The Most Powerful Nanoscale Microscopy for Life Science

Park NX-Bio

The Power of Three Integrated into One:

Scanning Ion Conductance Microscopy for Single Live Cell Imaging

Atomic Force Microscopy for Biomechanical Property Measurements

Inverted Optical Microscopy for Magnified Viewing

www.parkAFM.com

Park SYSTEMS

Park NX-Bio

Discover the physiological phenomena of living cells at nanoscale

As a life scientist, you want to see how how biological materials look like at nanoscale resolution and how soft they are in liquid and buffer conditions. Park NX-Bio enables that with its innovative in-liquid imaging Scanning Ion Conductance Microscopy (SICM) and its highly acclaimed Atomic Force Microscopy (AFM) technology.

More powerful physiological biology study solutions

Park NX-Bio is a powerful 3-in-1 bio-research tool that uniquely combines SICM with AFM and an inverted optical microscope (IOM) on the same platform. The modular design of the Park NX-Bio allows researchers to easily switch between its SICM and AFM capabilities. Designed for non-invasive in-liquid imaging, Park NX-Bio is the ideal tool for studying biological materials under physiological conditions. It combines the bio-mechanical property measurement capability of the AFM and nano imaging of the SICM in liquid, and the optical viewing of the IOM.

Easy to use, even for entry level researchers

Park NX-Bio has a user-friendly design and automated imaging software for SICM, so you won't have to spend so much time for in-liquid imaging. The basic setup for operation can be learned through a simple training course in only a few hours. This allows you to quickly shift your time to conducting more advanced research for your subject.

Physiological Morphology Imaging for Biological Research Laboratories

A Scanning Ion Conductance Microscope (SICM)

- In-liquid imaging with ease
- Delicate membrane morphology imaging at cellular and sub-cellular level
- Biological tissue imaging in three-dimensional (3D) structure

B Atomic Force Microscopy (AFM)

- High resolution bio-imaging for single molecule with True Non-Contact™ Mode
- Force-distance (FD) spectroscopy for mechanical property characterization of various bio-materials
- Accurate FD spectroscopy control with leading low noise Z detector
- Force volume imaging

C Live Cell Chamber

- Optimal temperature, pH, humidity control to maintain viable bio-activity

Reliable and Repeatable Nano Bio-imaging for Better Experimental Verification

- Non-invasive SICM to preserve naïve morphological information of soft bio-materials
- Excellent imaging repeatability in automatically programmed and running software
- Accurate height/depth analysis from 3D structure measurements

Full Integration with Inverted Optical Microscope for High Productivity

- Bright field and phase contrast for easier sample finding
- Access to full range of objective lenses up to 100x magnification
- Integration with confocal and fluorescence microscopy
- Advanced image overlay functions

