system can be used to investigate tiny, large, even massive samples. NT-MDT DualScan mode extends the conventional scanning range to 200 µm. The scanning head can also be used as a portable, stand-alone device, making it possible to measure samples of unlimited size.

NTEGRA Prima's standard configuration includes everything necessary for atomic resolution imaging in ambient and even in fluid environment. Start with a simple scanner and base then, as your needs grow, choose from dozens of techniques available in **NTEGRA** Prima to analyze your sample surface.

Not only does **NTEGRA Prima** provide all of the conventional techniques such as topography, phase, and magnetic force measurements, it extends to techniques that are unique to NT-MDT. For example, NT-MDT *Scanning Capacitance Microscopy* (SCM) maps variations in electron carrier concentration across the sample surface with the unprecedented sensitivity (1 aF), setting the international standard for capacitance measurements.

Atomic Force Acoustic Microscopy (AFAM), the latest tool used for advanced research in elasticity, is another NT-MDT exclusive. An easy-to-install accessory, AFAM uses local elasticity to provide direct and non-destructive imaging of polymer domains and texture as well as direct, quantitative measurement of Young's modulus and related surface parameters including adhesion and friction.

Quality and Precision – accurate, reproducible measurements

When working at the atomic scale, precision positioning is critical. To guarantee that precision, the full **NTEGRA** line features specifically engineered, built-in, closed loop capacitive sensors. Even when scanning areas are as small as 50x50 nm, their exceptionally low noise levels (down to 0.1 nm typically) allows **NTEGRA** to image and modify the surface with the sensors engaged.

The reliable scanner feedback assures high accuracy in the quantitative measurements of interaction forces between the probe and sample surface

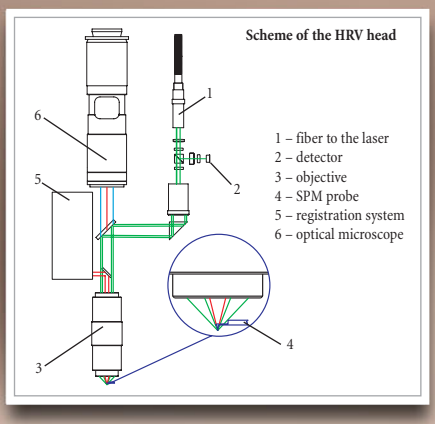
Focus on what's important

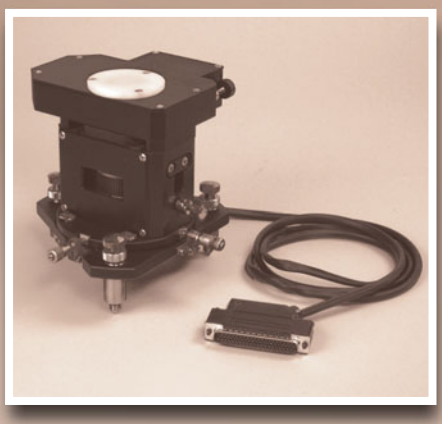
Using the integrated optical viewing system, find just the right area to measure. Zoom in to target your SPM tip on that exact area then control the scanning process in real time and compare optical image to the SPM information. Need still higher resolution? Drop the optical resolution on the **NTEGRA** Prima to 0.4 µm with the unique HRV (High Resolution Viewing) system. By combining the optical viewing system with either an STM or AFM head into one module, the HRV allows you to peer under the working probe. Interested in going to the next level? The same head provides laser input/output and focusing of the laser spot under the probe, expanding conventional scanning probe technology to include TERS[1] or apertureless SNOM[2] experiments on opaque samples.

One Core, Next-generation integration

NTEGRA Prima is just the beginning. Designed by NT-MDT professional R&D engineers with totally open architecture for hardware, software, and signal integration, this nanolaboratory forms the platform for interfacing with advanced spectroscopy, microtomy, high-throughput screening and thermal accessories to form the next-generation of integrated analytical instrumentation. Whether your SPM needs are simple or bleeding-edge, **NTEGRA** Prima can form the foundation for successful imaging and measurement in your lab.

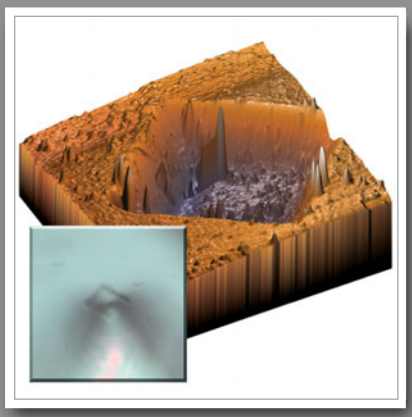
Design solutions. HRV (High-Resolution Viewing) head.



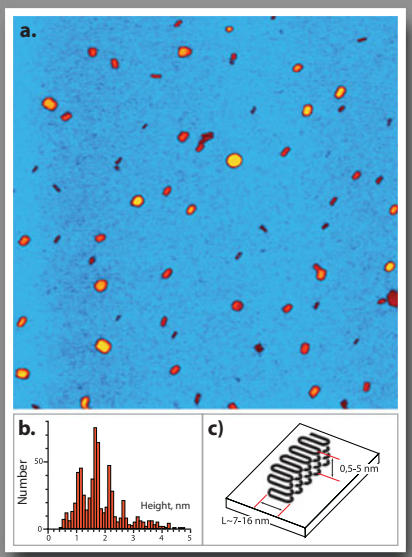


[1] Tip Enhanced Raman Scattering
[2] Scanning Near-field Optical Microscopy

Silicon Test Echeloned Pattern STEPP.
Monatomic step image with closed-loop on.
Step height 0.31 nm. Scan size: 7x7 µm.



AFM image of a 5 µm crater and its optical image captured during the scanning process. The probe tip looks as a transparent "ghost" and does not obstruct optical imaging.



a) UHMW-PE single-molecule nanocrystallites on mica. AFM Topography image. Scan size 800x800 nm.
b) Typical histogram of the nanocrystallites height distribution for the population of 614 nanoparticles. The height is quantized with a step of approximately 0.5 nm (PE-chain diameter).
c) Simplified model of the nanocrystallite structure.

Scanning probe microscopy

In air&liquid: AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Phase Imaging/Force Modulation/ Adhesion Force Imaging/ Lithography: AFM (Force)

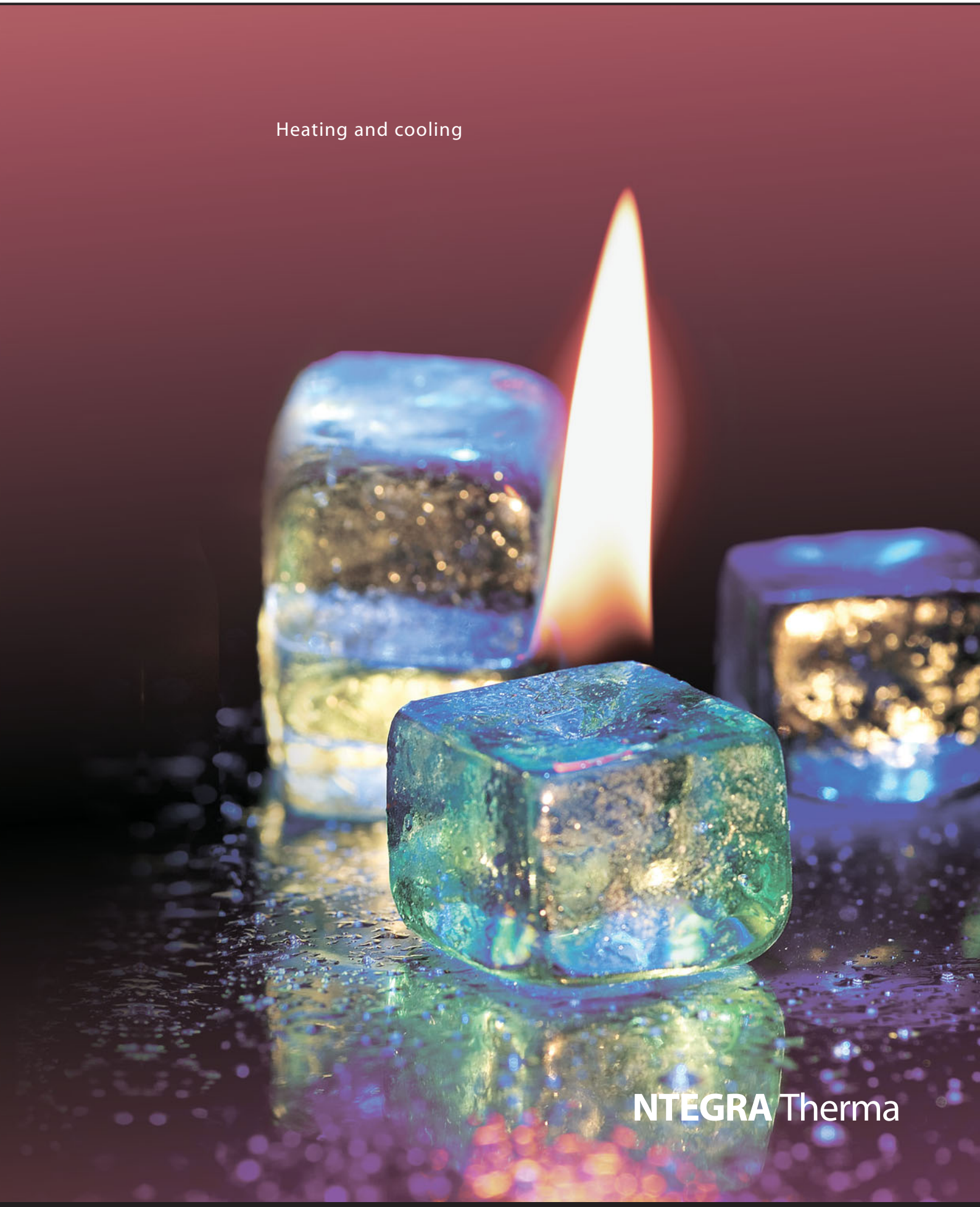
In air only: STM/ Magnetic Force Microscopy/ Electrostatic Force Microscopy/ Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Current), STM/ AFAM (optional)

Specification / Scan type		Scanning by sample	Scanning by probe*
Sample size		Up to ∅40 mm, up to 15 mm in height	Up to ∅100 mm, up to 15 mm in height
Sample weight		Up to 100 g	Up to 300 g
XY sample positioning range		5x5 mm	
Positioning resolution		5 µm	
Scan range		100x100x10 µm 3x3x2.6 µm	100x100x10 um 50x50x5 µm
		Up to 200x200x20 µm ** (DualScan™ mode)	
Non-linearity, XY (with closed-loop sensors)		⩽0.1%	⩽0.15%
Noise level, Z (RMS in bandwidth 1000 Hz)	With sensors	0.04 nm (typically), ⩽0.06 nm	0.06 nm (typically), ⩽0.07 nm
	Without sensors	0.03 nm	0.05 nm
Noise level, XY* ** (RMS in bandwidth 200 Hz)	With sensors	0.2 nm (typically), ⩽0.3 nm (XY 100 µm)	0.1 nm (typically), ⩽0.2 nm (XY 50 µm)
	Without sensors	0.02 nm (XY 100 µm) 0.001 nm (XY 3 µm)	0.01 nm (XY 50 µm)
Linear dimension estimation error (with sensors)		±0.5%	±1.2%
Optical viewing system	Optical resolution	1 µm (0.4 µm optional, NA 0.7) ****	3 µm
	Field of view	4.5-0.4 mm	2.0-0.4 mm
	Continuous zoom	available	available
Vibration isolation	Active	0.7-1000 Hz	
	Passive	above 1 kHz	

* Scanning head can be configured to serve as a stand-alone device for specimens of unlimited sizes.
** Optionally can be expanded to 200x200x20 µm.
*** Built-in capacitive sensors have extremely low noise and any area down to 50x50 nm can be scanned with closed-loop control.
**** High Resolution Viewing system (HRV head) is optional and provides additional functionality making it possible to generate and detect tip-localized aperture less near-field effects.

Articles:
• D. Azulay, M. Eylon, O. Eshkenazi, D. Toker, M. Balberg, N. Shimoni, O. Millo, and I. Balberg Electrical-Thermal Switching in Carbon-Black-Polymer Composites as a Local Effect The Racah Institute of Physics, The Hebrew University, Jerusalem 91904, Israel Physical Review Letters VOLUME 90, NUMBER 23 (2003)
• P.J. Ajikumar, M. Kamruddin, R. Nithya. P. Shankar, S. Dash, A.K. Tyagi, Baldev Raj. Surface nitridation of Ti and Cr in ammonia atmosphere. Scripta Materialia 51, 361-366 (2004).

Heating and cooling

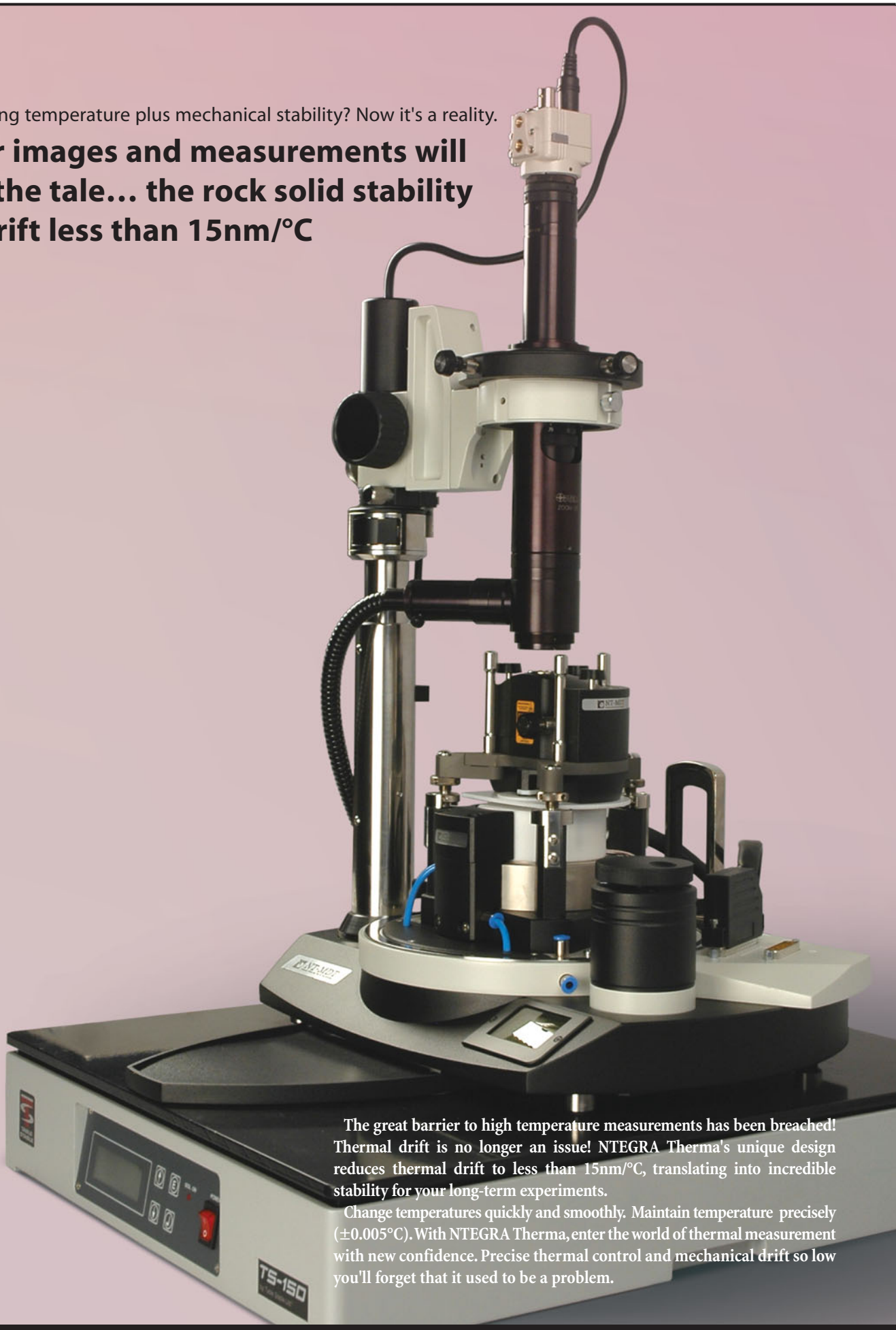


NTEGRA Therma

NTEGRA Therma

Changing temperature plus mechanical stability? Now it's a reality.

