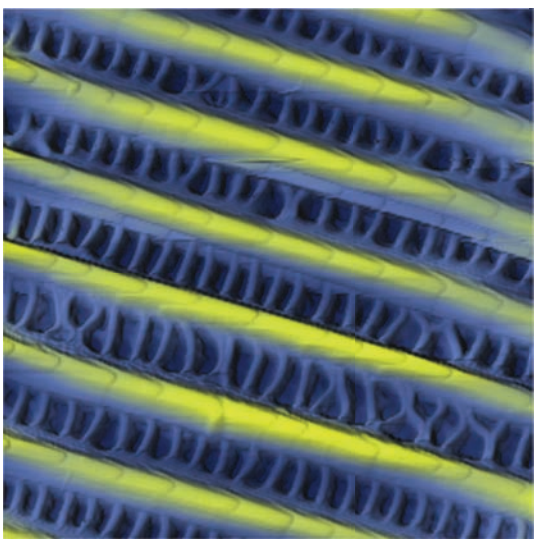
NT-MDT



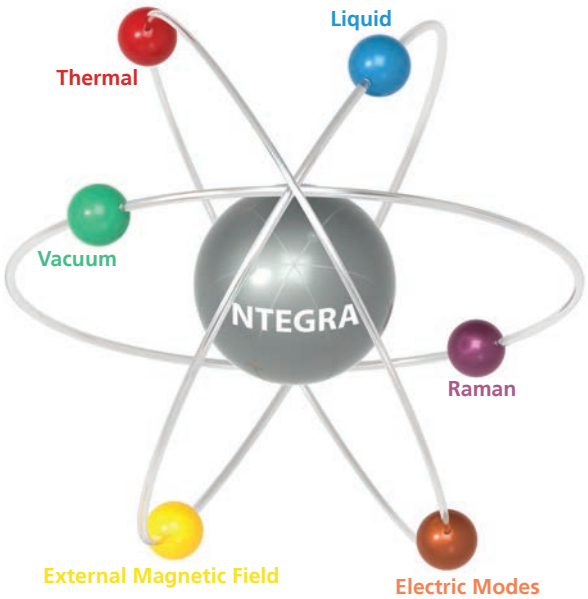
Butterfly wing, 15 x 15µm

NTEGRA PRIMA

The most diverse set of accessories, options, and open modular platform for your custom designed experiments

Your AFM & Raman Company

NTEGRA -Modular integration

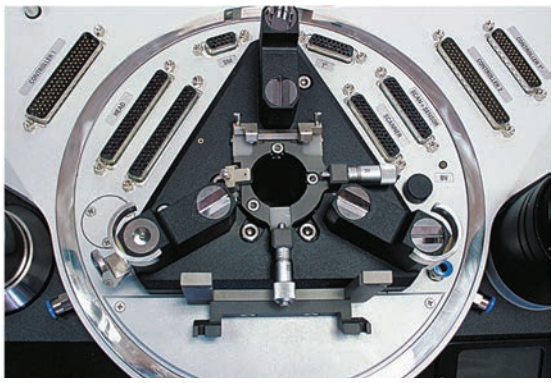


NTEGRA's name is derived from many sources. It came from classical languages for ages associated with pure science. In Latin, word 'integer' means perfect, absolute, or complete. The concept of 'completeness' reflects the NanoLaboratory concept: each system serves as a core for the whole laboratory. Moreover, ancient roots can be seen in the name of every model – from Solaris and Prima to Vita and Spectra.
The first two letters in NTEGRA are closely connected with our company name, NT-MDT, which in turn refers to the initial letters in word NanoTechnology...