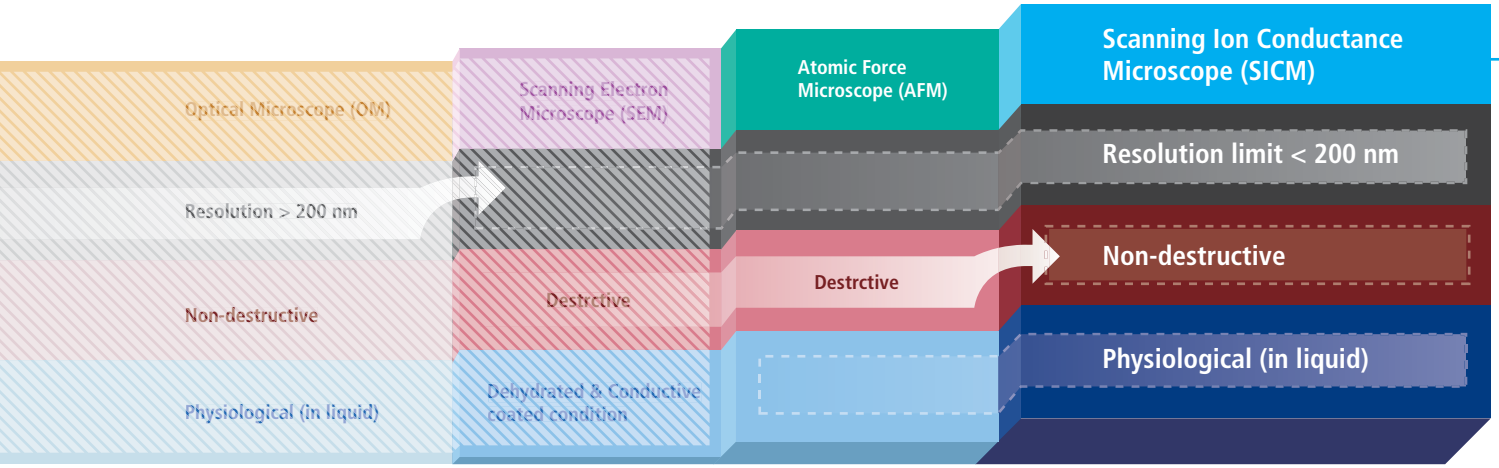
Park NX-Bio

The Scanning Ion Conductance Microscopy (SICM) Technology

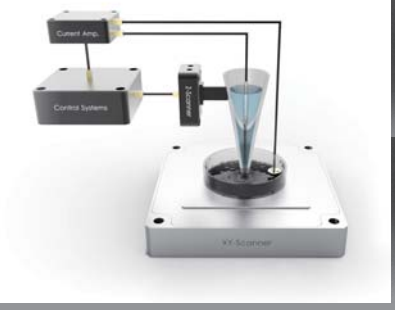
The SICM of Park NX-Bio is the next generation nanoscale microscope for life science

Park SICM can acquire biological images at nanoscale in physiological conditions, attaining high resolution of less than 200 nm. The biological images obtained from SICM are free from morphological deformation, which can occur from scanning electron microscopy (SEM) or even AFM systems.

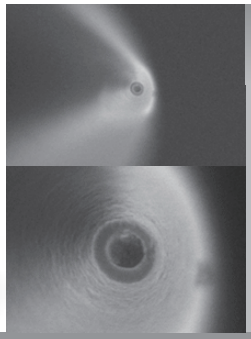
- Scanning Ion Conductance Microscope (SICM)
- Atomic Force Microscope (AFM)
- Scanning Electron Microscope (SEM)
- Optical Microscope (OM)



AFM uses a micro-thin cantilever and tip as a probe.



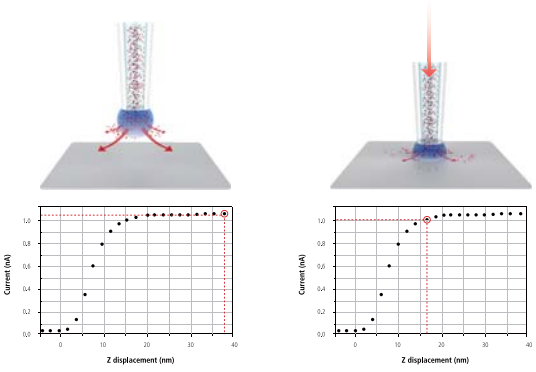
Park SICM uses nanopipettes.



In Scanning Ion Conductance Microscopy developed by Park Systems (Park SICM), a glass nanopipette filled with an electrolyte acts as an ion sensor that provides feedback on its location relative to a sample completely immersed in liquid. The pipette tip maintains its distance from the sample by keeping the ionic current constant. In comparison, AFM typically relies on interaction of forces between its probe tip and the sample.

For Park SICM, the pipette is a probe with an inner diameter ranging from 80 to 100 nanometers for pipettes made of glass and 30-50 nanometers for those made of quartz.