Your images and measurements will tell the tale… the rock solid stability of drift less than 15nm/°C



The great barrier to high temperature measurements has been breached! Thermal drift is no longer an issue! NTEGRA Therma's unique design reduces thermal drift to less than 15nm/°C, translating into incredible stability for your long-term experiments.

Change temperatures quickly and smoothly. Maintain temperature precisely (±0.005°C). With NTEGRA Therma, enter the world of thermal measurement with new confidence. Precise thermal control and mechanical drift so low you'll forget that it used to be a problem.

Rigidity and stability

High temperature measurements are always a challenge. Different components of the system respond differently to heat, creating a mechanical drift that confounds long term measurement. **NTEGRA** Therma solves that problem, providing unprecedented low thermal drift and high stability.

Therma's design and composition are the keys. First, the THead construction separates a working cell with a measuring part and includes an independent registration unit. The tight construction of the cell provides negligible temperature difference while temperature variations. This compact unit is very proof against external vibrations. The temperature of probe and sample are the same as the temperature of the cell. The scanner with integrated capacitive sensors is confined to a separate block made of invar alloy carefully formulated with coefficient of thermal expansion near zero. Moreover, placed outside a working cell the scanner stays at room temperature.

The ultimate test: your results. Whether you are working at constant, elevated temperatures over long time periods or are running variable thermal programming, **NTEGRA** Therma provides the stability for impressively clear images and precise, repeatable measurements.

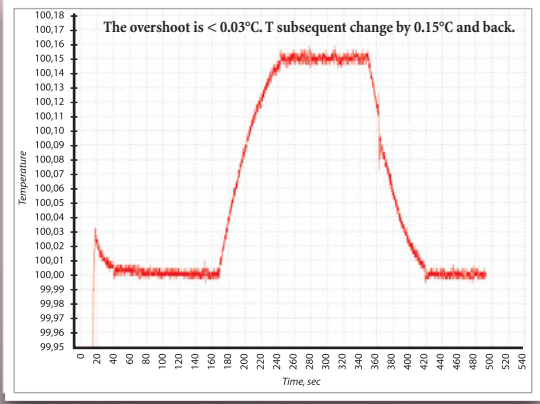
A new level of thermal control

The special smart heating algorithm ramps the temperature quickly and precisely to a given value with minimal overshooting. This algorithm provides much less overshooting comparing to the common PID (Proportional Integral Differential) control, thus ensuring no unwanted overheating.

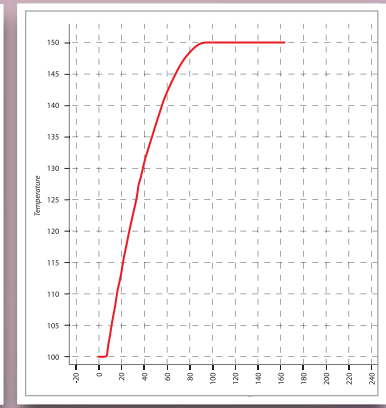
Nova PowerScript: the power to integrate and manage

The Nova PowerScript is a software tool specially designed for the **NTEGRA** line, opening the interface to external devices through the TTL[1] synchronization. Determine your own signal. When it reaches the pre-defined value, it will initiate your own user-defined program, sending a TTL signal and activating an external device. For example, integrate a high-speed oscilloscope for external fast response to initiate a specific process at a defined temperature. Nova PowerScript can be used to integrate a number of external devices.

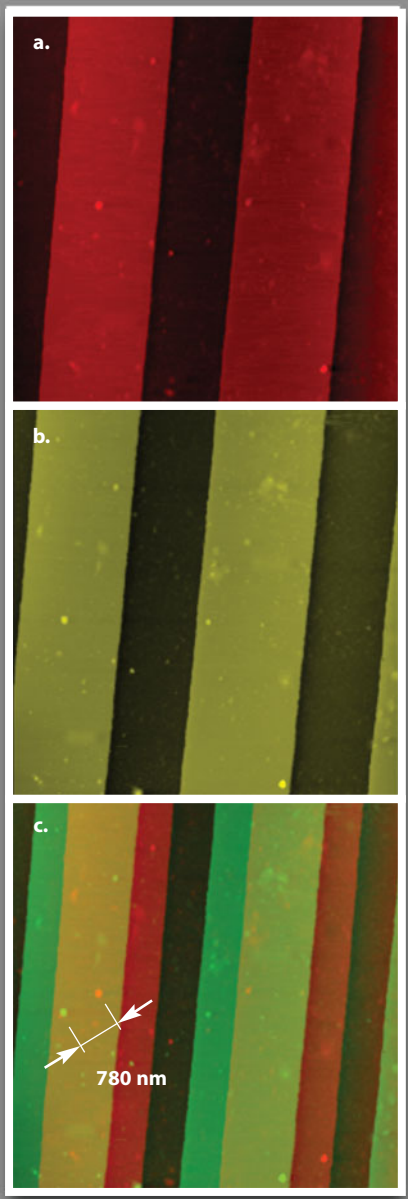
[1] Transistor-Transistor Logic



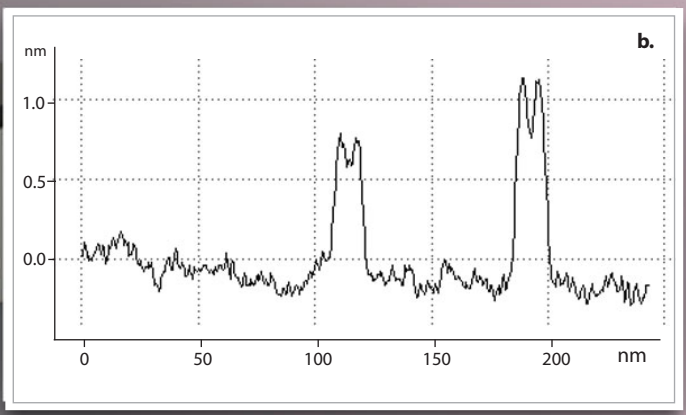
Temperature rise from 50°C (beyond the plot range) to 100°C .



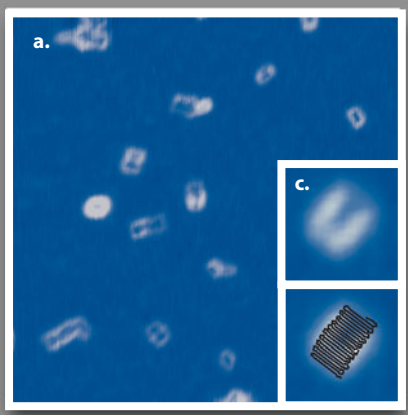
Temperature increase from 100°C to 150°C for ~ 90 sec.



Silicon wafer.
(a) Topography image at 28 °C
(b) Topography image at 130 °C
(c) Composed picture consisting of two images (at 28°C and at 130°C respectively), white arrows indicate initial (28°C) and final (130°C) position of the same feature.
Thermal drift is less then 8 nm/°C.
Scan size: 7x7 µm



IPP single-molecule nanocrystallites on mica.
(a) AFM Topography image. Scan size: 240x240 nm.
(b) Height section drawn through the black line.
(c) The interpretation of the intramolecular substructure seen on AFM images.



Scanning probe microscopy

STM/ AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Phase Imaging/Force Modulation/ Adhesion Force Imaging/ Magnetic Force Microscopy/ Electrostatic Force Microscopy / Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Force and Current),STM

Specification	Scan type	Scanning by sample	Scanning by probe*
Sample size	Ambient environment	Up to ∅40 mm, up to 15 mm in height	Up to ∅100 mm, up to 15 mm in height
	Heating or cooling	10x10x1.5 mm 15x12x1.5 mm	Up to 15x17x1.5 mm
XY sample positioning range		5x5 mm	
Positioning resolution		5 µm	
Temperature control	Range	From -30°C to +80°C/ RT – +150 C	From RT to 300°C
	Stability	±0.005 (typically), ⩽ ±0.01°C	±0.01°C (typically), ⩽ ±0.02°C
Scan range	-30 C – +80 C	10x10x5 µm	—
	Ambient conditions/ RT – +150 C	100x100x10 µm 3x3x2.6 µm	50x50x5 µm
	RT – +300 C	—	50x50x5 µm
	DualScan™ mode	Up to 150x150x15 µm** (DualScan™ mode)	
Thermal drift* ** (typically)	XY	15 nm/°C	
	Z	10 nm/°C	
Non-linearity, XY with closed-loop sensors		<0.1%	<0.15%
Noise level, Z (RMS in bandwidth 1000Hz)	With sensors	0.04 nm (typically), ⩽0.06 nm	0.06 nm (typically), ⩽0.07 nm
	Without sensors	0.03 nm	0.05 nm
Noise level, XY** ** (RMS in bandwidth 200 Hz)	With sensors	0.2 nm (typically), ⩽0.3 nm (XY 100 µm) 0.025 nm (typically), ⩽0.04 nm (XY 10 µm)	0.1 nm (typically), ⩽0.2 nm
	Without sensors	0.02 nm (XY 100 µm) 0.002 nm (XY 10 µm) 0.001 nm (XY 3 µm)	0.01 nm
Linear dimension estimation error (with sensors)		±0.5%	±1.2%
Optical viewing system	Optical resolution	1 µm/ 3 µm	3 µm
	Field of view	4.5–0.4 mm	2.0–0.4 mm
	Continuous zoom	available	available
Vibration isolation	Active	0.7–1000 Hz	
	Passive	above 1 kHz	

* Scanning head can be configured to serve as a stand-alone device for specimens of unlimited sizes.
** Optionally can be expanded to 200x200x20 µm.
*** For temperature range –30°C – +80°C
**** Built-in capacitive sensors have extremely low noise and any area down to 50x50 nm can be scanned with closed-loop control.

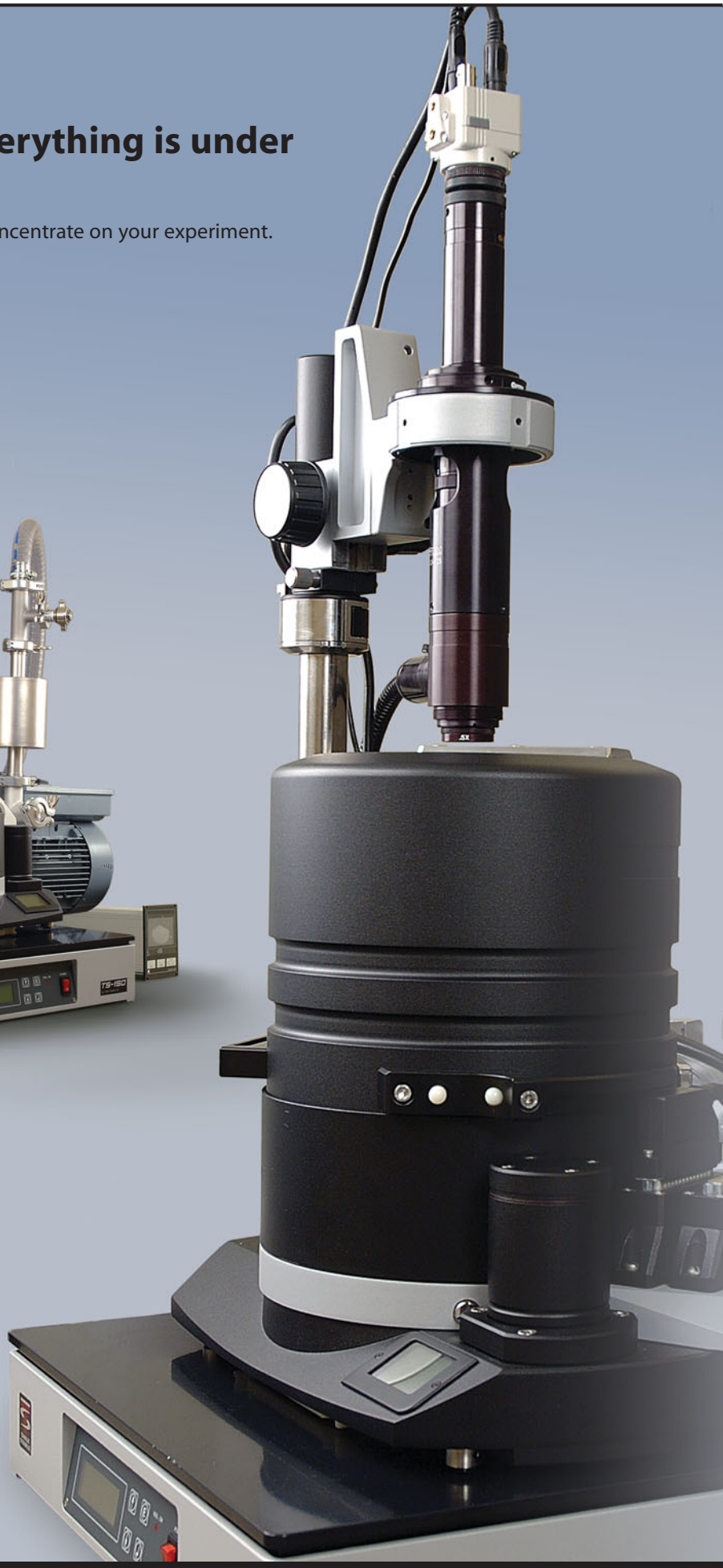
Articles:

- *C.A. Cooper, S.R. Cohen, A.H. Barber and H. Daniel Wagner. Detachment of nanotubes from a polymer matrix. Appl. Phys. Lett. 81, 3873-3875 (2002).*
- *M. Tian, M. Dosiere, S. Hocquet, P. J. Lemstra, and Joachim Loos. Novel Aspects Related to Nucleation and Growth of Solution Grown Polyethylene Single Crystals. Macromolecules 2004, 37, 1333-1341.*


Pure environment
NTEGRA Aura

Feel confident when everything is under control?

