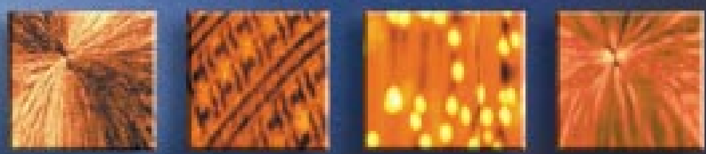
NANONICS IMAGING Ltd.

Shedding light on the unseen



MultiView 1000™

TEST & MEASUREMENT
RESEARCH & DEVELOPMENT
BIOLOGY
CHEMISTRY
PHYSICS
MEDICINE

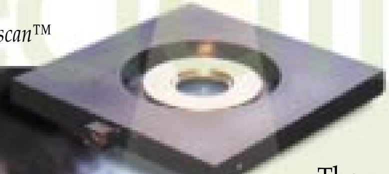
INTRODUCTION

MultiView 1000™

Since its incorporation in 1997, Nanonics Imaging Ltd. has been focused on bringing to the market near-field scanning optical microscopy systems (NSOM) which incorporate ease of use and flexibility in their design and construction. With one of the largest assembled teams of scientists specializing in near-field optics and with its connection to a world-class laboratory working in this field, Nanonics Imaging has and will continue to provide its customers with cutting-edge, robust and flexible NSOM and scanning probe microscopy (SPM) systems.

Bridging the gap between complementary microscopy techniques, our unique system architecture enables our customers to combine far-field imaging, NSOM, AFM, confocal microscopy and Raman spectroscopy, to name a few, into fully integrated and modular systems.
Our in-house team of experts works with each customer on a one-to-one basis to provide customized solutions that suit the particular requirements of the research to be undertaken. Nanonics Imaging's continuous, high-quality consultation and support of our customers facilitates successful research - which is, after all, the ultimate goal.

MultiView 1000™



3D Flatscan™

The award winning MultiView 1000™ (formerly NSOM/SPM-100™) is the first system available that fully integrates all forms of scanned probe microscopy (SPM) with conventional optical microscopy. Designed around Nanonics' patented, award winning 3D Flatscan™ scanner technology and incorporating sophisticated cantilevered optical fiber probes, the instrument can simply and transparently be combined with any inverted, upright, or dual optical microscope.

Normal Force Sensing

With cantilevered optical fiber probes, the MultiView 1000™ system does away with much of the complexity long associated with near-field imaging. Awkward shear-force techniques are a thing of the past as the normal-force sensing capability of the probe makes tip approach identical to that used in ordinary atomic force microscopy.

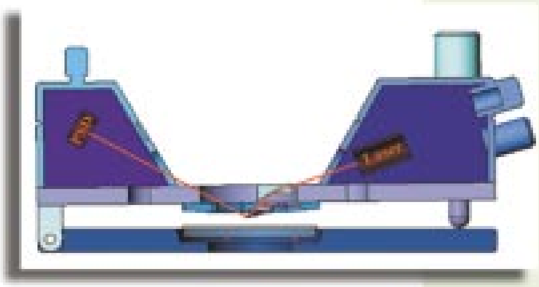
Large Z Scan Range

The large, 70-micron x, y and z-range of the Nanonics 3D Flatscan™ makes it ideal for optical sectioning in confocal imaging. Used in this way, the MultiView 1000™ integrates conventional far-field imaging, confocal microscopy, AFM, and near-field optics in a single system.

Open System Architecture - reflection, transmission, and collection imaging

The unique geometry of the Nanonics NSOM head and cantilevered probes leaves the optical axis free both above and below the sample, allowing the user to view the tip positioning during scanning and to perform NSOM imaging in reflection, transmission, and collection modes.

▲ *MultiView 1000™ Head* ▼



Integration with Complementary Techniques

The open system architecture also enables the MultiView 1000™ to be integrated with other instruments:

- Commercial micro-Raman microscopes, such as those developed by Renishaw Plc. This combination permits correlation of SPM topographic, thermal and electrical properties of a sample surface with micro-Raman spectra.
- In SEM/FIB systems the MultiView 1000™ can be simply and transparently placed inside the SEM/FIB sample chamber providing simultaneous AFM/SEM imaging.

Electrical and Thermal Measurements

The flexibility of the MultiView 1000™ also makes it compatible with numerous types of specialized SPM and NSOM probes.

For example, Nanonics designs wired probes that are capable of performing simultaneous AFM and thermal measurements, NSOM/electrical/topographic measurements, or AFM and electrical measurements, such as spreading resistance and capacitance.

