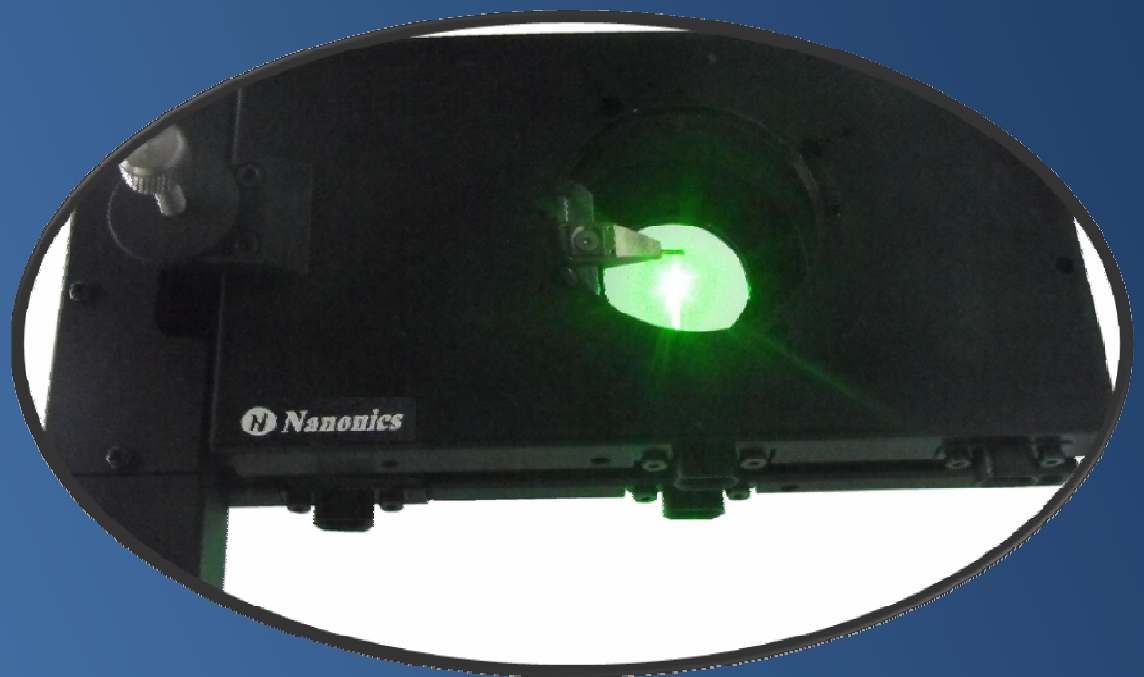


# MultiView 2000™

The First Tip and Sample Scanning Probe Microscope



*The Next Evolution in SPM*

# MultiView 2000™

## Using Two Award Winning Nanonics 3D FlatScan™ Stages



MultiView 2000™ Top-View (Top) and open position (Bottom).



The MultiView 2000™ series is a premium ultra-sensitive scanned probe microscope with a variety of modes of AFM/SPM/NSOM imaging. Like every system in the MultiView™ series, the MultiView 2000™ can achieve integration with AFM/SPM, without compromising optical performance. Nanonics has designed The MultiView 2000™ for excellence in scanned probe microscopy while allowing for near-field and far-field optical NSOM/Raman imaging without perturbation.

Patented award-winning 3D FlatScan™ scanner technology is used in concert with cantilevered optically friendly probes allowing for new horizons in Scanning Probe Microscopy at the highest resolution on real samples with previously unachievable Z extent.

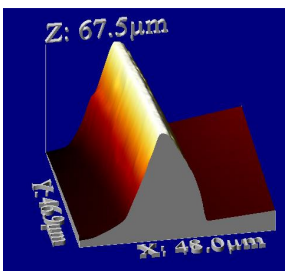
Interference free versatile transparent integration leads to unique combinations without complexity. Nanonics pioneered combinations with:

- Raman microProbes
- Electron and Ion Optical Microscopes
- 4Pi Dual Optical Microscopes
- Upright Microscopes with Water Immersion Objectives
- Synchrotrons

## Key Features



Online integration with Water Immersion Objectives from above for Liquid Cell operation.