We'll worry about the environment… you concentrate on your experiment.



Need vacuum? Exact, predefined temperature? Precisely controlled scan area? **NTEGRA Aura** understands the importance of reliable and efficient control and will create the perfect conditions for your experiment, according to your design, leaving you free to concentrate on science and masterful results.

Optimized conditions/Maximized outcome

Conducting SPM measurements in vacuum offers significant advantages in comparison to measuring under ambient conditions. Working in vacuum optimizes the resonance frequency or "Q factor" of the cantilever, producing clearer, crisper, higher resolution images for semi-contact AFM modes and significantly increased sensitivity for non-contact modes such as MFM (magnetic force microscopy) and EFM (electrostatic force microscopy). On the other hand, working in vacuum can be a hindrance because of the long delays necessary when pumping down the system and the challenges in changing samples within bulky and very expensive pumping systems.

NTEGRA Aura solves these problems. Engineered in an economical, compact package, Aura's vacuum improves the Q-factor ten-fold after only one minute of pumping. For many experiments, 10^{-2} torr is sufficient to optimize the Q-factor.

Immediate readout of true sample environment

Built-in into the **NTEGRA** body and protected by a transparent crystalline sapphire plate, a compact LCD monitor constantly reports temperature and humidity inside the system enclosure. Need to dry out your sample before measuring? Or keep it at temperature? NT-MDT engineering maintains thermal stability to ± 0.005°C (typically).

Also common to all **NTEGRAs**: the direct optical viewing system. Use it to scan for the right measurement area. Zoom in to target the tip. Record an optical image for documentation to correlate with your AFM images and measurements.

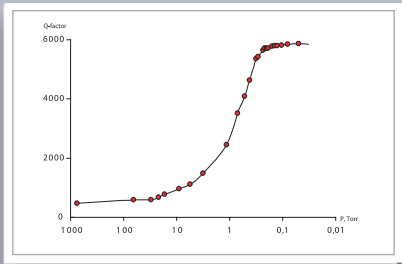
Extending ultimate control to ultra small area.

NTEGRA Aura incorporates the closed loop feedback sensors common to the full **NTEGRA** line. These sensors read the real scanner displacement and compensate for parasitic properties including non-linearity, hysteresis and creep. Proprietary NT-MDT sensors design produces exceptionally low noise level, a significant breakthrough in scanning technology. As a result you can scan the areas as small as 50x50 nm with the closed loop feedback enabled.

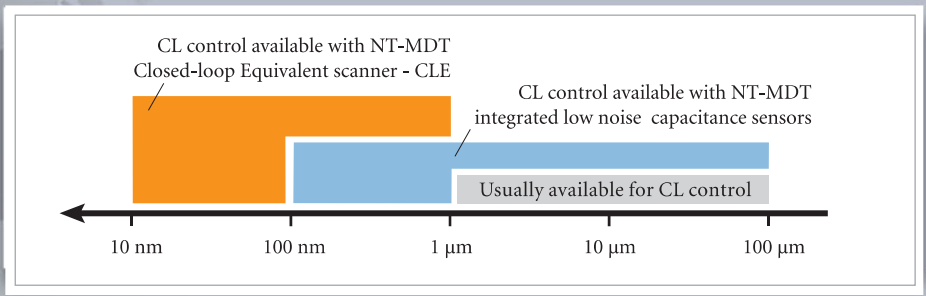
Need to go smaller? No matter how low the noise level, sensor noise will distort imaging on ultra-small areas. With other systems, researchers have had to switch the sensors off. To eliminate this problem, NT-MDT offers the unique Closed-Loop Equivalent™ Scanner using a built-in reference scanner housed in a remote module but connected in parallel to the active scanner. Closed loop capacitive feedback sensors are installed in the reference scanner. The final noise depends directly on the ratio between the maximum scanning ranges of the active and reference scanner. Using this approach, sensor noise is dramatically decreased while still enabling closed loop feed back on extremely small areas… as a small as 10nm x 10nm.

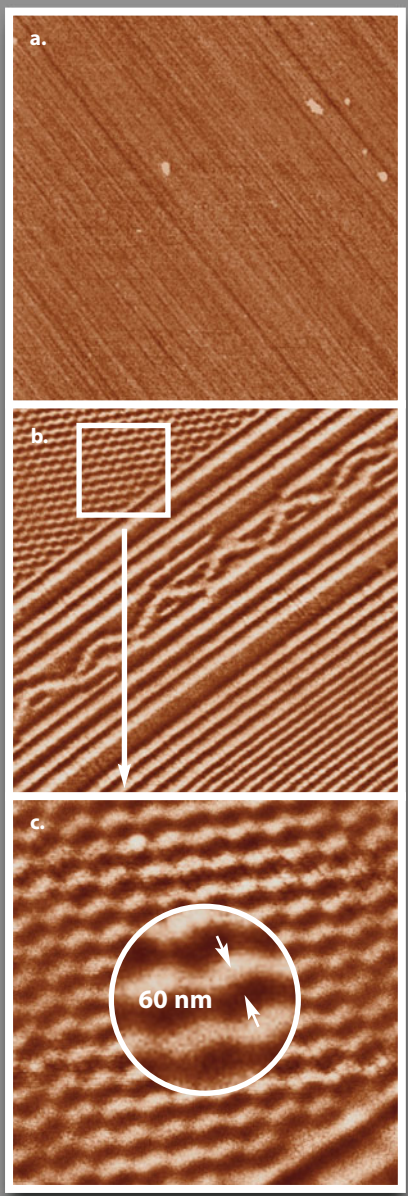
Precise control - accurate influence

Precisely controlling the environment also opens a unique opportunity for controlled surface modification. **NTEGRA** Aura includes a wide range of tools and methods for mechanical, magnetic and electrical surface modification. Raster or vector nanolithography is standard in all **NTEGRA** software. For example, without any preset sequence, length or patterning direction, the system can make a template from common graphic image files then translate the template to the sample surface, all using standard, included algorithms.



Q-factor vs pressure. Q-factor reaches a plateau at about 10^{-1} Torr and higher vacuum does not increase substantially its value.





HDD topography (a) and MFM images (b, c). Distance between magnetic poles of a bit is about 60 nm (white pointers on the MFM image) Scan size: (a,b) 5x5 µm, (c) 1.5x1.5 µm

LCD monitor on the base unit panel

Scanning probe microscopy

STM/ AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Phase Imaging/Force Modulation/ Adhesion Force Imaging/ Magnetic Force Microscopy/ Electrostatic Force Microscopy / Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Force and Current), STM

Specification / Scan type		Scanning by sample	Scanning by probe*
Sample size		Up to ∅40 mm, up to 15 mm in height	Up to ∅100 mm, up to 15 mm in height
Sample weight		Up to 100 g	Up to 300 g
XY sample positioning range		5x5 mm	
Positioning resolution		5 µm	
Scan range		100x100x10 µm 3x3x2.6 µm	50x50x5 µm
		Up to 150x150x15 µm** (DualScan™ mode)	
Non-linearity, XY with closed-loop sensors		⩽0.1%	⩽0.15%
Noise level, Z (RMS in bandwidth 1000Hz)	With sensors	0.04 nm (typically), ⩽0.06 nm	0.06 nm (typically), ⩽0.07 nm
	Without sensors	0.03 nm	0.05 nm
Noise level, XY *** (RMS in bandwidth 200Hz)	With sensors	0.2 nm (typically), ⩽0.3 nm (XY 100 µm)	0.1 nm (typically), ⩽0.2 nm
	Without sensors	0.02 nm (XY 100 µm) 0.001 nm (XY 3 µm)	0.01 nm
Closed-Loop Equivalent™	Noise level, XY (RMS in bandwidth 200 Hz)	0.012 nm (XY 3 µm)	
	Noise level, Z (RMS in bandwidth 1000Hz)	0.02 nm	
	Zoom accuracy	5% typically	
Optical viewing system	Optical resolution	1 µm	3 µm
	Field of view	4.5 – 0.4 mm	2.0 – 0.4 mm
	Continuous zoom	available	available
Temperature control	Range	From RT to +150°C	
	Stability	±0.005°C (typically), ⩽±0.01°C	
Vacuum system	Pressure	10^{-2} Torr	
Vibration isolation	Active	0.7 – 1000 Hz	
	Passive	above 1 kHz	

* Scanning head can be configured to serve as a stand-alone device for specimens of unlimited sizes.
** Optionally can be expanded to 200x200x20 µm.
*** Built-in capacitive sensors have extremely low noise and any area down to 50x50 nm can be scanned with closed-loop control.

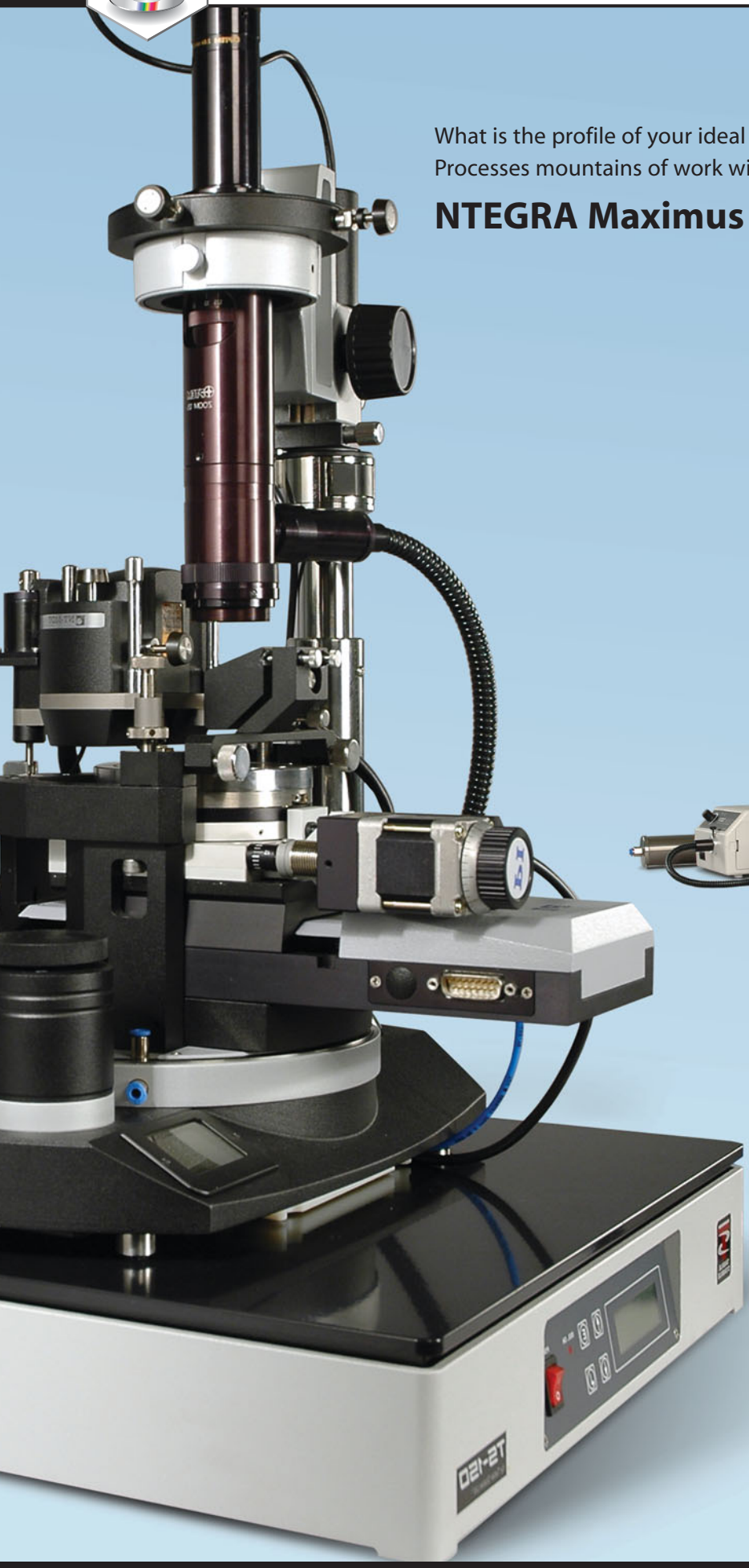
Articles:
•L. Wilkens, D. TraËger, H. DoËtsch, A. M. Alexeev, A. F. Popkov, V. I. Korneev. Compensation walls in gallium and aluminum substituted gadolinium-bismuth-iron garnet films created by laser annealing:Measurements and simulations. Journ. Appl. Phys. 93 (2003) 2839-2847.
•D.H. Qin, M. Lu, H.L. Li. Magnetic force microscopy of magnetic domain structure in highly ordered Co nanowire arrays. Chemical Physics Letters 350, 51-56 (2001).

Large samples and automation

NTEGRA Maximus

What is the profile of your ideal assistant? – Smart? Autonomous? Efficient? Processes mountains of work without complaining?

NTEGRA Maximus fits the bill



NTEGRA Maximus is the instrument of choice when you have large number of routine analyses to conduct and really need that knowledgeable robot assistant to take the work off your hands. You won't feel how easily it does its work. You'll just get what's important: dozens of high quality images and related measurements, all presented in neat, statistical format… the key information to draw your final conclusions.

Different applications… Universal effectiveness

Consider the following very different applications. Case A: you need to make multiple microscopic measurements in different regions on the surface of a large sample. Extremely useful, for example, in controlling roughness on optical lenses or wafers or testing magnetic properties on disk drives. Case B: You are working on a new formulation and need to characterize multiple properties on a large selection of micro samples. One example: the polymer industry where several parameters of a new material are optimized based on the microanalysis of a great number of samples. **NTEGRA** Maximus has the solution for these and many more similar applications.

Expanded sample positioning

Clearly, to analyze either large samples or multiple small samples, you need more than XY motion. To meet that need, NT-MDT has designed an "RL" (Rotary-Linear) stage for **NTEGRA** Maximus. Rotate it to any angle (Rotary) and move the sample along a line (Linear) by software control. Fully motorized, the new RL stage is driven by software which includes mark-and-find programming, expanding your ability to measure automatically at dozens of locations.