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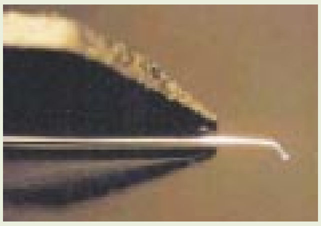


▲ *A cantilevered NSOM probe*

Probes

The standard probes used in Nanonics systems are cantilevered optical fibers. They provide for normal force feedback, have unique advantages in permitting a second channel of illumination or collection, and allow transparent, integrated and simultaneous far-field, lens-based imaging. Straight NSOM fiber probes, micromachined cantilevered NSOM probes and standard, silicon AFM probes can also be used with the MultiView 1000™. In addition, Nanonics produces customized fiber probes to customer specifications, such as probes with tip lengths greater than 500 mm for deep-trench probing and probes with unique force constant and resonance frequency combinations.

Complete NSOM/AFM/Confocal Systems

Nanonics provides a complete NSOM/SPM microscopy system, including a host microscope with confocal detection, a control system, an illumination/detection system, and the widest variety of additional system accessories available on the market.

Modular & Customized Systems

Another important advantage of the MultiView 1000™ is its modularity. Because the Nanonics system readily sits on the sample stage of any conventional far-field microscope and is compatible with most commercial control systems, users can also incorporate the MultiView 1000™ into pre-existing microscopy systems. Our in-house team of experts also works with each customer on a one-to-one basis to provide customized solutions that suit the particular requirements of the research to be undertaken.

Available options for the MultiView 1000™

- Liquid Cell - perform NSOM/AFM measurements on samples in liquid.
- Closed Loop Scanner - closed loop operation for scanning and positioning.
- Environmental Chamber - control your measurement environment.
- Nanochemical Delivery - deliver chemicals with nanometer precision to your sample surface.
- 3D Nanolithography - software for lithography applications.
- For more options and additional details see backcover.

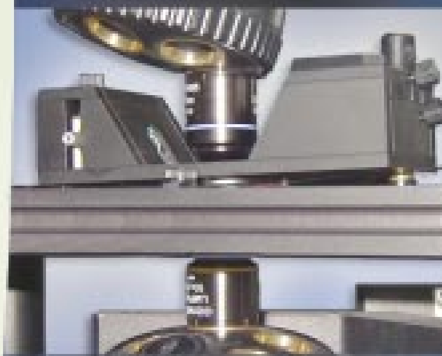
Other Systems Available

The following systems are also available from Nanonics:

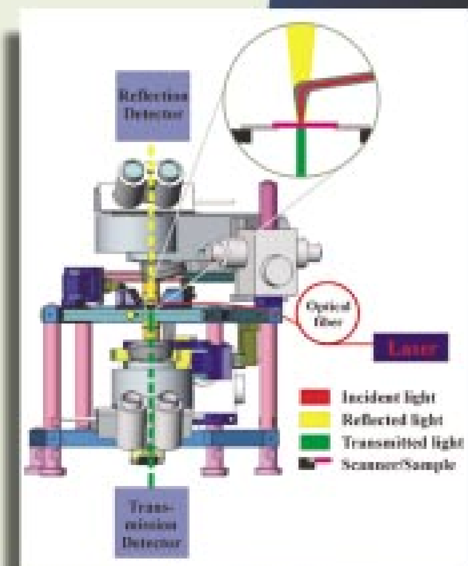
- MultiView 2000™ – a tip scanning NSOM/SPM system.
- Low Temperature – perform SPM measurements at temperatures down to 25 K or 10 K.
- Beam Scanning Confocal – beam scanning or combined beam and sample scanning systems.

Overall, the MultiView 1000™ is a robust and versatile SPM system which allows the user to zoom, with overlapping fields of view, from the lowest resolutions of conventional far-field imaging to the higher resolutions of confocal microscopy, and finally, to the ultimate resolutions of AFM and NSOM.

▲ *Dual microscope system*

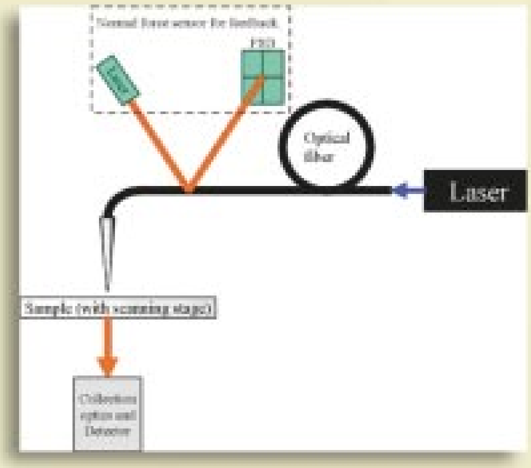


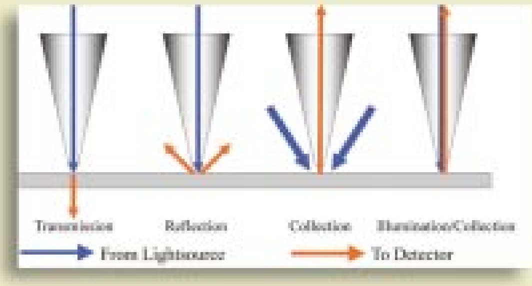
▲ *MultiView 1000™ Head integrated with a standard microscope*



◀ *Complete MultiView 1000™ system with a dual microscope providing optics for the collection of transmitted/reflected light and for viewing the sample before and during the AFM scan. The system is also available with either an upright or an inverted microscope. A cantilevered optical fiber is used to illuminate the sample.*

WHY NSOM?