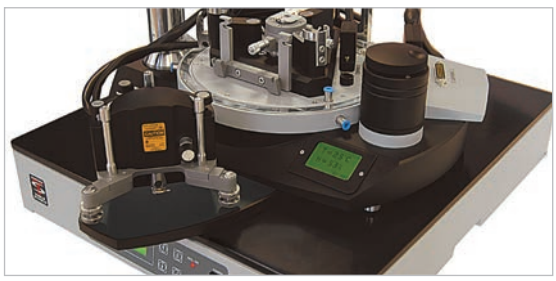
Prima - The heart of the NTEGRA system

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.
Another advanced technique – piezoresponse force microscopy (PFM) for high spatial resolution imaging is based on the deformation of the sample surface due to the converse piezoelectric effect and the analysis of the resulting surface displacement.

Design / ergonomic solutions



Universal base unit, top view.



Removable "lug" on the base unit.

A user-friendly design solution allows easy modification of an existing configuration by changing active parts and external devices. The basement unit is perfectly adapted for the addition of many different user devices.

The system face panel is equipped with an LCD monitor that shows environmental conditions such as the temperature and humidity.

There are some unique ergonomic solutions providing comfortable system operation. For example, a special removable "lug" (tongue-shaped support) is designed on the base unit to provide additional usability and to secure the working head during probe set up or the specimen change procedures.

An integrated, easy-to-use optical viewing system provides optical resolution of 1 to 3 μm (depends on the scanning head used). It is very convenient for the operator not to be "blind" while targeting the probe to the sample surface.

NTEGRA Probe NanoLaboratory

Example of the work site arrangement.

The Probe NanoLaboratory NTEGRA opens a new era of scanning probe instrumentation. NTEGRA links a top of the range SPM to:

- Perfect optics
- Complex spectral analysis
- Tomography techniques
- Combined material research

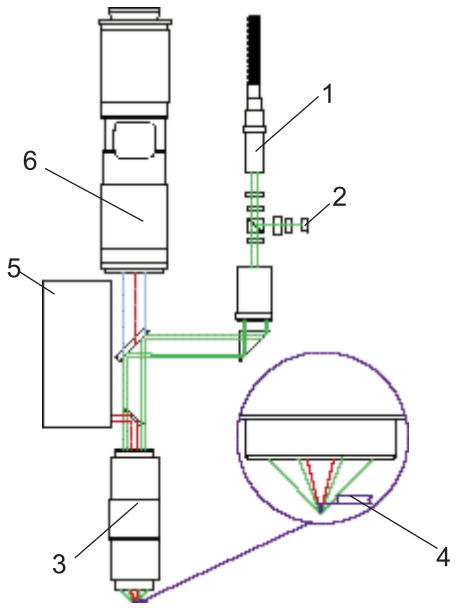
Thus NTEGRA is a superb nanolaboratory which can be successfully applied to:

Material sciences (optical and optoelectronic, magnetic and superconducting materials, organic and soft materials, etc.); Polymers; Biological sciences (structural biology, molecular and cell biology, microbiology, etc.); Data storage devices, semiconductor materials, microelectronic devices.

Optical facilities

An inverted optical microcoscope is one of the basic instruments for transparent sample investigation. Its conjunction with the NTEGRA SPM base unit enables a molecular scale study of object usually seen at micron resolution. An inverted microscope objective lens is integrated into the central base unit providing high mechanical rigidity and stability of the system making quality images and long-term experiments possible.

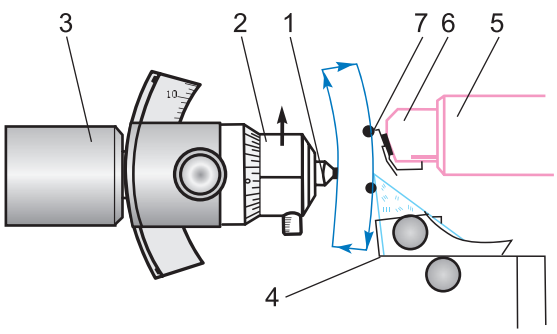
Bright-field as well as fluorescence high-sensitivity observations and measurements are available in addition to SPM facilities. A different optical scheme has been realized to meet the requirements of non-transparent object visualization and SPM investigation. An objective lens with a long working distance integrated into the special head allows observation of the surface just below the cantilever. Due to the high numerical aperture of the objective lens, precise laser beam focusing has been achieved.