Optical viewing to confirm just the right location

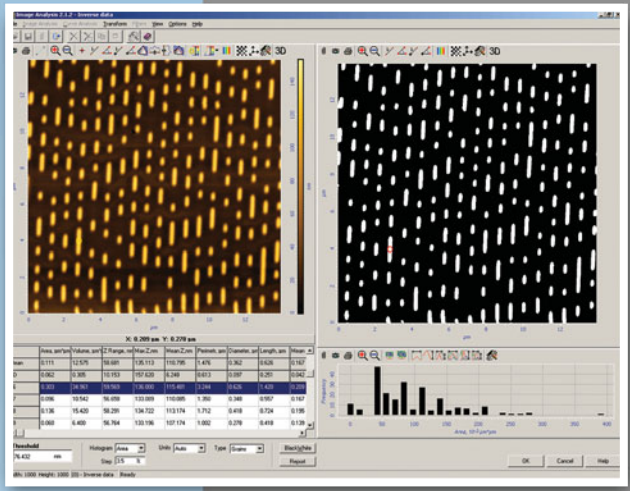
As with the full **NTEGRA** line, **NTEGRA** Maximus sports a zooming optical viewing system. Use the low magnification to find fields of up to 2 mm in diameter. After locating the general area, zoom in to mark specific small features or areas for measurement. This feature is especially useful when multiple microsamples are spotted onto one substrate or when locating test sites on single large substrates such as hard drives or wafers. Coupling a camera to the viewing system also provides light microscopy images which are stored along with your AFM images and measurements, providing important visual documentation of the areas analyzed.

Flexible, optimized algorithms for the production environment

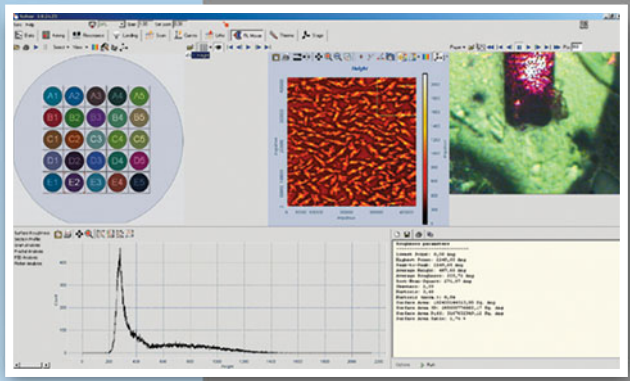
NTEGRA Maximus optimizes your production cycles. Need to analyze large numbers of field for grain analysis? Apply NT-MDT proprietary "Grain Analysis" option. Need to crunch data from multiple surface properties on a large variety of microsamples? **NTEGRA** Maximus has an algorithm to track the trends, showing how properties changes from one sample to another. Use it to select the optimal combination of properties based on the analysis of your whole data array. Ask about other algorithms to fit your production challenges.

Customize your application

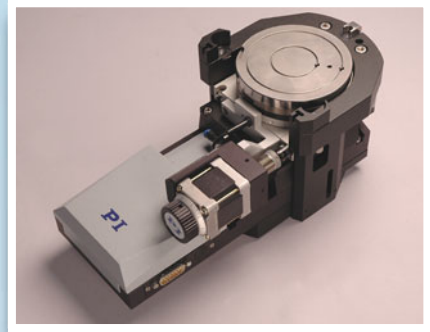
Need to drive **NTEGRA** Maximus according to your own analytical regime? Nova PowerScript provides the maximum freedom for choosing the most effective tactics of your measurement then creating the macros to implement repeatedly and consistently. Acquire, archive, even filter… all hands-off and automatically.



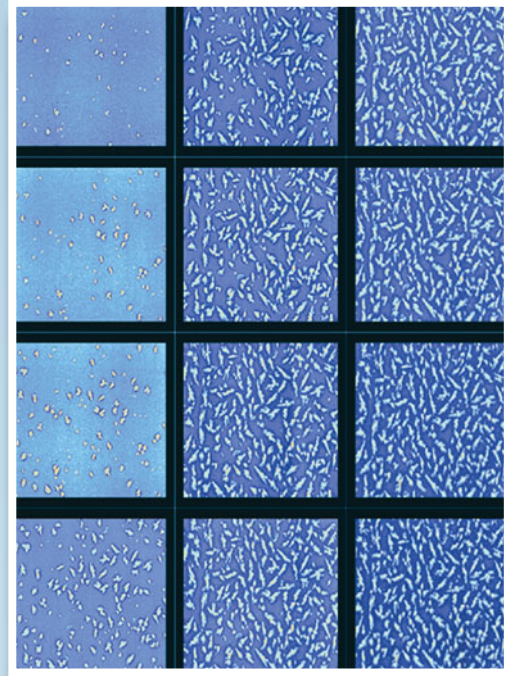
"Grain analysis" software.



Analysis software for multiple microsamples.



Design solutions. RL stage.



Growth of lamellar aggregates from LB film of 5 bilayers mel-7 at 75°C.

Scanning probe microscopy

AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Phase Imaging/Force Modulation/ Adhesion Force Imaging/ Magnetic Force Microscopy/ Electrostatic Force Microscopy / Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Force and Current)

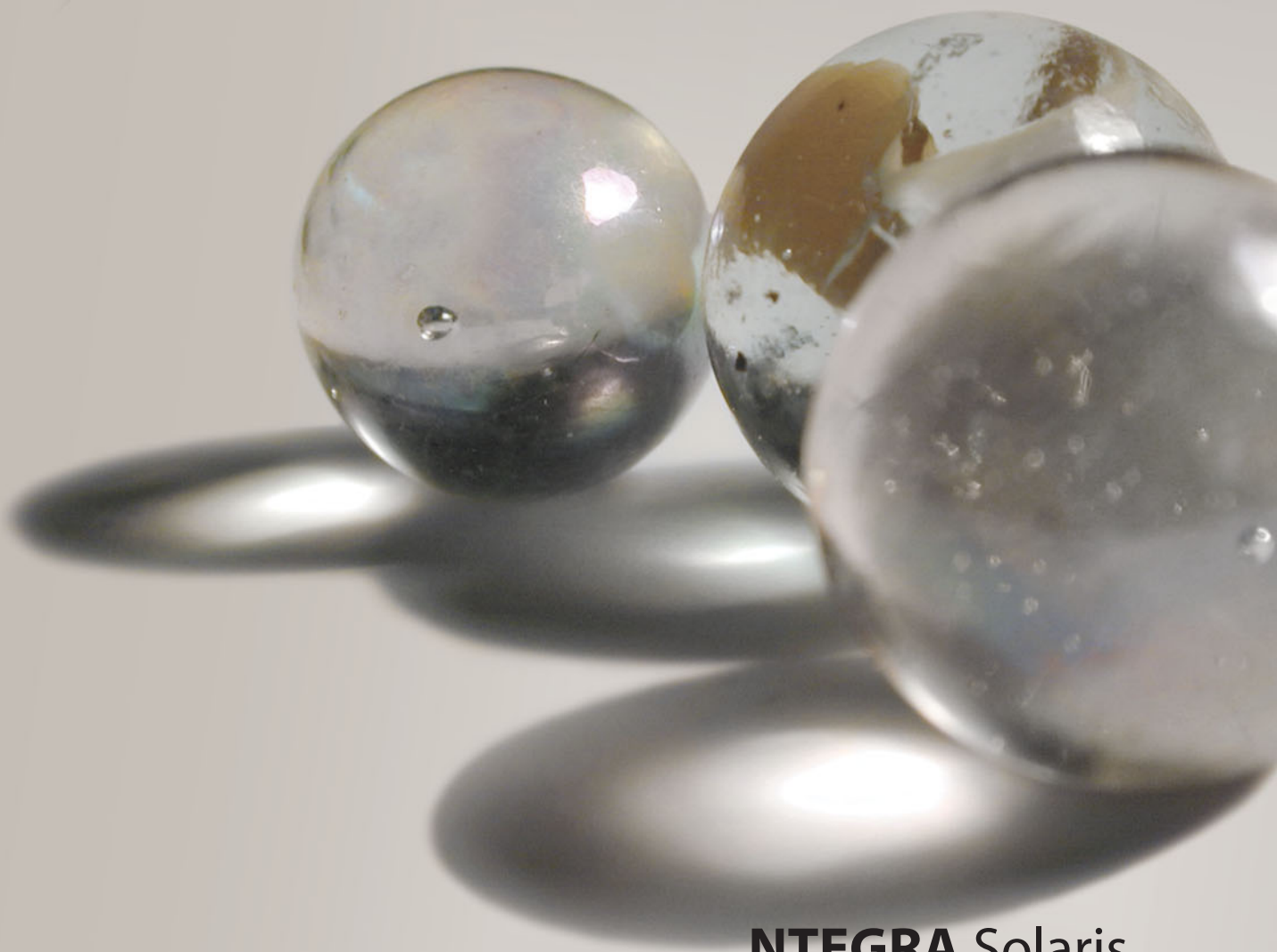
Specification

Sample size		Up to ∅100 mm, up to 15 mm in height
Sample weight		Up to 1 kg
XY sample positioning	Linear movement range	50 mm
	Positioning resolution	2.5 µm
	Rotary movement range	360°
	Positioning resolution	0.005°
Scan range		50x50x5 µm
Sample holder		Vacuum chuck
Non-linearity, XY (with closed-loop sensors)		⩽0.15%
Noise level, Z (RMS in bandwidth 1000Hz)	With sensors	0.06 nm (typically), ⩽0.07 nm
	Without sensors	0.05 nm
Noise level, XY* (RMS in bandwidth 200 Hz)	With sensors	0.1 nm (typically), ⩽0.2 nm
	Without sensors	0.01 nm
Linear dimensions estimation error (with sensors)		⩽1.2%
Optical viewing system	Optical resolution	3 µm
	Field of view	2.0 – 0.4 mm
	Continuous zoom	available
Vibration isolation	Active	0.7 – 1000 Hz
	Passive	above 1 kHz

* Built-in capacitive sensors have extremely low noise and any area down to 50x50 nm can be scanned with closed-loop control.

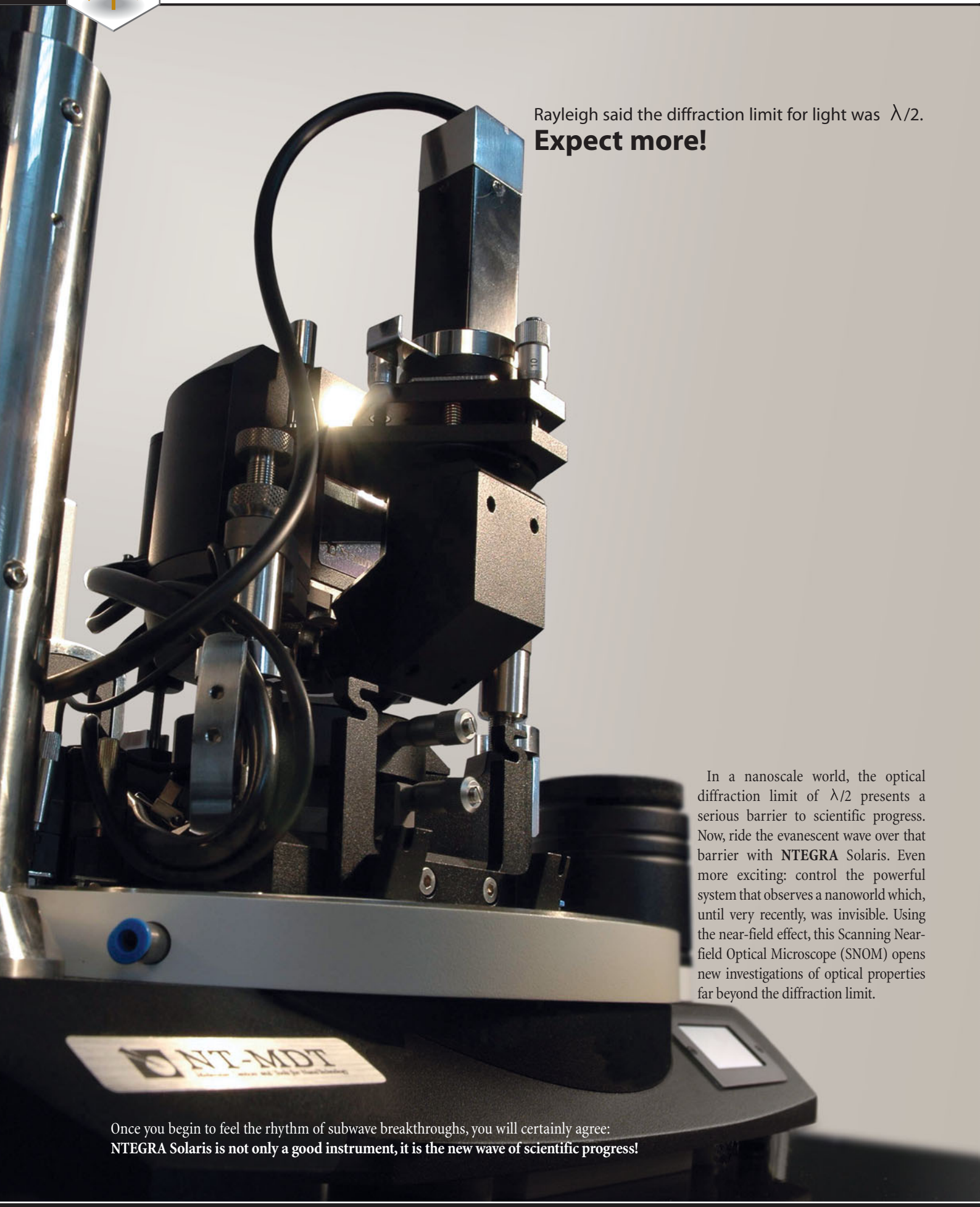
Articles:
- *R. Neffati, A. Alexeev, S. Saunin, J. C. M. Brokken-Zijp, D. Wouters, S. Schmatloch, U.S. Schubert, J. Loos. Automated Scanning Probe Microscopy as a New Tool for Combinatorial Polymer Research: Conductive Carbon Black/Poly(dimethylsiloxane) Composites. Macromol. Rapid Commun. 2003, 24, 113-117.*
- *Daan Wouters and Ulrich S. Schubert. Constructive Nanolithography and Nanochemistry: Local Probe Oxidation and Chemical Modification. Langmuir 2003, 19, 9033-9038.*

Collect the light



NTEGRA Solaris

NTEGRA Solaris



Rayleigh said the diffraction limit for light was $\lambda/2$.

Expect more!

In a nanoscale world, the optical diffraction limit of $\lambda/2$ presents a serious barrier to scientific progress. Now, ride the evanescent wave over that barrier with **NTEGRA** Solaris. Even more exciting: control the powerful system that observes a nanoworld which, until very recently, was invisible. Using the near-field effect, this Scanning Near-field Optical Microscope (SNOM) opens new investigations of optical properties far beyond the diffraction limit.