NSOM (SNOM) is the only way to get sub-wavelength optical information from a sample, and as it is usually combined with AFM, the optical information can easily be correlated to topographical information.

NSOM is able to provide information about the following sample properties:

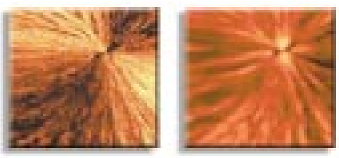
- Changes in reflectivity
- Changes in transparency
- Changes in index-of-refraction/polarization/sample material
- Stress at certain points of the sample which changes its optical properties
- Magnetic properties which change the optical properties
- Fluorescent molecules
- Molecules excited through a Raman shift, SHG, or other effects

The Basic Setup of NSOM

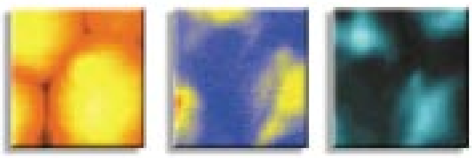
In order to make an NSOM experiment, a point light source (1) must be brought near (nm distances) the surface to be imaged. The point light source is then scanned over the surface (2), and the optical signal from the surface is collected and detected (3) (see diagram on the left for a schematic view of a basic setup).

1) To achieve a point light source, it is possible to use tapered optical fibers (pulled optical fibers) that are coated with metal except for an aperture at the fiber's tip. The light is coupled into the fiber and is then emitted at the sub-wavelength (30 nm or larger) aperture of the fiber. The resolution of an NSOM measurement is defined by the size of the point light source used (typically 50-100 nm).

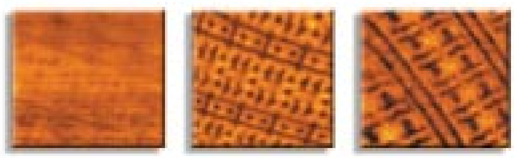
MultiView 1000™ GALLERY



15x15µm images of PEO spherulite. The AFM image (on the right) shows the nucleus and the lamellar crystallites. The transmission, polarization NSOM image shows the radial dependence of the birefringence (butterfly pattern).

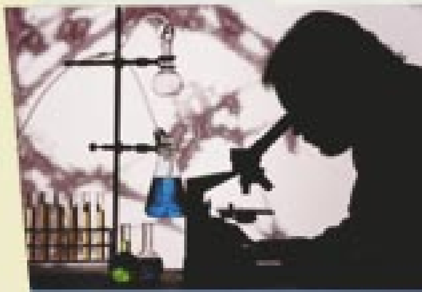


7x7µm images of GFP labelled yeast cells in physiological media. From left to right: AFM, NSOM fluorescence and NSOM transmission.



12x12µm images of a SRAM after CMP. The left side shows an AFM image, where almost no structure can be seen. In the reflection NSOM image in the middle, clear structures are visible, caused by differences in the index-of-refraction. The image on the right shows an electrical resistance image.

tiView 1000™



2) The distance between the point light source and the sample surface is usually controlled through a feedback mechanism that is unrelated to the NSOM signal.
The easiest method to use is a normal force feedback (the standard feedback mode used in AFM), which enables one to perform experiments in contact, intermittent contact and non-contact mode.

3) There are four possible NSOM modes of operation:

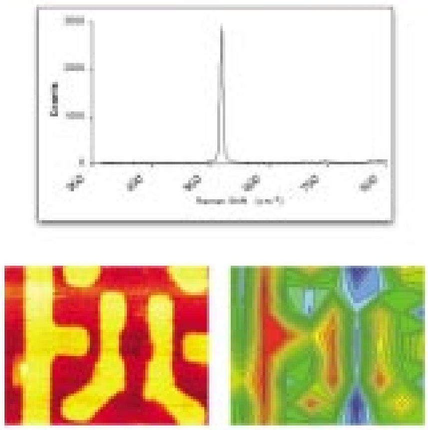
Transmission mode imaging.
The sample is illuminated through the probe, and the light passing through and interacting with the sample is collected and detected.

Reflection mode imaging.
The sample is illuminated through the probe, and the light reflected from the sample surface is collected and detected.