AFM large Z range topography of Razor Blade

### ➤ Specialized scanning:

- Two award-winning **Nanonics' FlatScan™** stages for Tip and Sample Scanning.
- Up to 100 microns in X,Y & Z axis per scanner
- Up to 200 microns in X,Y & Z axis in combined scanners
- High step resolution and high resonance frequency
- Unique Large Z range of 100 μm

### ➤ Feedback: The accepted ultimate in feedback of tuning forks without any optical interference.

*(Additional module for beam bounced feedback is available)*

### ➤ Optical & other Online Integrations:

- Free optical axis for transparent integration with true confocal optical microscopes of upright, inverted and dual configurations.
- Powerful objectives of high magnification (100x) and Large NA (0.75) including Water Immersion Objectives from top.
- Raman microscopes, electron and ion optical microscopes, environmental glove box and high vacuum chambers,

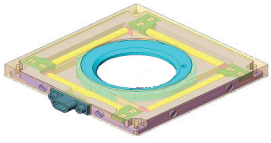
### ➤ Samples:

- Odd size and large samples including hanging geometries
- Customized for various samples geometries.

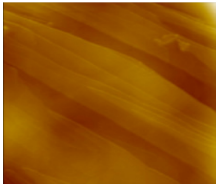
### ➤ Probes: All forms of cantilevered glass probes from Nanonics' exclusive **NanoToolKit™**; Nanosensors including Akiyama tuning forks probes and Si probes

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## Technology & Innovation



▲ 3D FlatScan™  
▼ Atomic Steps of HOPG



### The 3D FlatScan™ Scanner Technology

Unlike the geometric constraints of standard piezo scanners, the design of the 3D FlatScan™ is a novel planar, folded-piezo, flexure scan design which provides the ultimate in AFM resolution (e.g. atomic steps in Highly Oriented Pyrolytic Graphite [HOPG], see picture). The FlatScan™ provides a large vertical (axial) displacement of up to 100 microns that facilitates tracking structures with very large topographical features, and simultaneous lateral scanning of large areas.

Furthermore, 3D FlatScan™ stages can be incorporated with systems such as optical microscopes, Raman microscopes, SEMs/FIBs and environmental chambers for online operation, whereas conventional scan stages are too bulky and geometrically limiting. Its diminutive height of 7 mm allows for easy access with high-powered microscope objectives from either above or below the scanning stages

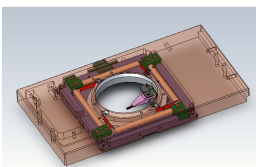
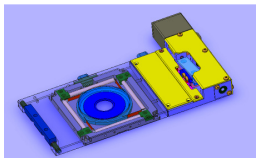
### Breakthrough in Tuning Fork Feedback



NSOM Probe mounted  
on tuning fork

- Provides ultra-sensitive phase and amplitude feedback with high Q-factors
- Normal force tuning fork feedback
- Allows for frequency modulation mode with high force constant
- Ultra-sensitive force spectroscopy modes free from jump-to-contact or ringing artifacts
- Improved imaging quality
- Optically free feedback
- Friendly geometry for integration with optical microscopes
- Full operation in liquid cells
- Minimal adjustments required
- Allows for integration with Water Immersion Objectives from above

### Tip and Sample Scanning Capabilities



MV2000™ Sample (top) and  
Tip Scanning stages (bottom).

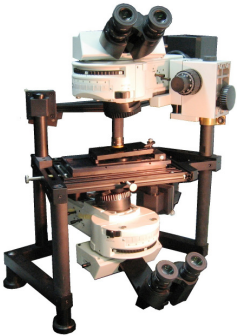
The MultiView 2000™ was the first SPM system to incorporate tip and sample scanning capabilities using one SPM head. The thin height and friendly geometry of the 3D FlatScan™ stages allow the user to join two stages on one SPM platform. A scan range of 100µm can be obtained with each scanner on the X, Y and Z-axes. Furthermore, combined scanning modes (XY sample scan- Z tip scan and XY tip scan- Z sample scan) are readily obtained to reduce XY and Z decoupled scans.