The Park SICM image on the right is a suspended collagen fibril



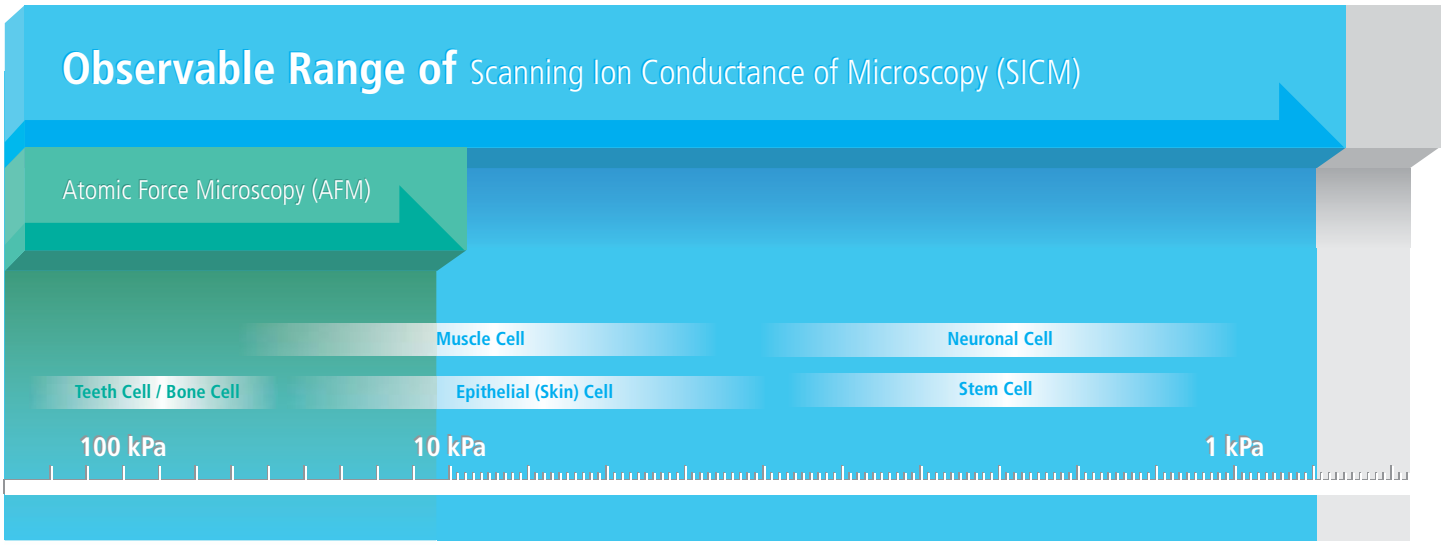
No Force, Non-Contact Imaging in Liquid

Similar to Scanning Tunneling Microscopy (STM) operating in ambient air, the Park SICM operates in liquid without making physical contact with the sample. Electrodes on either side of the sample and pipette produce ionic current that flows through the surrounding solution.
A sensor measures the current flow, which decreases as the distance between the pipette and sample becomes smaller, and monitors the distance between the pipette and the sample to obtain the topology.

The suspended fibrils have a very complex structure, floating just microns from the bottom substrate in the liquid.
This is an impossible configuration for traditional AFMs as the force of a physical probe would displace the suspended fibrils.

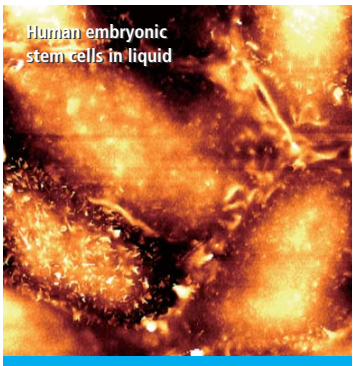
Park SICM Can Image All Cell Types

Park SICM can image even the softest cells such as the neuron cells, live—something that's impossible with any other microscopy techniques.

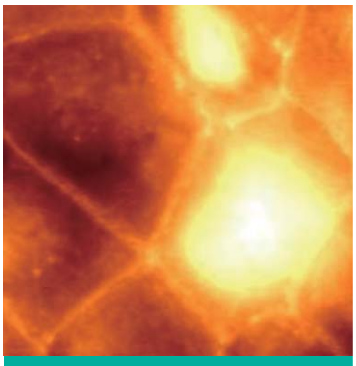


Park SICM is able to **visualize delicate and tiny micro-villi structures** on celluar membrane

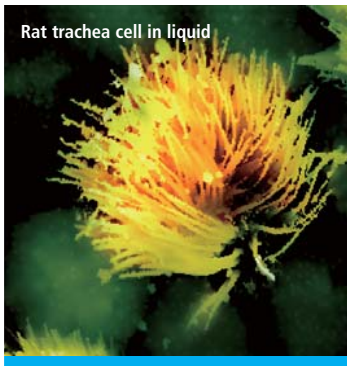
Park SICM does not damage or remove **a cell's delicate hair-like structures**