Scheme of the optical head

1- Fiber to the laser
2- Detector
3- Objective
4- SPM probe
5- Registration

SPM tomography



SPM tomography scheme (ultratome combination)

1- Sample
2- Sample holder
3- Movable bar
4- Ultratome cutter
5- SPM piezoscanner
6- Probe holder
7- SPM measuring probe

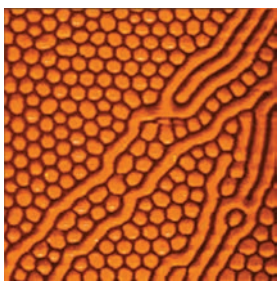
Unique instrumentation is incorporated into the Probe NanoLaboratory NTEGRA for polymer or biological objects investigation. For example, SPM analysis of cryosectioned cells or tissues allows visualization of tiny details based on physical properties heterogeneity inside the object. This is very close to conventional image processing in transmission electron microscopy based on nonhomogeneous transparency for electron beams. The SPM image has the same or even better spatial resolution as the conventional technique and often is more informative because of the many measuring and analysis modes available. Information concerning local stiffness, adhesion, viscosity and many other parameters can be easily obtained for the region of interest. Sequential removing of ultra thin slices from the sample using an ultratome permits serial observations of a fresh cut surface followed by 3D reconstruction of the object's spatial structure. Compared to conventional TEM/ SEM, the NTEGRA tomography technique has several attractive advantages; There is no need of chemical fixation and staining that allows the object to be observed intact and avoids contact with poisonous substances.

Operation in different environments

Temperature control with sample temperature alteration is possible in the range of -30°C (with the use of Peltier element) to 300°C with high temperature maintenance accuracy. This allows observation of the structural changes on the specimen surface, such as crystallization, melting, growth processes, etc., with precise control of experimental conditions. The special THead™ used provides extremely low thermal drift (less than 15 nm/°C) ensuring high stability of the tip-sample system. This allows long-term experiments to be done in a defined point on the specimen surface. Measurements in liquid environments, which are very important for biological, chemical and some material applications, are possible due to the availability of the closed cell with liquid flow and heating up to 60°C. Biological objects, such as living cells or interacting macromolecules, can now be observed in-situ.

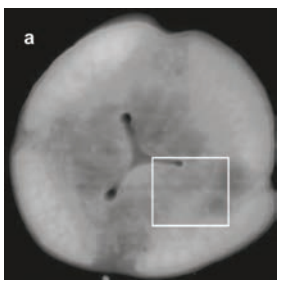
Special metal hood and inlet/ outlet pipes on the base unit allow operation in a controlled gas atmosphere. There is also a configuration that provides vacuum environment under the hood (10^{-2} torr). It extends the system performance and enables study and modification of nanostructures in different rarefied gas environments with a controlled gas composition. Moreover in the absence of ambient atmosphere the cantilever q-factor is significantly increased leading to higher cantilever sensitivity.

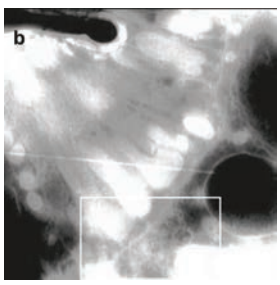
Operational nanostructure obtained by high voltage anodic tip-induced oxidation.
Scan size: 800 x 800nm

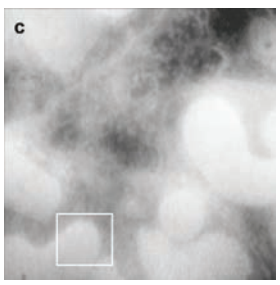


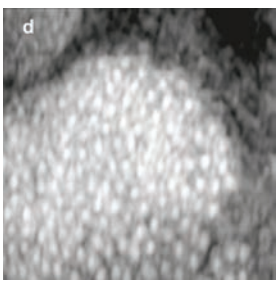
Domain structures in a magnetic garnet film. The MFM phase image.
Scan size: 38 x 38µm