Independent Tip and Sample scanning modes combined at one SPM platform allows for unique protocols in many unique applications such as Photonics/Plasmonics and Tip Enhanced Raman Spectroscopy (TERS). Furthermore, it allows for scanning of large samples with complicated geometries.

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# MultiView 2000™ On-line Integrations

## Optical Microscope



- MultiView 2000™ allows for transparent integration with true confocal optical microscopy, including upright, inverted and dual configurations.
- Complete free optical axis from top and bottom with powerful objectives having large NA, including water and oil Immersion objectives
- Near-field and far-field optical measurements of NSOM transmission, reflection & collection, fluorescence, sSNOM and confocal DIC measurements

## Integration Package



MV2000™ Integration  
Package

Integration Package allows for complete isolation of MultiView 2000™ from Raman noise sources with high optical throughput of hard optical coupling.

- Ultra stable platform for on-line hard optical coupling of an SPM with:
  - Raman
  - Fluorescence/Photoluminescence
  - Non-linear optics
- Optimal SPM performance with full isolation from on-line noises of Femto-second lasers and CCDs, as well as environmental noises
- Free optical axes of inverted, upright and 4pi configurations of optical microscopes with infinity corrected lenses that have parallel beams perpendicular to the sample stage

## Raman and TERS

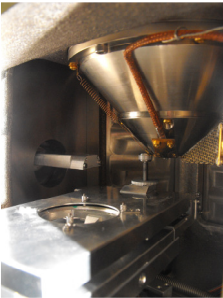


- Free optical axis from top and bottom of upright and inverted optical microscopes for online AFM/Raman and TERS measurements.
- Direct mounting of MultiView 2000™ on various confocal Raman microscopes
- Raman integration through Nanonics Integration Package

← Direct mounting of MV2000™ on HORIBA Jobin Yvon Xplora (Top) and Renishaw PLC Invia (Bottom) Raman Microscopes.

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## SEM/FIB/Ion Beam Integration



Complementary and transparent operation of both SEM/FIB and AFM imaging techniques in one system. A powerful combination of SEM imaging speed with AFM topographical information.

- Vacuum compatible SPM head for integration with SEM/FIB/ion beam systems
- Clear electron and optical axes for on-line AFM/NSOM with SEM/FIB/ion beam operation

← *Transparent integration of the MV2000™ inside SEM chamber.*

## Glove Box Integration/Environmental Control



- Sealed container designed to allow manipulation of the MultiView 2000™ head in a Glove Box for controlled atmosphere of inert gas, vacuum, humidity and chemicals.
- Transparent optical axis for integration with optical microscopy

## High Vacuum Integrations



- Compatible with high vacuum chambers with integration into optical microscopes and free optical axes from top and bottom
- Monitored humidity-control capabilities ranging from 5% - 95%
- Cooling to 40C and heating to 40oC inside the chamber
- Inlets for additional environmental-control substances, including gas inlets
- Optical fiber inlets

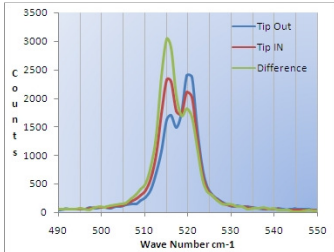
← *Flexible integration of MultiView 2000™ inside high vacuum chambers with free Z optical axis.*

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# MultiView 2000™ Applications

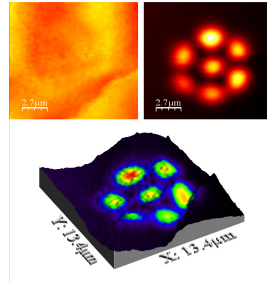
## Unique NSOM/ANSOM and AFM/Raman/TERS Protocols

### Tip Enhanced Raman Spectroscopy



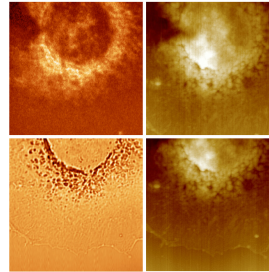
Difference Raman spectrum (green) of 15nm strained Si layer on top of Si bulk differentiated by the near-field enhanced spectrum (red) and the far-field spectrum (blue.)