Park SICM

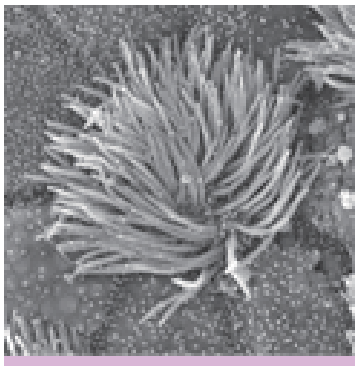


Atomic Force Microscopy (AFM)



Courtesy of Prof. Ushiki, Niigata Univ., Japan

Park SICM

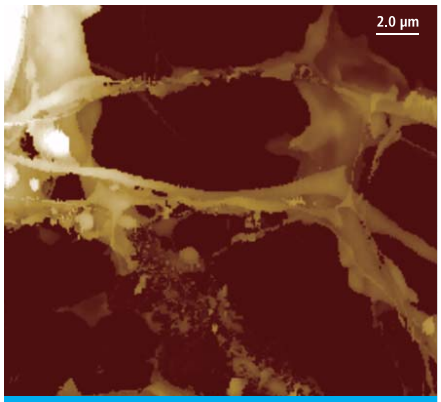


Scanning Electron Microscope (SEM)

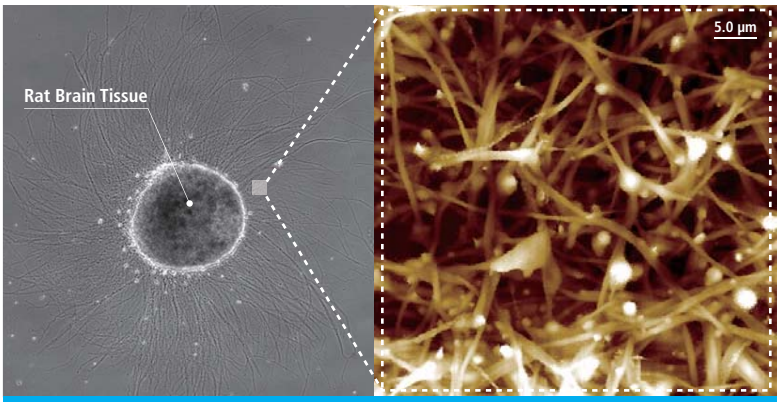
Park SICM acquire images of neuronal cells, **which are extremely soft and delicate**

Park SICM can even **image suspended network of neurons**

Neuronal cell morphology



Neuronal cell's synaptic connection



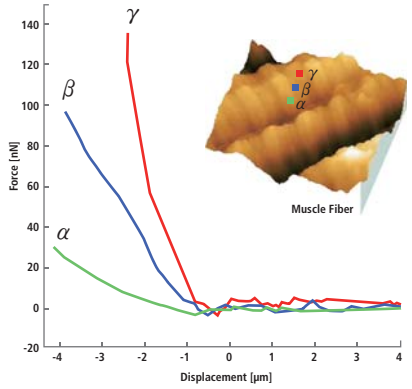
Courtesy of Prof. Ushiki (Niigata Univ., Japan)

Park NX-Bio
Park AFM Technology

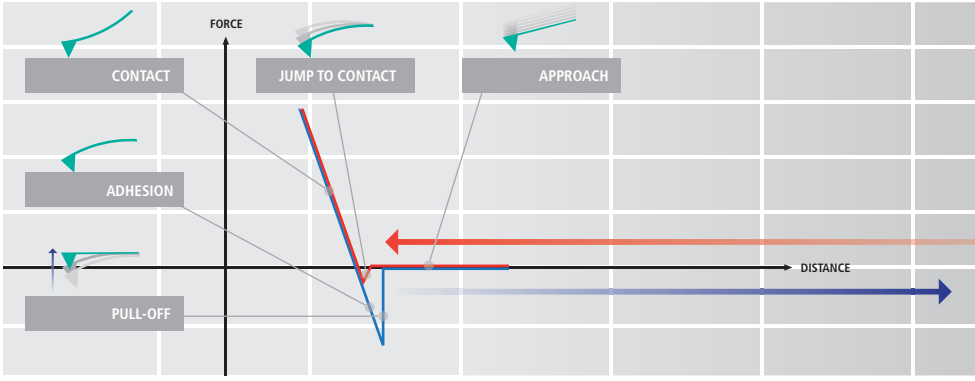
Advanced Park AFM Technology Enables Accurate Force-distance Spectroscopy

Force-distance (FD) spectroscopy using an AFM is a beneficial tool to characterize bio-mechanical properties of various biological materials. In FD spectroscopy, the cantilever tip touches the sample surface with a user prescribed amount of force accurately applied using the AFM's Z scanner. Park AFM's industry leading low noise Z detector allows the researcher to control Z scanner movement to apply an exact amount of force very accurately to a sample surface during FD spectroscopy. This enables the researcher to collect detailed bio-mechanical characterization data at the nano-newton scale.