Needle-like crystals of azobenzene derivative formed from monomolecular LB-layer on silicon surface at 75°C.
Scan size: 32 x 32µm









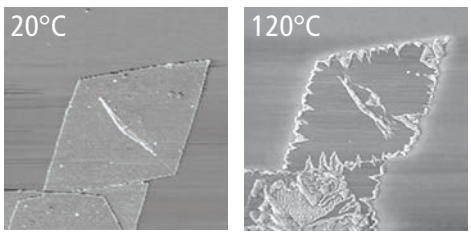
The sequence of AFM topography images of the cross-section surface of a nematode C. elegans made by microtom.

a) 23 x 23 x 1.6µm
b) 6 x 6 x 0.3µm
c) 3 x 3 x 0.05µm
d) 0.8 x 0.8 x 0.02µm

Thermal

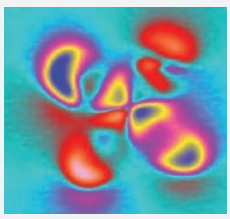
Features

- **Smart Heat** - special algorithm ramps the temperature quickly and precisely virtually eliminating overshoot
- Maintain temperature precisely (±0.01°C)
- Low thermal drift and high mechanical stability (<15nm/°C)



Single Polyethylene crystal, 4.2 x 4.2µm


FeCr Ferromagnetic Nanostructures, 6.5 x 6.5µm


FeCr Ferromagnetic Nanostructures 1.7 x 1.7µm

Magnetic Fields

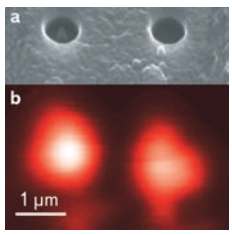
Features

- External magnetic fields: vertical (up to 1 Tesla) and horizontal (up to 0.6 Tesla)
- Non-magnetic scanner to avoid interference with external magnets and sample
- Options for permanent magnet source (uncooled) or electromagnet source (cooled)

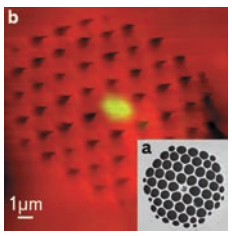
Raman / SNOM

Features

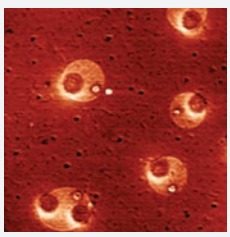
- Simultaneous AFM Raman with multi-objective optical turret
- Hot Spot - Automatic location of active TERS region of the probe
- Scanning Near-Field Optical Microscopy (SNOM)

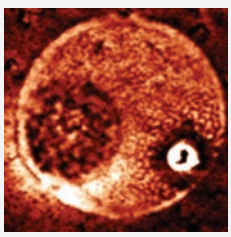


(a)SEM image of VSAL facet, (b) Intensity distribution at 650nm



(a) SEM fiber optical cross section. (b) SNOM topography map overlay


Semiconductor polymer, 12 x 12µm


Surface Potential image, 2.5 x 2.5µm

Vacuum

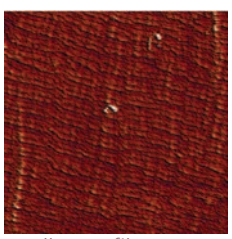
Features

- Control your sample environment for vacuum, humidity, temperature
- 10 fold increase in Q factor after 1 minute pump-down
- 10^{-3} Torr vacuum capable
- Increased sensitivity for magnetic and electrical modes