### Photonic Devices Characterization



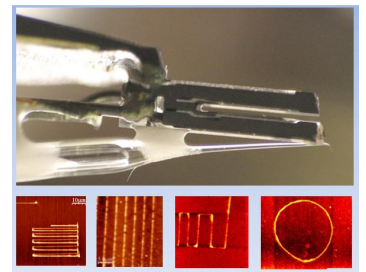
Flexible geometry for complete integration of near-field and far-field optics for photonics/plasmonics characterization and manipulation. Above: Multi mode optical fiber online AFM and near-field profiling

### Liquid Cell Imaging



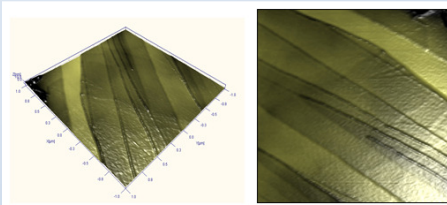
Ultrahigh sensitive tuning for complete integration of near-field and far-field optics for photonics/plasmonics characterization and manipulation. Above: Multi mode optical fiber online AFM/NSOM/Fluorescence imaging of STEM cells

### Fountain Pen nanolithography

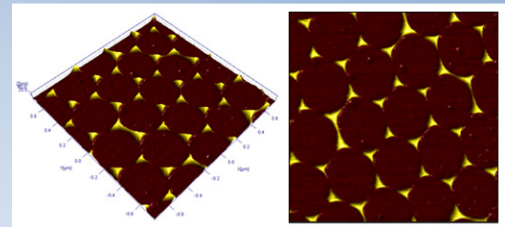


Fountain pen nanolithography for liquid and gas delivery. Variety of materials can be deposited on different kinds of samples within nanometric accuracy. Electrophoretic deposition is also available with capillary nanopipettes.

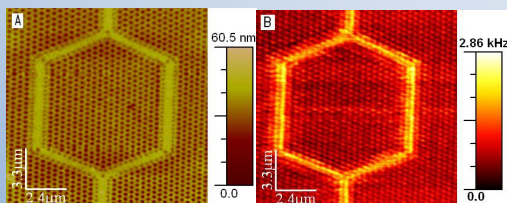
## Ultimate AFM/NSOM/Raman Performance



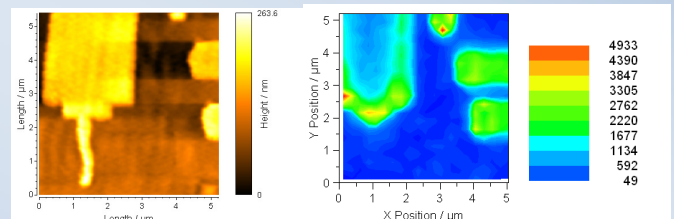
AFM image shows single atomic steps of HOPG sample with low Z noise of less than 2Å.



AFM image of Fischer samples shows the high resolution of 5nm probe.



AFM (left) and online correlated NSOM (right) images show an NSOM resolution of <100nm in reflection mode.



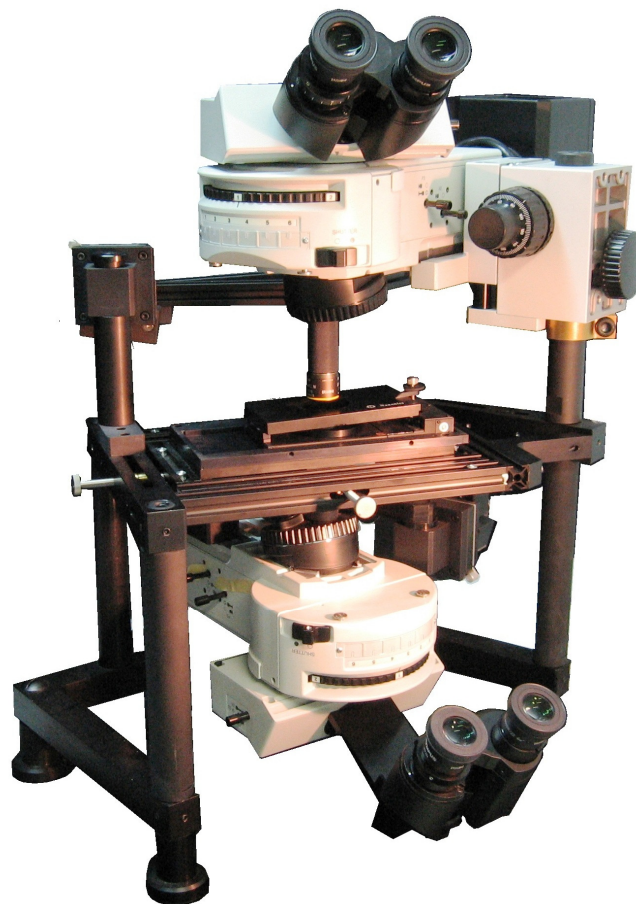
AFM image (left) of a state of the art transistor and online correlated Raman map of the strained silicon 400 cm<sup>-1</sup> peak (right).