Cell's Mechanical Property Measurement



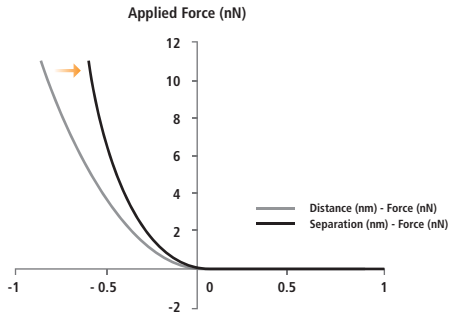
Force Distance Spectroscopy measures the mechanical interaction force between the tip end and the sample.



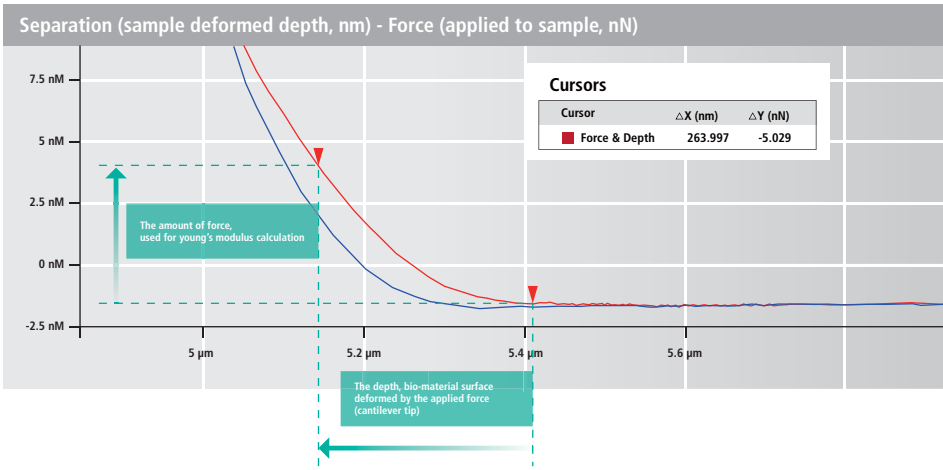
Advanced Biomechanical Property Measurement by Calculating Elastic Modulus (Young's Modulus)

The Herzian and Oliver Pharr models are calculated automatically from the Park AFM's accurate FD spectroscopy data to determine the elastic modulus (Young's modulus). Both of these calculation methods are included in Park XEI, the data analysis software in Park NX-Bio. They strengthen the biomechanical data verification of FD curves obtained in your experiments.

Acquiring the actual depth, sample deformed by applied force (separation - force curve)



Calculating Young's Modulus in Hertzian model



Scanning Ion Conductance Microscope (SICM)
Atomic Force Microscope (AFM)

Park NX-Bio

Park SICM and Park AFM Technologies Put Together

Outstanding Investigation Tool for Biological Research by Combining Physiological Morphology with Bio-Mechanical Property Measurements

Park NX-Bio combines Park SICM's ability to interpret morphology under true physiological conditions and Park AFM's capacity to acquire bio-mechanical property data (elastic modulus) accurately. This enables researchers to understand the fundamentals of their biological materials at a deeper level.