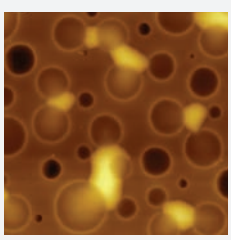
Liquid

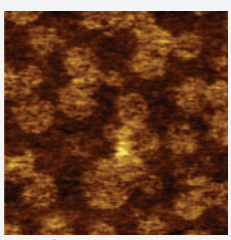
Features

- Unique sealed fluid cell with input/output ports providing controlled flow of your liquids
- Precise heating from ambient to 60°C with±0.01°C accuracy
- Chemically stable materials withstand many acids, bases, and salt solutions
- Small volume fluid cell (>1mm) also available


Collogen fibers, 1 x 1 µm


Onion Skin, 5 x 5 µm


PS:PVAC, Height, 7 x 7µm


Surface Potential, 7 x 7µm

Electric Modes

Features

- Multi-frequency Measurements
- Broad frequency range with up to 5 MHz for photodetector and 5 lock-in amplifiers
- Amplitude/Phase Modulation detection of electrostatic tip-sample interactions

- Simultaneous measurement
- Topography
- KPFM
- dC/dZ , dC/dV

Technical Specification

Specification / Scan type	Scanning by sample	Scanning by probe
Sample size		
	Up to ø40x20mm	Up to ø100x20mm and unlimited for measuring
	10x10X5mm with AFAM transducer use	head used for stand alone operation
In liquid	14x14x2.5	Up to 15x15x3mm
Weight		
In air	Up to 100g	Up to 100g
In liquid	Up to 30g	Up to 30g
Scanners		
With sensors	50x50x6µm (±10%)	50x50x5µm (±10%)
	100x100x10µm (±10%)	100x100x10µm (±10%) (for Shear force)
Without sensors	3x3x2.6µm (±10%)	
	10x10x4µm (±10%)	100x100x10µm (±10%)
DualScan™ mode	up to 200x200x20µm	up to 200x200x20µm
Nonlinearity		
With sensors		
XY	0.1% peak to peak/2 with correction	0.15% peak to peak/2 with correction
Z	1%	1%
Without sensors		
Fast direction	0.4%	0.4%
Slow direction	0.8%	0.8%
Noise level, XY RMS		
With sensors (in the bandwidth 200Hz)	0.1nm (typically), less than 0.2nm	0.1nm (typically), less than 0.2nm
Without sensors (in the bandwidth 100Hz)	0.02nm (typically) less than 0.04nm	0.02nm (typically) less than 0.04nm
Noise level, Z RMS in the bandwidth 1000Hz		
With sensors	<0.06nm (Z range 6µm)	<0.05nm (Z range 5µm)
Without sensors	0.03nm	0.05nm
Linear dimensions estimation error		
With sensors	±0.04% with correction	±0.06% with correction
Without sensors	5% typically	5% typically
SPM heads		
	AFM	AFM
	STM: 30pA - 50nA, RMS noise	Shear force
	4 pA (standard preamplifier)	
Optical viewing system		
Resolution	1µm	3µm
Numerical aperture	0.28	0.1
Mag. With ½"CCD camera on 14" monitor	233x to 2910x	47x to 579x
Horizontal field of view	1.2 to 0.1mm	2 to 0.49mm
XY sample positioning	5x5mm	5x5mm
Positioning resolution	5µm	5µm
Heating	Room - up to 130°C	-30°C - up to =300°C
Temperature maintenance accuracy (typically)	0.005°C	
Settling time	300 sec	
Overshoot	1°C	
Voltage supply	90-240 V, 50/60HZ	
Power	60W	
Vibration isolation	Dynamic vibrartion isolation system	
Isolation: dynamic in fr. Range	0.7 to 1000Hz	
Isolation: passive beyond fr. Range	1000Hz	
	electric shielding and acoustic isolation is provided by the specail cast metal hood	
Full software control		

NT-MDT
INTEGRATED SOLUTIONS FOR NANOTECHNOLOGY

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