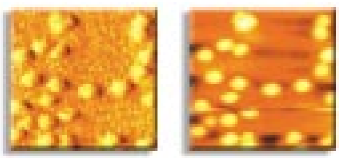
Collection mode imaging.
The sample is illuminated with a macroscopic light source from the top or bottom, and the probe is used to collect the light from the sample surface.

Illumination/collection mode imaging.
The probe is used for both the illumination of the sample and for the collection of the reflected signal.

Detection of the collected light can be achieved with a wide variety of instruments: an Avalanche Photo Diode (APD), a Photomultiplier Tube (PMT), an InGaAs Detector, a CCD, or a spectrometer. The signal obtained by these detectors is then used to create an NSOM image of the surface.

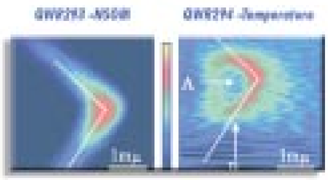


Simultanously recorded topography and Raman intensity image (scan size 9x7µm) of a silicon semiconductor device. The Raman intensity image shows the distribution in space of the Raman intensity of the silicon peak at a 520 cm^{-1} Raman shift. The Raman instensity distribution shows correspondence with the topographic features seen in the AFM image.



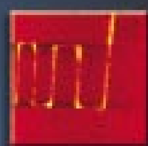
1x1µm AFM(right) and NSOM image (left) of 30 nm gold balls.

8x8µm image of a slab waveguide laser with an injection current of 50mA. The topography is shown as 3D rendering, and the light distribution, measured in collection mode, is shown as colorcode in the same image.



4x4µm collection NSOM (left) and temperature (right) images of a V-grooved quantum wire laser during operation.

900x900nm AFM Topography of DNA image (z-range 2.5nm).



30x30µm AFM image of a BSA protein line printed using a Nanonics Nanopipette NanoFountainPen™.

MultiView 1000™ Technical Specifications

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Modes of Operation

Near-field Optical Microscopy	Transmission, reflection, collection, fluorescence.
Atomic Force Microscopy	Contact, non contact, intermittent contact (shear force optional).
Feedback Mechanism	Optical beam deflection (shear force optional).
Confocal Microscopy	Transmission, reflection, fluorescence.

Scanning/Sample

Scanner	Piezo electric flat scanner (thickness 7 mm). Scan Range:70 µm Z-range, 70 µm XY-range (30 and 10 µm on request). Maximum Load: 75 g.
Step Size	< 1 nm for 70 µm scanner, <0.1 nm for 10 µm scanner.
Sample Positioning	Inertial piezo motion (6 mm range, accuracy 1 µm).
Maximum Sample Size	16 mm diameter, custom mounts for larger samples can be provided.

Probes

NSOM Probes	Cantilevered or straight, pulled optical fiber probes, apertured silicon cantilevers.
AFM Probes	Cantilevered, pulled glass probes or any commercially available AFM probes.
Specialized Probes	Cantilevered probes for electrical or thermal measurements. AFM controlled Nanopens for gas and liquid chemical delivery. Custom probes available on request.

Optics

Viewing/Detection Optics	Free optical access to the sample from top and bottom for optical observation of the sample (all conventional far-field modes of operation are available) and for detection of the NSOM signals with any optical microscope (upright, inverted, dual) or other optics.
Detectors	Photomultiplier Tube (PMT), Avalanche Photodiode Detector (APD), InGaAs Detector for IR, CCD.
Lasers	A large variety of laser systems can be used (UV, VIS, IR).
Video System	Optional CCD camera.

Optical Resolution

Confocal Microscopy	Diffraction limited.
Near-field Microscopy	From 50 nm upwards, depending on the aperture size of the NSOM probe used.
Controller & Software	Nanonics Analogue Controller: Software package-Win 95/98 and NT, XP, Real time image display, image acquisition (up to 8 channels) and analysis, 3D rendering. LabVIEW based software packages also available with up to 4 channel data acquisition. Digital Instrument controllers and software can also be used to control the MultiView 1000™ Microscope.

Options

Liquid Cell	For NSOM/SPM measurements in liquids.
Closed Loop	Closed Loop operation for scanning and positioning.
Phase Imaging	Enables Phase Imaging.
Electrical Measurements	Options for resistance,thermal measurements.
STM Module	Enables STM Imaging.
3D Nanolithography	Perform Lithography at nanometer dimensions.
Beam Scanning Confocal	Confocal Imaging with beam scanning in addition to the sample scanning confocal included in the standard system.
Environmental Chamber	Control the measurement environment (humidity, gases), with vacuum and ambient pressure chambers.
Nanochemical/Gas Delivery	Deliver a chemical via the Nanopipette-AFM tip to your sample surface.
Raman	Fully integrated with Renishaw Raman microscopes. The only system supported by Renishaw.
SEM Add-on	Enables simultaneous SEM/AFM imaging.

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