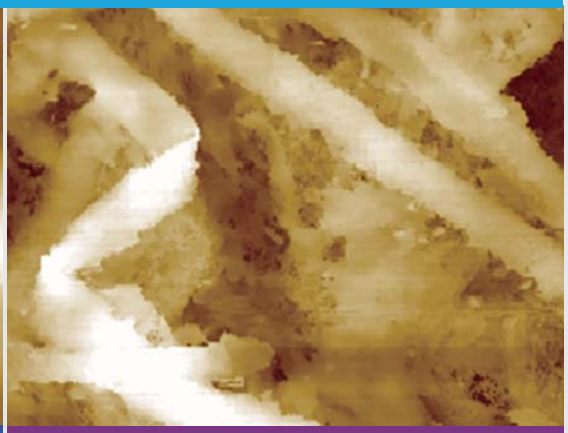
Bio-Mechanical Property Measurement with FD Spectroscopy
Park AFM

Interactive & Fundamental
Understanding of Bio-Materials
Park NX-Bio

Physiological Morphology Imaging
Park SICM

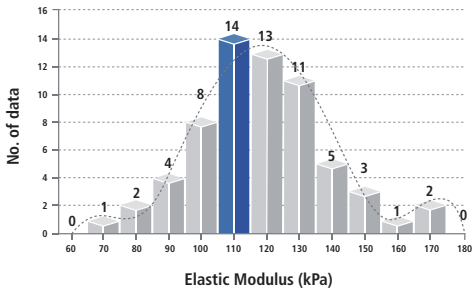
Physiological Morphology Imaging with Park SICM

Collagen-film A Scan Size: 20 μm x 15 μm

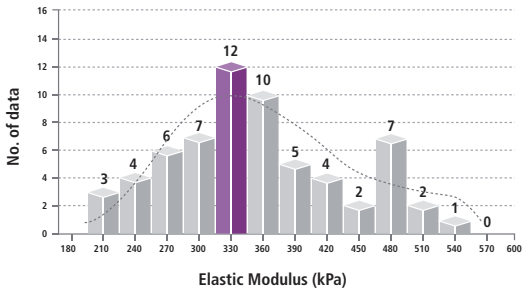


Collagen-film B Scan Size: 20 μm x 15 μm

Elastic Modulus: 113.2 kPa



Elastic Modulus: 345.1 kPa



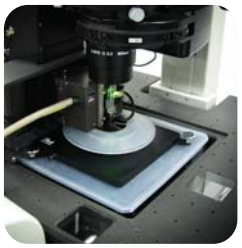
Bio-Mechanical Property Measurement with FD Spectroscopy of Park AFM

Park NX-Bio
Application Options

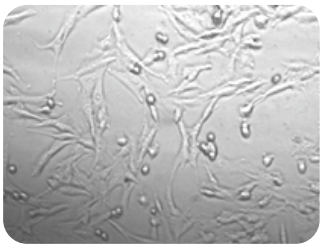
Live Cell Study with Live Cell Chamber (SICM & AFM)

The live cell chamber creates an ideal environment for cells, improving their life expectancy during long measurement durations through controlled temperature, pH, and humidity at optimal conditions. Experiments with the live cell chamber have demonstrated cell survivability of more than 20 hours.

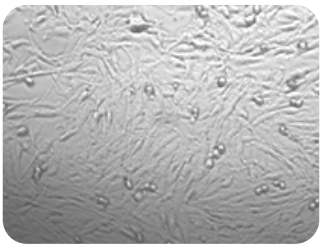
Live Cell Chamber



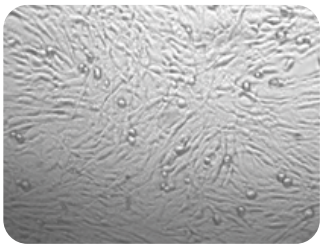
0 hours



24 hours



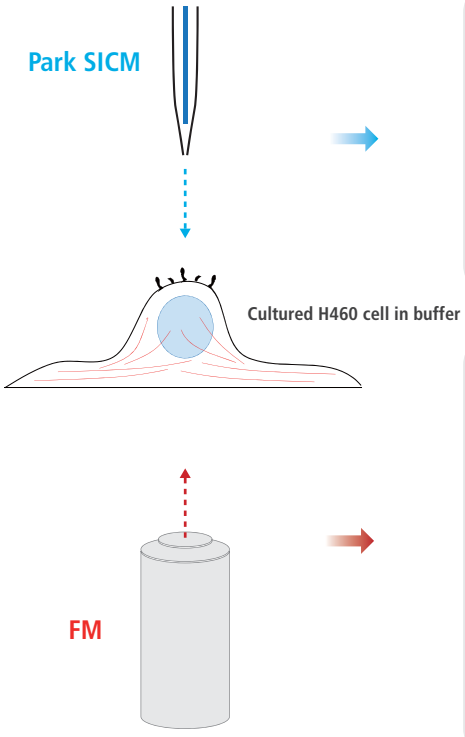
48 hours



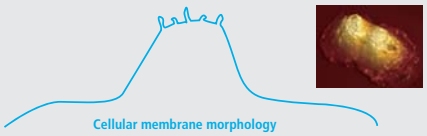
Human fibroblast cells in the Live Cell Chamber of Park NX-Bio survive over 48 hours.