Once you begin to feel the rhythm of subwave breakthroughs, you will certainly agree:
NTEGRA Solaris is not only a good instrument, it is the new wave of scientific progress!

Three microscopes in one!

NTEGRA Solaris combines three different microscopy techniques: light, scanning nearfield optical microscopy (SNOM), and atomic force microscopy (AFM). Integration at this advanced level creates enormous design challenges because the conventional light microscope which uses standard optics and mechanics cannot provide the accuracy, precision of movement, and stability required for scanning probe microscopy or the efficiency necessary to collect the weak SNOM signal. When they invented **NTEGRA** Solaris, NT-MDT engineers took a unique approach. They built a stable, rigid light microscope objective right into the base of the SPM. The result: high resolution imaging with none of the optical microscope instability. Coupling this exceptional stability with a delicately sensitive detection makes **NTEGRA** Solaris perfect for advanced measurements, even at molecular scale.

Sensitive detectors + stray light elimination yield "pure" signal

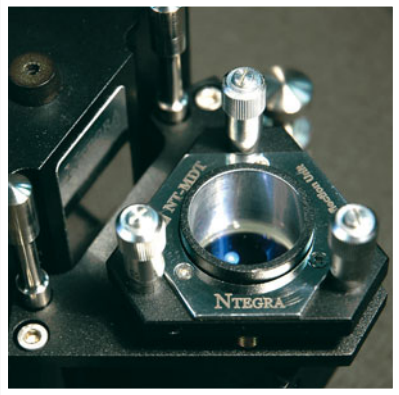
SNOM signals are much weaker than ambient light, demanding precise stray light control. Proprietary NT-MDT engineering and robust but elegant construction combine to guarantee that **NTEGRA** Solaris will provide you with superior protection from parasitic illumination. For the ultimate in sensitivity, Solaris incorporates the latest in PMT detectors. The proof is in the performance and validation tests confirm it: **NTEGRA** Solaris offers excellent high signal/noise ratio.

Reflected light + Transmitted light = Maximum characterization

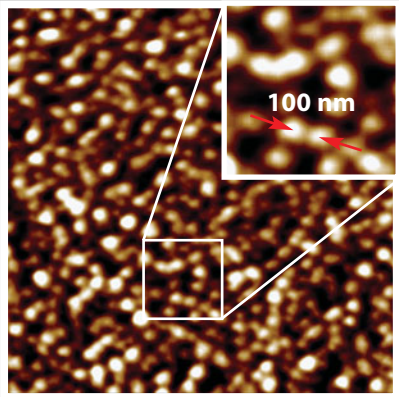
Every nearfield quantum carries critical information and, with weak SNOM signals, every quantum is precious. It is also well known that the transmitted and reflected light present different views of the sample. **NTEGRA** Solaris delicately detects the light from both channels simultaneously, instantly providing correlative images and measurements.

New engineering meets traditional quality

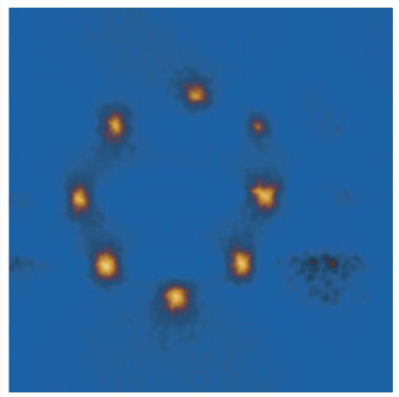
Successful nearfield microscopy rests on solving two problems: spatial resolution and detection efficiency. As a company, **NT-MDT** has grown from strong roots in physics and, as a result, our engineers and designers understand both these parameters and many others critical to SNOM. By consolidating all the traditional advantages of scanning probe microscopy with new directions in SNOM performance, they've built **NTEGRA** Solaris to take optical imaging and measurements on a whole a new level.



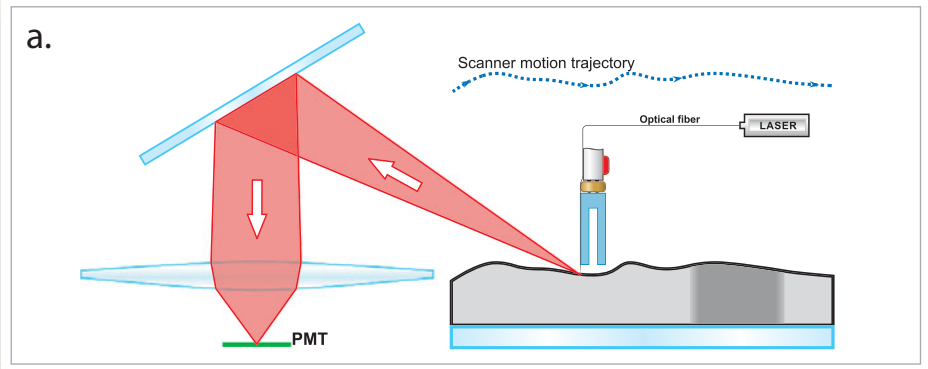
Design solutions. Reflection unit.

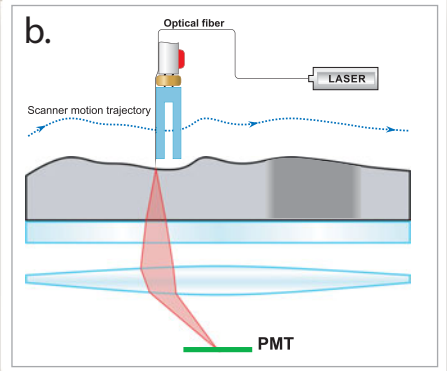


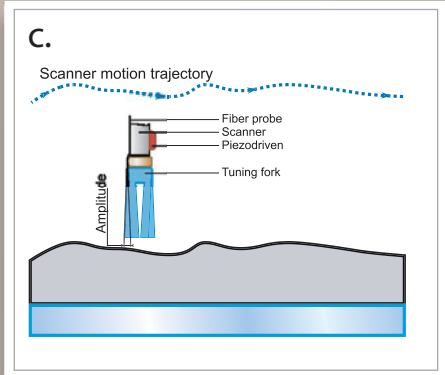
SNOM image of polymer with globular structure.
The enlarged scan area shows spatial resolution.
Scan size: 3.5x3.5 µm.



SNOM lithography on positive photoresist
made with 488 nm Ar laser.
Scan size: 16x16 µm.







SNOM Reflection mode principle (a) ,SNOM Transmission mode principle (b) and Shear force microscopy principle (c).

Scanning Near-Field Microscopy

Shear Force Microscopy / SNOM reflection, transmission, luminescence (optional)/ any AFM modes are available optionally

Specification

Laser module	Wavelength*	441, 488, 514, 532, 633 nm	
	Coupling unit	X-Y-Z positioner, positioning accuracy 1 µm	
		V-groove fiber holder	
		Coupling 40X objective	
Shear Force Imaging	Sample size	Up to ∅100 mm, up to 15 mm in height	
	XY sample positioning range	5x5 mm	
	Sample positioning accuracy	5 µm	
	Closed-loop operation	Capacitive sensors for 3 axes	
		Scanning by sample	**Scanning by probe**
	Scan range	100x100x25 µm	100x100x7 µm
	Non-linearity, XY	0.03 % (typically)	<0.15 %
	Noise level, Z	<0.2 nm (typically)	0.04 nm (typically), ⩽0.06 nm
	Noise level, XY	<0.5 nm (typically)	0.2 nm (typically), ⩽0.3 nm
	Quartz tuning fork base frequency	190 kHz	
	Optical fiber diameter	90 µm (for 480-550 nm), 125 µm (for 600-680 nm)	
	Aperture diameter	<100 nm	
Channels for simultaneous registration		Reflection	
		Transmission/Fluorescence	
PMT detectors (for each channel)	Spectral response	185-850nm	
	Sensitivity at 420 nm	$3x10^{10}$ V/W	
	Current-voltage conversion amplifier (built-in)	$1x10^{6}$ V/A	
	Frequency band width	20kHz	
	High voltage power supply	built-in	
Vibration isolation	Dynamic	0.7-1000 Hz	
	Passive	above 1kHz	

* 488 nm laser is included as a default; other lasers can be supplied optionally.

Articles:
• V.N. Konopsky, K.E. Kouyanov, N.N. Novikova. Investigations of the interference of surface plasmons on rough silver surface by scanning plasmon near-field microscope. Ultramicroscopy, 2001, Vol.88, pp. 127-138.
• V. N. Konopsky, S. A. Saunin, V. A. Bykov and E. A. Vinogradov. Scanning plasmon near-field microscopy: signal-noise ratio of different registration schemes and prospects for single molecule detection. Phys. Chem. Chem. Phys. 4, 2733 (2002).

Live and delicate

NTEGRA Vita

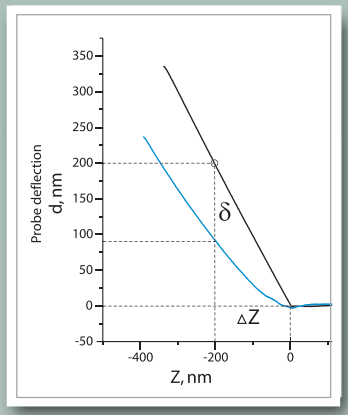
Life. Chemistry. Process.

Good instrumentation makes it real.

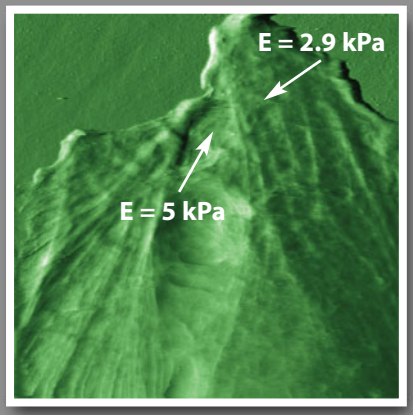
From molecules to living organisms, NTEGRA Vita opens the window to the world of biology and biochemistry. Especially designed to integrate seamlessly with your optical microscope, NTEGRA Vita preserves the *in situ* environment so that you can observe, image and measure what is really there. Turn on NTEGRA Vita and concentrate on your experiment. Enjoy your work and so much expected results. Our system is not the most important thing here. It is just you who can achieve everything with NTEGRA Vita.

Maintaining stasis

To maintain life and present the best conditions for measurement, most biological samples must be kept in fluid solutions. For conventional AFM biological imaging as well as biochemistry and bioorganic applications, **NTEGRA** Vita uses a unique sealed fluid cell which maintains an enclosed volume. Input/output pipes provide controlled flow of nutrient liquids and a heating element precisely maintains temperature, from room temperature to 60°C, with an accuracy of ±0.005°C (typically). Made of chemically stable materials, the fluid cell can withstand aggressive solutions, including acids, bases, or salt solutions.



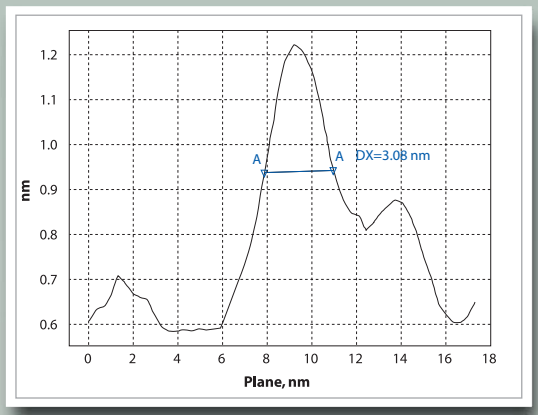
Two curves obtained from very stiff (black line) and rather soft (blue line) materials. Delta of probe deflection shows the sample deformation by the probe. It can be transformed into the Young's modulus.



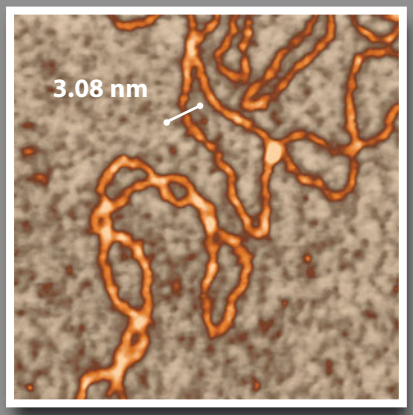
Porcine kidney living cell. Difference in rigidity within a cell is estimated by Young's modulus (for comparison the Young's modulus value for the Petri dish surface underlying the cell was 1.4 GPa). Scan size: 28x28 µm.

From millimeters to angstroms

Need to study live cells? **NTEGRA** Vita offers a special cell to hold standard Petri dishes. As with our sealed liquid cell, this system maintains liquid flow and temperature control. Most importantly, you can still use your inverted microscope for classic optical methods. With **NTEGRA** Vita, use fluorescence to image internal structures and the SPM to provide higher resolution surface detail or physical parameters such as membrane conductance or elasticity. Merge fluorescence and SPM images for further comparison. NT-MDT DualScan™ option expands the scan size up to 200x200x20 µm, giving you the opportunity to image either whole cells or even larger cell aggregates.



DNA cross-section draft.

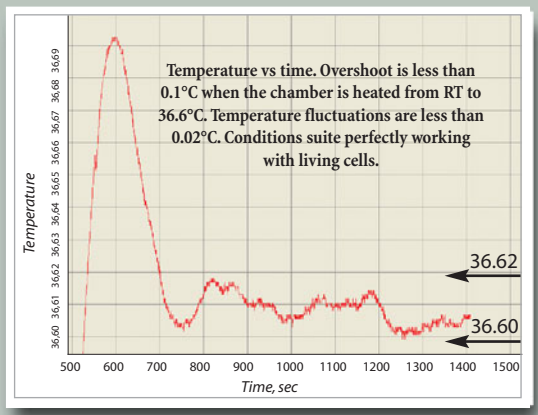


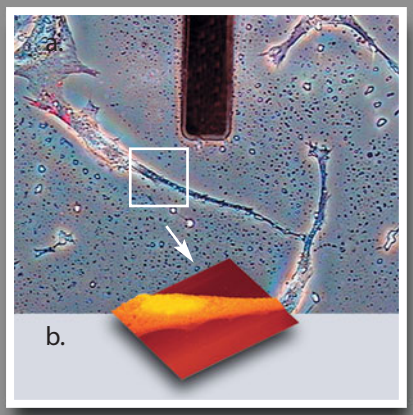
Unfolded DNA deposited on mica. AFM image obtained by DLC tip. DNA width 3.08 nm. Scan size 160x160 nm.

Ultimate resolution requires ultra-small volumes

Need the ultimate in resolution? You need "scanning-by-sample", a mode in which a small sample is scanned with great precision under a fixed probe. Our engineers have developed a special little fluid cell specifically for this application. This cell is also helpful when using expensive chemicals.

From large format to ultrahigh resolution, **NTEGRA** Vita has a solution for your lab.