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# MultiView 2000™ Specifications

Function	Specs	
<b>Imaging modes</b>	Active Channels	Height, Phase, Amplitude and Force imaging: 16 Online channels
	Functional Modes	Electrical & Thermal Conductivity
	Manipulation Modes	Nanolithography, NanoIndentation, NanoManipulation
	Spectroscopy modes	Force-Distance , I-V
	Optical Far-field	Confocal, Florescence, DIC, Raman: Top, Bottom & Dual microscopes
	Optical Near-field	NSOM, ANSOM, TERS, Shadow NSOM: Reflection, Transmission and Collection
<b>Feedback</b>	Electromechanical Feedback via Tuning fork with high Q-factors	
<b>Scanning Modes</b>	<ul style="list-style-type: none"> <li>- XYZ scan range: up to 100 <math>\mu\text{m}</math> (Tip-scanning and Sample-scanning)</li> <li>- XYZ combined scan range: up to 200 <math>\mu\text{m}</math></li> </ul>	
<b>Scanner Resolution</b>	Z : 0.002nm XY : 0.005nm	
<b>Close Loop</b>	Closed loop for hardware linearization(Easy switching to open loop)	
<b>Z noise</b>	< 0.2nm p-p	
<b>Rough Positioning</b>	<ul style="list-style-type: none"> <li>- 75x50mm Via manual XY stage or 100x100mm of motorized stage. (Optional: customized stages)</li> <li>- 6mm via fine and controlled Inertial motions of Piezo Scanner</li> </ul>	
<b>Sample size &amp; Geometries</b>	Up to 16 mm (standard), (Larger samples: 120mm diameter, 30mm thickness) Unconventional Geometries: Hanging samples for edge profiling and other unconventional geometries.	
<b>Optical Microscope</b>	Free optical axis for integration with all types of optical microscopes, upright, inverted and dual configurations. Video Microscopes	
<b>Objective</b>	<b>Upright Microscope</b>	Optical Objective: 100 X with 0.75NA Water immersion (for liquid cell)
	<b>Inverted Microscope</b>	All available objectives including oil immersion optical objectives
<b>Probes</b>	All forms of cantilevered glass probes from Nanonics exclusive <b>NanoToolKit™</b> , Nanosensors including Akiyama tuning forks probes and Si probes.	

<b>Environmental Control</b>	<ul style="list-style-type: none"> <li>- Full integration with optical microscopes</li> <li>- Humidity Control: 5%-95%</li> <li>- Cooling/Heating: 4°C/40°C</li> <li>- Gas inlets</li> <li>- Fiber inlets</li> </ul>
<b>Sample Cooling/Heating</b>	-20°C/350°C (Solid samples with chamber evacuation)
<b>Liquid Cell</b>	Liquid Cell Assembly capable for liquid flow and exchange and water immersion objective from top.
<b>Integra Controller</b>	Modular Design
	Up to 16 imaging channels
	Three independent scanning axes (-145v to +145v) enabling tip/sample-scanning with adjustable Scanning XY and Z ranges.
	All ADCs and DACs have 16-bit resolution.
	Built-in lock-in amplifier
	All signals are accessible and compatible for connection with other devices



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