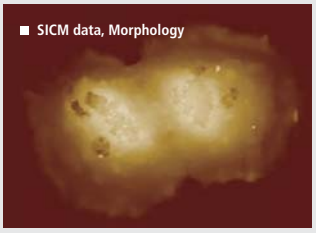
More Comprehensive Cell Biology Study, by Integrating Fluorescence Microcopy with Park SICM

Combining fluorescence microscopy (FM) techniques with Park SICM can create new benefits and provide comprehensive information for cell biology studies that cannot be obtained when using only one of those techniques. While monitoring external cellular surface morphology with SICM, the internal cellular behavior can be observed by FM.

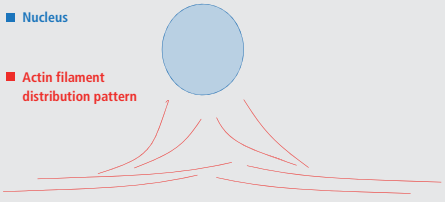


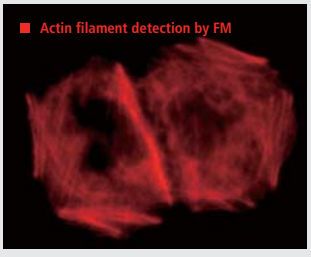
Cellular Surface Morphology in liquid, acquired by
Scanning Ion Conductance Microscopy (SICM)





Inner Cellular specified molecules
Fluorescence Microscopy (FM)