Human embryo fibroblast (primary culture). (a) Phase contrast optical image of the cells, obtained during AFM scanning. (b) AFM image of the framed area. Semicontact mode in air. Scan size: 50x40x0.5 µm

Extremely small force measurements

Measurements and analysis of probe-to-sample forces in pico- and nano-Newton range provide new insight into cellular properties. "Pushing" a cell with the probe then evaluating the cantilever deflection provides qualitative information about the cell turgidity, cytoskeleton network rigidity, and cellular matrix density. "Touching" the surface-bound receptor molecules with a ligand-coated probe quantifies molecular interaction forces. **NTEGRA** Vita low noise closed loop sensors afford unprecedented accuracy of both probe movement and force measurements. Need even higher registration rate? Optional modules are available to achieve registration rate down to 10^{-6} sec.

Scanning probe microscopy

SPM methods	in air & liquid	AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Adhesion Force Imaging/ Force Modulation/ Phase Imaging/ AFM Lithography (scratching)/ Force-Distance curves	
	in air only	STM/ Magnetic Force Microscopy/ Electrostatic Force Microscopy / Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Current), STM	
		Scanning by sample	**Scanning by probe***
Sample size	in air	∅40 mm, 15 mm in height	∅100 mm, 15 mm in height
	in liquid	Up to 14x14x2.5 mm	Up to 15x15x3 mm
XY sample positioning range	in air	5x5 mm, 5 µm resolution	
	in liquid	1x1 mm, 5 µm resolution	
Scan range		100x100x10 µm, 3x3x2.6 µm	100x100x10 µm, 50x50x5 µm
		Up to 200x200x20 µm** (DualScan™ mode)	
Non-linearity, XY (with closed-loop sensors***)		<0.1%	<0.15%
Noise level, Z (RMS in bandwidth 1000 Hz)	With sensors	0.04 nm (typically), ⩽0.06 nm	0.06 nm (typically), ⩽0.07 nm
	Without sensors	0.03 nm	0.05 nm
Noise level, XY*** (RMS in bandwidth 200 Hz)	With sensors	0.2 nm (typically), ⩽0.3 nm (XY 100 µm)	0.1 nm (typically), ⩽0.2 nm (XY 50 µm)
	Without sensors	0.02 nm (XY 100 µm) 0.001 nm (XY 3 µm)	0.01 nm (XY 50 µm)
Temperature control (For operation in fluid environment)	Range	—	from RT to 60°C
	Stability	—	±0.005°C (typically), ⩽±0.01°C

* Scanning head can be configured to serve as a stand-alone device for specimens of unlimited sizes.
** 200 µm scan range is possible with the unique DualScan™ mode when scanning by sample and scanning by probe can be done simultaneously.
*** Built-in capacitive sensors have extremely low noise and any area down to 50x50 nm can be scanned with closed-loop control.

Optical microscopy*

		Upright viewing		Inverted viewing Scanning by probe
		Scanning by sample	Scanning by probe	
Objective lens	Magnification	x1/ x10	x1	x60**
	Numerical aperture	0.1/ 0.28	0.1	0.7
Continuous zoom		available		NA
Observation methods***	Bright field imaging	available		available
	Fluorescence imaging	NA		optional
	Contrast methods	Phase contrast imaging, Polarization, DIC	NA	optional

* System upgrade is possible to convert it into a near-field optical microscope or a laser confocal microscope.
** Any additional objectives can be supplied optionally.
*** Can be performed without compromise in optical or AFM performance.

Articles:
• Electrical properties of short DNA oligomers characterized by conducting atomic force microscopy. C. Nogues, S.R. Cohen, S.S. Daubeb and R. Naaman. Phys. Chem. Chem. Phys., 6, 4459 (2004).
• A. Yu. Kasumov, D. V. Klinov, P.-E. Roche, S. Gueron, and H. Bouchiat. Thickness and low-temperature conductivity of DNA molecules. Appl.Phys.Lett. 84, 2004, 1007-1009.

From flat slice to volume knowledge

NTEGRA Tomo

Flat 2D data from an intriguing 3D world? Not any more!

Add the real 3rd dimension to your nanoworld!

Have you ever dreamed about looking inside the matter, seeing the distribution of domains or particles within a polymer? Examining the 3D ultrastructure of a cell? Tracing the true context of branching structures such as polyurethane forms or nerves?

NTEGRA Tomo makes your dream come true. This integrated AFM/ultramicrotome slices your sample into nanometer thin layers then renders its 3D mage in a dynamic virtual model. See your sample's internal landscape in a whole new context.

Image of Leica EM UC6 Ultramicrotome. Courtesy of Leica Microsystems

Nanotomography: strong traditions and progress unite

The microtomy has a history nearly two centuries long. Although the much-younger, SPM has been known for less than a quarter of a century, it is rapidly becoming the instrument of choice for nanotechnology. In **NTEGRA** Tomo, NT-MDT has linked the two technologies, re-defining 3D imaging.

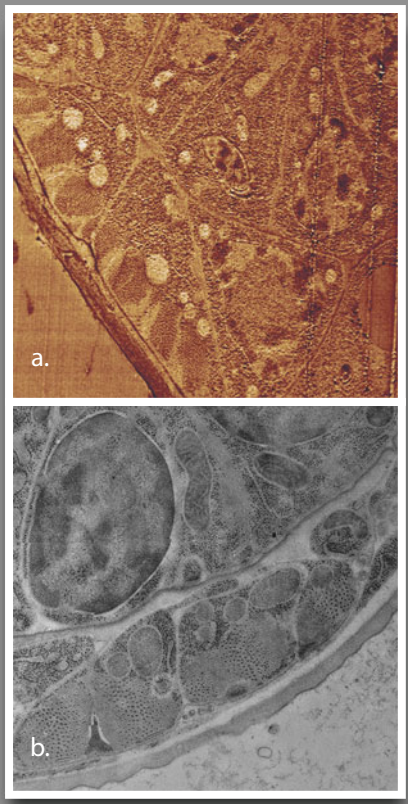
Today's state-of-the-art ultramicrotome produces high quality sections only a few nanometers thick. SPM, using a variety of imaging modes, also elicits scientific data in nanometers. Uniting them two opens the door to true 3D information at the nanoscale. **NTEGRA** Tomo images directly from the block-face, generating stable, well-oriented volumetric data and eliminating typical cutting artifacts such as tearing, stretching, and distortion. All you have to do is turn on the system, prepare your samples, insert and voila! Slice... image… slice… image… **NTEGRA** Tomo puts ultrastructure and internal structure at your fingertips.

Contrast from unexpected sources.

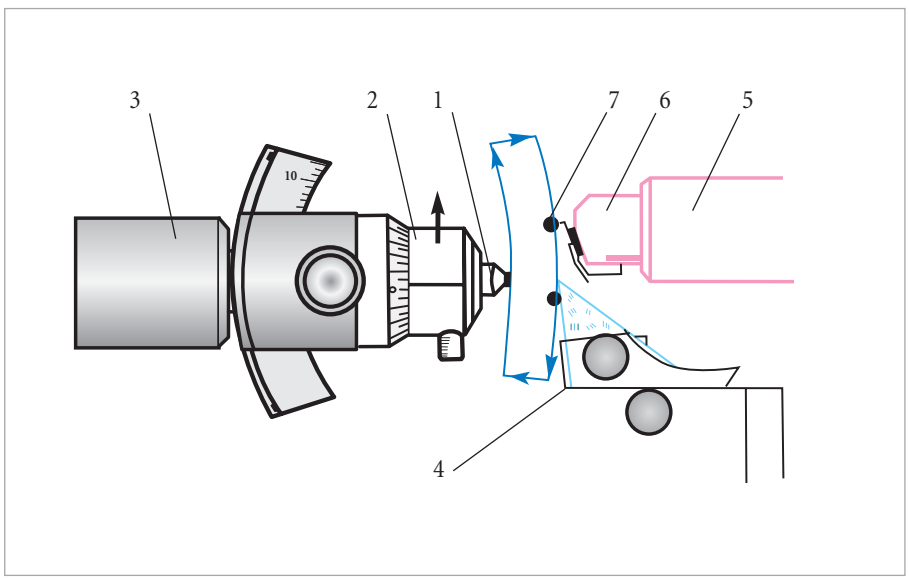
Conventionally, ultramicrotomy is used for TEM imaging. To generate contrast in the fine ultrastructure for the TEM requires elaborate staining with heavy metals. SPMs minimize this type of sample preparation by using local physical properties in the surface ranging from elasticity and adhesion forces to dielectric capacitivity. Can't get contrast with one AFM technique? No need to prepare a new sample or restain. Whether you are investigating the 3D distribution of domains in a polymer or the ultrastructure in tissue, just switch to another AFM mode for the maximum in information.

AFM , EM and LM: The perfect complement

NTEGRA Tomo is the perfect fit in your EM suite. Although it images directly from the block face, it still produces traditional sections that can be used for your TEM or light microscopy studies. Since each microscopy uses different mechanisms for imaging, the information is complementary. **NTEGRA** Tomo bridges the gap.

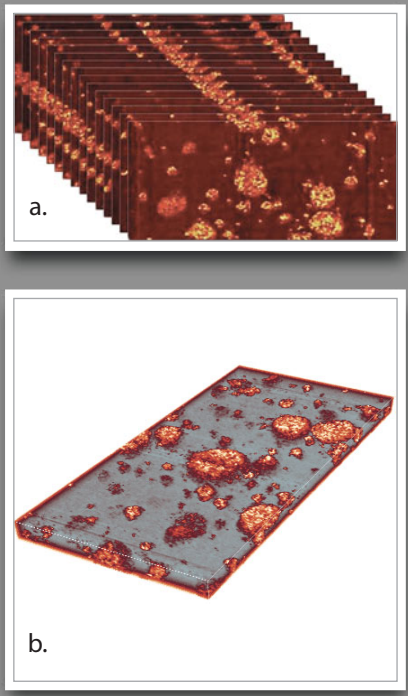


Nematode section revealing cell morphology.
(a) AFM Phase imaging, 10x10 µm.
(b) TEM image of a similar nematode part.
Sample and TEM image courtesy Dr. M. Mueller and Dr. N. Matsko, ETH Center, Zurich, Switzerland.



SPM tomography scheme (ultramicrotome combination with the SPM)

1 - sample
2 - sample holder
3 - ultratome movable bar
4 - ultratome cutter
5 - SPM piezoscanner
6 - probe holder
7 - SPM measuring probe



(a) PS/HIPS blend with silica. 15 sequential AFM images. Each section image is 40x20 µm. Space between sections is 200 nm.
(b) 3D reconstruction.
Sample courtesy of Dr. Aliza Tzur, Technion, Israel.

Scanning probe microscopy

in-situ: AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Phase Imaging/Force Modulation/ Adhesion Force Imaging/ Magnetic Force Microscopy/ Electrostatic Force Microscopy / Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Force and Current)

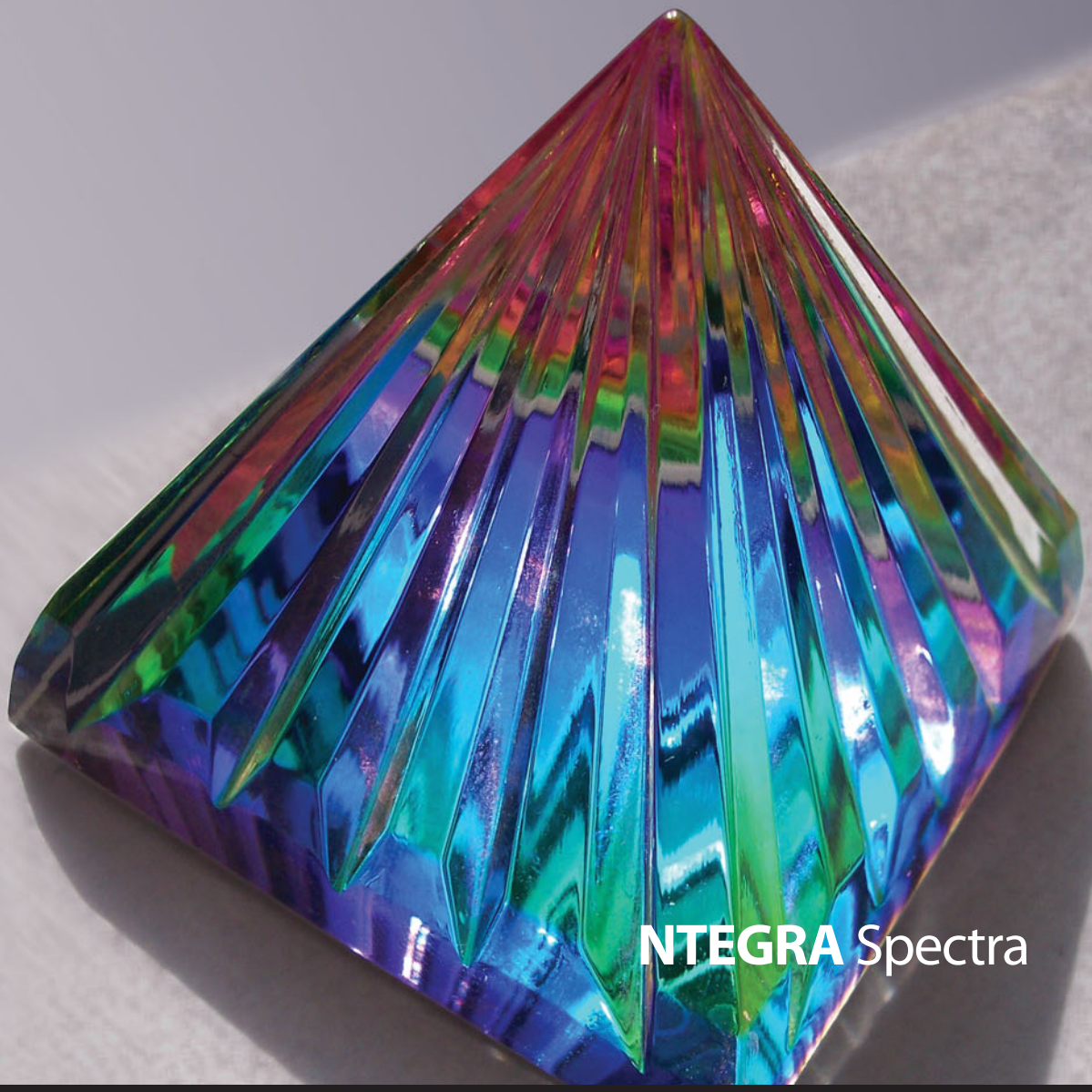
Sample size		Up to ∅8 mm, up to 15 mm in height
Sample weight		Up to 10 g
Scan range		50x50x5 µm
Positioning resolution		5 µm
Non-linearity, XY		<0.15%
Noise level, Z (RMS in bandwidth 1000 Hz)		0.06 nm (typically), ⩽0.07 nm
Noise level, XY (RMS in bandwidth 200 Hz)		0.1 nm (typically), ⩽0.2 nm
Vibration isolation	Dynamic	Frequency range 0.7 – 1000Hz
	Passive	For frequencies above 1kHz

Ultratomy

Self locking		Yes	**Section counter**		Yes
Graduation		±30° graduation	**Feed totalizer**		Yes
Clearance angle adjustment		-2° to 15° with 1°scale	**Count down**		Yes
			Rocking mode		Yes
Knife holder		For 6-12 mm knives	**E-W measurement**		Yes
Coarse knife-movements	N-S	10 mm stepping motor	**Auto trim**		Yes
	E-W	25 mm stepping motor	**Specimen advance indicator**		Yes
Cutting window		0.2-15 mm adjustable	**Working distance**		110 mm
Cutting speed		0.05-100 mm/s wheel contr.	**Universal specimen holder**		2pcs.
Section thickness		0-15000 nm wheel contr.	**Flat specimen holder**		1p.
FEED / SPEED storage		5	**Instrument table**	Dimensions	0.67 x 1.15 m
Return speeds		10, 30, 50 mm/s		Shock-absorbing elements	Yes
Step control		0.1-15 µm steps			

Articles:
• B. Foster. Focus on Microscopy: AFM's New Nanotomography Expands 3-D Imaging. American Laboratory (2005)

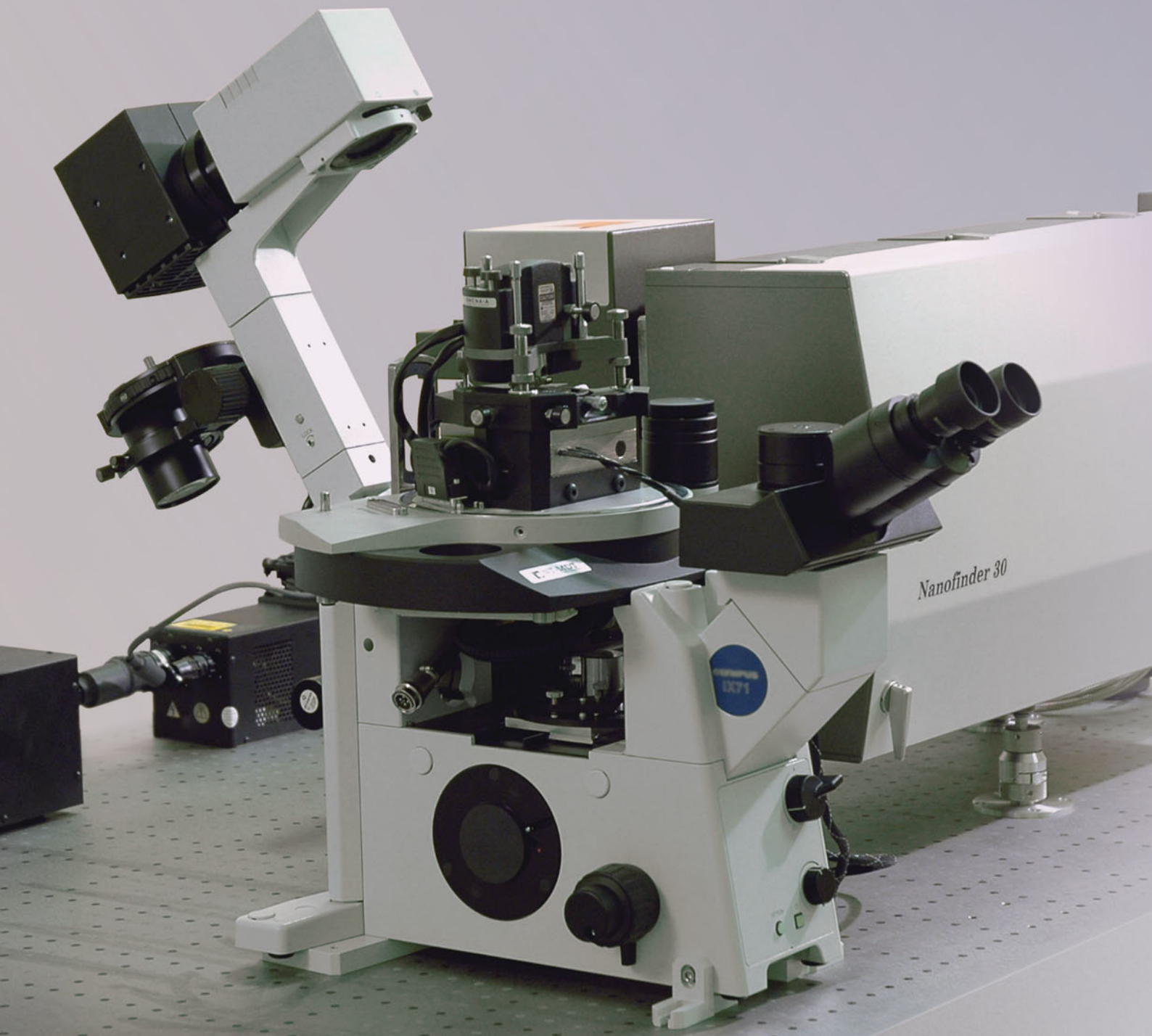
Color the nanoworld



NTEGRA Spectra

Chemistry + Structure = New Insights

What mysteries of nature will you uncover?



A swirl of light, a swoosh of color, the fine point of an SPM scan. NT-MDT designers anticipate "what's next" in your analytical thinking, giving new life to SPM instrumentation, filling your lab with new energy and opportunities. Add the power of chemistry to your SPM analyses. Correlate molecular structure and physical parameters. Detect changes and responses with a new vision. **NTEGRA** Spectra. Unlocking the mysteries of chemistry, structure, and function.

Integration: The key to the new sciences

Change happens at interfaces and today's most exciting changes in microscopy are happening where multiple technologies interface. **NTEGRA** Spectra is a prime example, uniting the full power of confocal microscopy, scanning probe microscopy, and Raman spectroscopy in one platform.

Simultaneous Confocal imaging and chemical mapping

Imagine acquiring not just structural and physical parameters from your sample but simultaneously mapping its chemical fingerprint. Watch as subtle changes in spectra reflect changes in the electronic environment caused by changes in pH, polarizability, or the introduction of a drug. **NTEGRA** Spectra provides two separate detection channels: One for acquiring the confocal fluorescence or reflected light signal and the second for simultaneous but independent collection of the delicate Raman map that reveals the local chemical composition.

NT-MDT high-precision scanning system and laser alignment assure that 3D spectral distribution can be studied with the spatial resolution close to the theoretical limit.

Microspectroscopy at the molecular scale

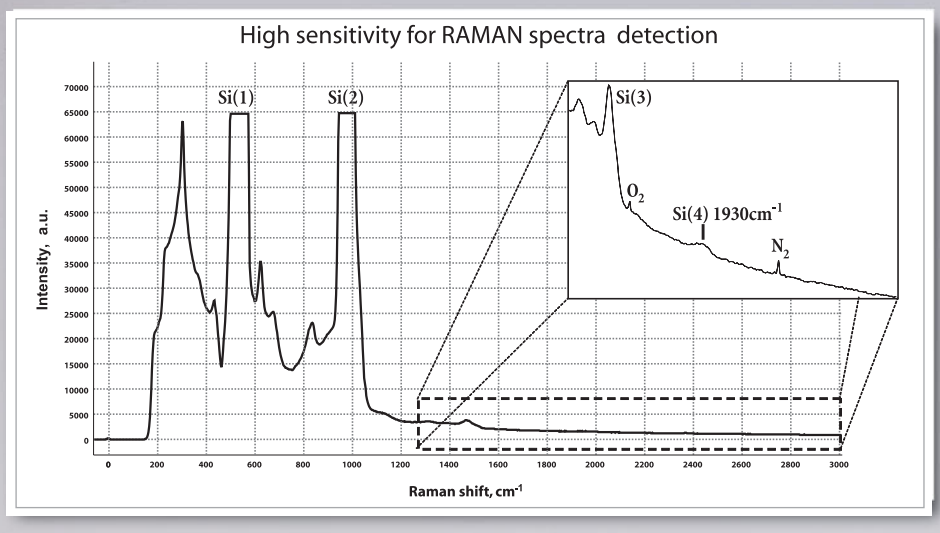
Signal strength is a major challenge in Raman measurements. The Raman signal is often only 1/millionth the strength of a fluorescence signal. The new world of nanotechnology has disclosed a fascinating phenomenon: the electromagnetic field is strongly enhanced near nanometer-scale asperities. The resulting effects are called Surface Enhanced Raman Scattering (SERS) and, when done in conjunction with an SPM tip, Tip-Enhanced Raman Scattering (TERS). By using a very sharp needle tip, **NTEGRA** Spectra can multiply the Raman signal strength by factors of hundreds, thousands and even millions from a precisely scanned, localized spot on the surface several nanometers in diameter. Even single molecules can be detected and recognized by their spectra.

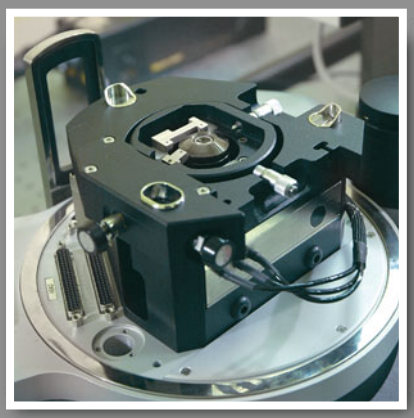
A laser for every purpose

NTEGRA Spectra is built to offer you maximum flexibility. As with many microscopy parameters, Raman presents trade-offs. The intensity of Raman scattering is inversely proportional to the fourth order of the excitation wavelength. Therefore, to obtain maximum signal, the experiment dictates the use of the shortest possible wavelengths. However, longer wavelengths penetrate deeper into the sample and are less harmful to delicate preparations, especially biological samples. To optimize your experimental design, **NTEGRA** Spectra can be configured with three different software selectable lasers. Simply choose the one that best fits your needs.

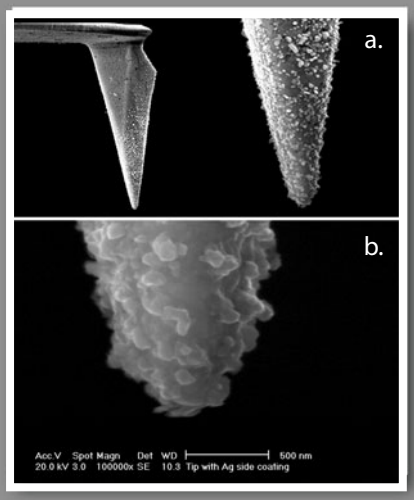
One master software program makes the complex simple

Truly great engineering makes complex processes transparent to the user. **NTEGRA** Spectra is prime example of NT-MDT's brilliant engineering. Taken piece by piece, Spectra can be overwhelming: there are multiple lasers, a spectrometer, a confocal laser system, pinholes, photo-multipliers and other detectors, and of course, the scanning probe microscope. All have to be individually controlled and seamlessly integrated. Not to worry. Manage them easily through the fully integrated system software. Specify the pinhole diameter on the confocal system, choose the appropriate laser, adjust the spectrometer… all with the click of your mouse.

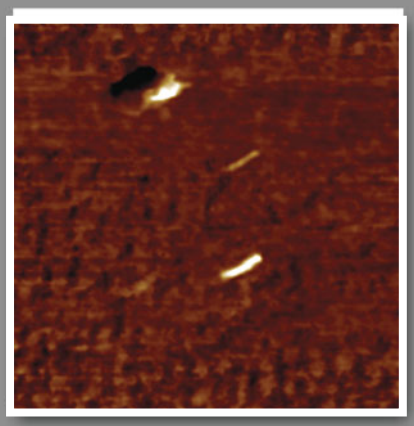




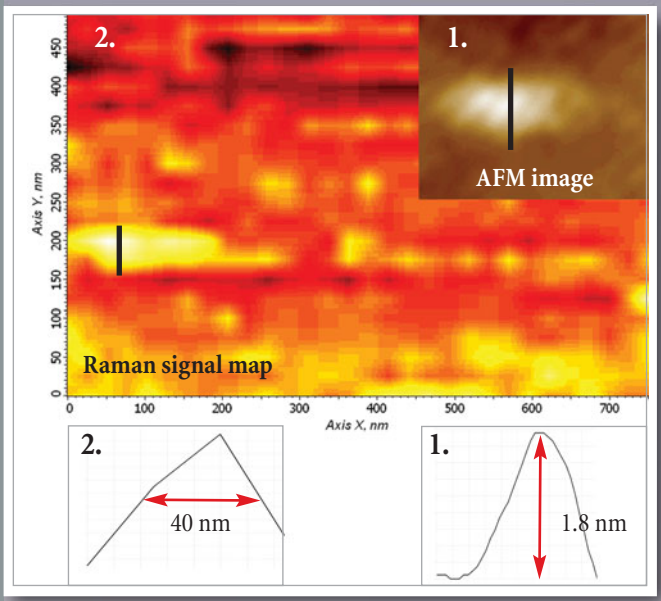
Design solutions.
Central base unit with integrated objective, providing high mechanical rigidity and stable performance of the system.



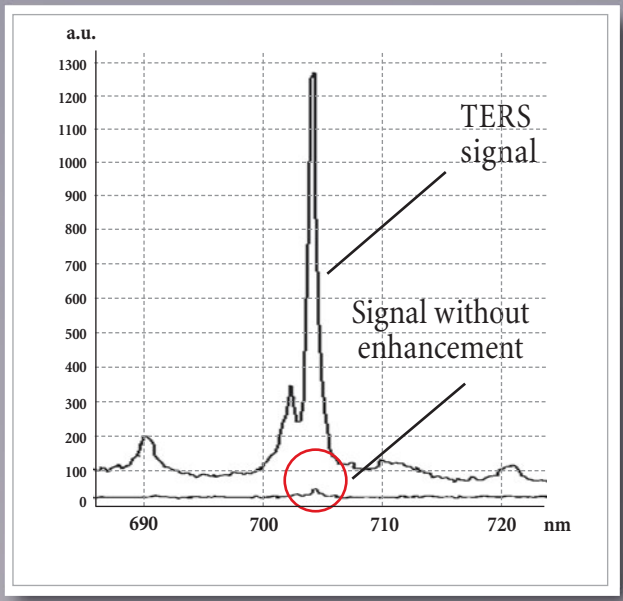
TERS active probes, TEM images.
(a) Probe coated by Ag nanoparticles with polymer protective film.
(b) Probe coated by Ag nanoparticles without polymer protective film.
Data courtesy Dr. Joachim Loos, TU Eindhoven, Department of Chemical Engineering and Chemistry, The Netherlands



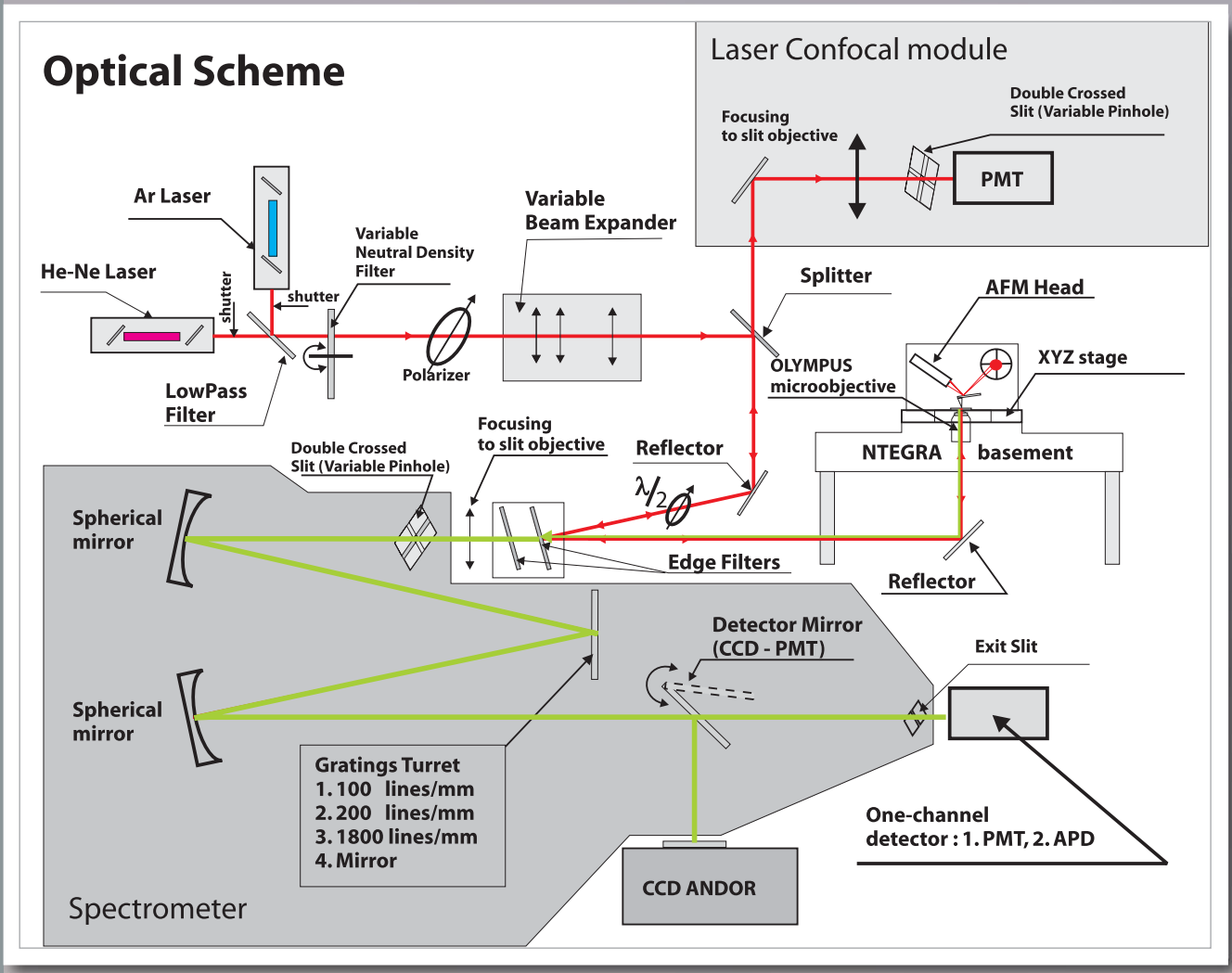
SWNT (Single Walled Carbon Nanotubes) deposited on Si substrate. SPM image made by XY stage with closed-loop sensors. Semicontact mode. Scan size: 1x1 µm.



Single Nanotube (CSi SWNT). AFM image and Raman signal mapping.
TERS imaging demonstrates SWNT width ~ 40 nm.
AFM profile shows SWNT height ~ 1.8 nm to confirm it is a real single nanotube.



Raman spectra of carbon nanotubes with and without tip enhancement.
Data courtesy Dr. Joachim Loos, TU Eindhoven Department of Chemical Engineering and Chemistry, The Netherlands



Laser confocal microscopy

Laser module	Wavelength*	441, 488, 514, 532, 633 nm
	Coupling unit	X-Y-Z positioner, positioning accuracy 1 µm
		V-groove fiber holder
		Coupling 40X objective
		Fiber Delivery System KineFlex
	Beam attenuator	VND filter
Optical module	Inverted microscope direct viewing system	
	Housing with VIS optics (390-800nm)	
	Polarizer in illuminator channel with Glan-Taylor prism 390-1000nm – manual	
	Polarizer in detection channel with Glan-Taylor prism 390-1000nm – motorized	
	1/2 wave plate, motorized – 3 position	
	Beam splitter	
	60x TIRF objective lens, NA 1,45**	
	Evanescent excitation option (for TERS)	
Scanning module	Sample weight	Up to 1000 g
	Scanning range	100x100x25 µm
	Closed-loop operation	Capacitive sensors for 3 axes
	Non-linearity, XY	0.03 % (typically)
	Noise level, Z	<0.2 nm (typically)
	Noise level, XY	<0.5 nm (typically)
Pinhole		Variable from 0 to 1 mm, step size 1 µm

* Basic configuration includes 488 nm laser, additional lasers can be supplied optionally
** Additional objectives can be supplied optionally

Spectroscopy

Spectrometer focal length	520 mm	
Stray light rejection	10^{-5} measured at 20 nm from 632 laser line	
Slit control	0–1mm, step size 1 µm, fully automated	
Flat field	28 mm x 10 mm	
Spatial resolution	<20 µm	
Spectral resolution	0.025 nm (1200 l/mm grating*)	
Ports	1 input, 2 output	
Grating mounts	4-position turret	
Detectors	CCD	Spectral response 200–1000 nm, thermoelectric cooling down to –80°C, 95 % quantum efficiency at 500 nm
	Avalanche photodiode for photon counting**	Spectral response 400–1000 nm, dark counts = 25 counts/sec, supplied with PCI board with 1 GHz counting speed

* Additional gratings can be supplied optionally
** PMT can be installed instead of APD

Scanning Near-Field Microscopy

Shear Force Microscopy / SNOM reflection, transmission, luminescence (optional)

Shear Force Imaging	Sample size	Up to ∅100 mm, up to 15 mm in height	
	XY sample positioning range	5x5 mm	
	Sample positioning resolution	5 µm	
	Closed-loop operation	Capacitive sensors for 3 axes	
		Scanning by sample	Scanning by probe
	Scan range	100x100x25 µm	100x100x7 µm
	Non-linearity, XY	0.03 % (typically)	<0.15 %
	Noise level, Z	<0.2 nm (typically)	0.04 nm (typically), ⩽0.06 nm
	Noise level, XY	<0.5 nm (typically)	0.2 nm (typically), ⩽0.3 nm
	Quartz tuning fork base frequency	190 kHz	
	Aperture diameter	<100 nm	
Channels for simultaneous registration		Reflection	
		Transmission/Fluorescence	
PMT detectors (for each channel)	Spectral response	185-850 nm	
	Sensitivity at 420 nm	$3x10^{10}$ V/W	
Vibration isolation	Dynamic	0.7-1000 Hz	
	Passive	above 1kHz	

Scanning probe microscopy

AFM (contact + semi-contact + non-contact) / Lateral Force Microscopy / Phase Imaging/Force Modulation/ Adhesion Force Imaging/ Magnetic Force Microscopy/ Electrostatic Force Microscopy / Scanning Capacitance Microscopy/ Kelvin Probe Microscopy/ Spreading Resistance Imaging/ Lithography: AFM (Force and Current)

Sample size*	Up to ∅100 mm, up to 15 mm in height
Scan range	50x50x5 µm
Closed-loop operation**	Capacitive sensors for 3 axes
Non-linearity, XY	<0.15%
Noise level, Z (RMS in bandwidth 1000 Hz, closed loop on)	0.06 nm (typically), ⩽0.07 nm
Noise level, XY (RMS in bandwidth 200 Hz, closed loop on)	0.1 nm (typically), ⩽0.2 nm (XY 50 µm)

* Scanning head can be configured to serve as a stand-alone device for specimens of unlimited sizes
** Built-in capacitive sensors have extremely low noise and any area down to 50x50 nm can be scanned with closed-loop control.

Articles:
• Konopsky V.N. Operation of scanning plasmon near-field microscope with gold and silver tips in tapping mode: demonstration of subtip resolution. Optics Communications, 2000, Vol. 185, pp. 83-93.
• Molecular-level pursuit of yeast mitosis by time- and space-resolved Raman spectroscopy.Yu-San Huang, Takeshi Karashima, Masayuki Yamamoto and Hiro-o Hamaguchi , The University of Tokyo.

Compatibility

The policy of NT-MDT is to provide the complete instrumentation compatibility with the world-famous manufacturers of SPM-associated devices.

Nanoindentation

Any **NTEGRA** based system can be supplied with the TriboScope® nanomechanical test instrument. The TriboScope® utilizes an in-situ imaging capability to realize the benefits of SPM imaging and nanoindentation in a single system.

The indenter utilizes a rigid probe that makes the quantification of the force and displacement measurements more reliable than a measurement made with a probe on the end of a cantilever, which introduces many uncertainties. The TriboScope® combines nanoNewton force sensitivity and picometer displacement resolution with SPM imaging for a powerful tool to aid in material studies from basic research to product development to quality control.

TriboScope® is a registered trademark of the Hysitron Inc. company.

Video-rate AFM

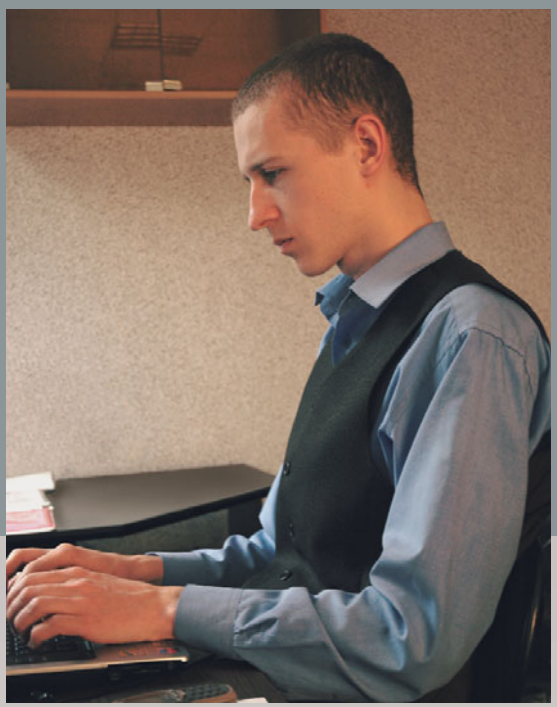
The Real Video speed AFM developed by Infinitesima Ltd. is now at first available for the NTEGRA platform. With the VideoAFM™ **NTEGRA** is capable of delivering real-time images at video frame rates. The VideoAFM™ allows users to view and interact with molecular processes in real time. It can deliver full video at frame rates of 15 and 25 frames per second thus processes can be observed in real-time with millisecond resolution. Areas of 3x3μm can be scanned. Images are collected, processed and displayed simultaneously, making the **NTEGRA**-based VideoAFM™ the first ever truly interactive SPM.

VideoAFM™is a trademark of the Infinitesima Ltd. company.

Q-Control

The ActivResonance Controller is an accessory for the **NTEGRA** family scanning probe microscopes. By electronically changing the effective properties of the force sensor, it allows users to fine tune its response to any interaction. It improves the performance of force microscopes, especially when working in liquid environment.

ActivResonance Controller is a product of the Infinitesima Ltd. company.



NT-MDT customer focus means ease of use and strong support

Modern scientific systems are getting more and more powerful and multifunctional. As systems become more complex, getting started can be daunting. NT-MDT designs systems that are easy to use then supports them with advanced-user workshops and strong installation training

Easy to use yet capable, expandable software

NTEGRA's global software is Window's based, with a friendly, comfortable software interface that makes alignment and measurement easy yet powerful. Need to adjust software to your specific experiment? Built-in NOVA PowerScript with the rich library of predefined macros are available either to program your routine measurements or to get access to the very specific functions of your hardware. We listen carefully to our users experience and input from our users, resulting in updates two to three times each year. All upgrades are free of charge.

SPM for the academic lab

NT-MDT is currently the only company that has developed a specialized mini-laboratory, academic SPM for learning first-level SPM skills. It includes a set of very simple, cost-effective, and student-proof SPM experiments, special software package for interactive study, a set of inexpensive accessories and probes, a special toolkit that allows students to prepare their own probes, well-defined specimens, and a package of training materials including specialized SPM training course written and edited by very experienced SPM users.

Training and workshops

For experienced SPM users, NT-MDT offers technique-focused training and workshops on the regular basis to enhance their skills and to expand the SPM usability. Interested in learning more about a specific NT-MDT's developments? Our staff scientists provide information and orientation. Interested in cutting edge technology and the newest applications? Attend one of our workshops. We invite world-renowned scientists to report on breakthrough applications and the latest in Scanning Probe Microscopy and SPM-based instrumentation.

Service and support

From tips and test gratings to on-line remote problem solving, NT-MDT provides extensive global after-sale support.

World-wide service

NT-MDT's systems are capably supported by a broad network of distribution and service world-wide. Qualified professional engineers in more than 20 centers in Europe, Asia, and America are ready to repair your SPM or perform hardware upgrades. For the nearest center go to **http://www.ntmdt.com/Distributors/index.html** or contact our head office **+7 (095) 535 03 05**

On-line support

Most problems can be solved quickly with a just little professional advice.

Just click on **http://www.ntmdt.com/chat_eng** and explain your question directly to a company expert via unique **"ASK-ONLINE"** service or e-mail. To make your experience more personal, you can also see our service engineers through the web camera installed in one of the service bays located in NT-MDT's central office.

Distant control facility

Facing a more difficult problem or one you just can't explain? NT-MDT has integrated a unique special software patch that allows us to access your system remotely, instantly putting an NT-MDT engineer at your elbow. The engineer can test all critical hardware and software parameters, perform the required tuning or adjustment, or advise you on optimizing operational algorithms.

Supercomputer power for advanced calculations

Need extra horsepower for advanced image processing? Specifically for NTEGRA customers, NT-MDT has launched exclusive access via the Internet NT-MDT's supercomputer-based information center.

Accessories on-line

NT-MDT manufactures a complete line of SPM accessories including wide range of probes, test samples, and test gratings, all available on-line at **www.ntmdt-tips.com**.

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