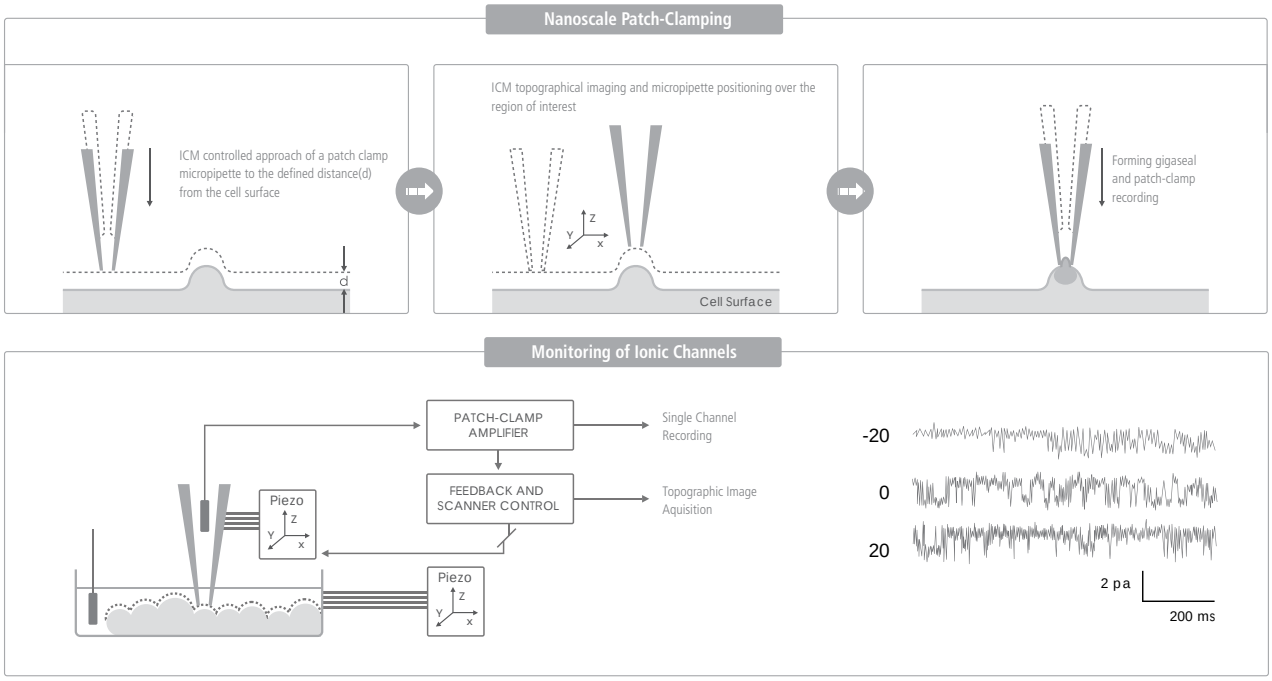




Ion Channel Recording of Targeted Patch Clamping

Conventional Patch Clamping is an optical microscope view-based technique used to monitor a single living cell's ion channel activity—a key quantifier of various cellular activities. Targeted Patch Clamping is the SICM-based version of this technique that enables the detection of ion channel activities of specific subcellular structures.

Park SICM + **Patch Clamping** = **Targeted Patch Clamping**

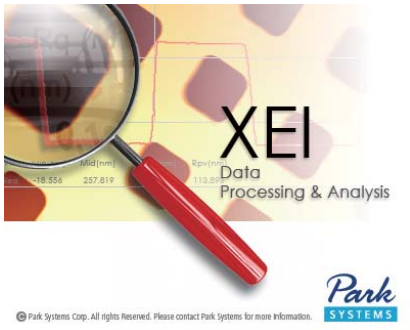


Software

XEP – Data Acquisition

XEP is a data acquisition software that provides all user controls of Park AFM measurements. The friendly user-oriented interface of XEP provides easy operation of the AFM.

- Simultaneous data acquisition of up to 16 images
- Maximum 4096 × 4096 pixels image size
- Dedicated Force-distance and I-V spectroscopy with batch processing
- Cantilever spring constant calibration



XEI – Image Processing and Analysis

XEI is the AFM image processing and analysis program. Its powerful processing algorithms make analyses easy and streamlined. With its most advanced and versatile imaging features, AFM users can obtain essential and critical information from their experiment.

- Image analysis of line profile, region, and 3D rendering
- Spectroscopy data analysis module (F-d, I-V)
- Directly copy/paste to presentation program
- Multiple image comparison
- Image overlay of two different images

Park NX-Bio
Specification

SICM Head with pipette probe holder

Includes a low-noise, high-precision ionic current amplifier
Includes a high-force Z scanner
- Flexure-guided structure driven by multiply-stacked piezoelectric stacks
- Z scan range: 25 μm (50 μm Z scanner is available optionally)
- 20-bit Z position control and 24-bit Z position sensor

Dovetail lock head mount for easy mount/removal of the SICM head
- Automatically connects to the electronics upon mounting

High Speed AFM head

Includes a high-speed Z scanner
- Flexure-guided structure driven by multiply-stacked piezoelectric stacks
- Z scan range: 25 μm
- 20-bit Z position control and 24-bit Z position sensor

Includes a probehand to which a cantilever is attached
- NCM oscillation frequency: Up to 3 MHz
- Voltage bias range to the cantilever: -10 V to 10 V

Detects the deflection of the cantilever using SLD (Super Luminescent Diode) for topography feedback
- SLD wavelength: 830 nm
- SLD has low coherence length eliminating optical interference
- SLD coherent length: ~50 μm

Dovetail-lock head mount for easy mount/removal of the AFM head
- Automatically connects to the electronics upon mounting

Supported Modes

SICM Standard Imaging
- DC mode
- ARS mode
- Z servo ARS mode

SICM Ionic Current Measurement
- Current-Distance (I-D) Spectroscopy
- Patch Clamping Integration (Targeted Patch Clamping)

AFM Force Measurement
- Force Distance (F-D) Spectroscopy
- Pin-Point mode for Surface Mechanical Property Imaging
- Force Volume Imaging
- Spring Constant Calibration by Thermal Method

AFM Standard Imaging
- True Non-Contact AFM
- Basic Contact AFM and DFM
- Lateral Force Microscopy (LFM)
- Phase Imaging

Optical Properties
- Raman Spectroscopy Integration
- Tip-Enahnced Raman Spectroscopy (TERS) Integration

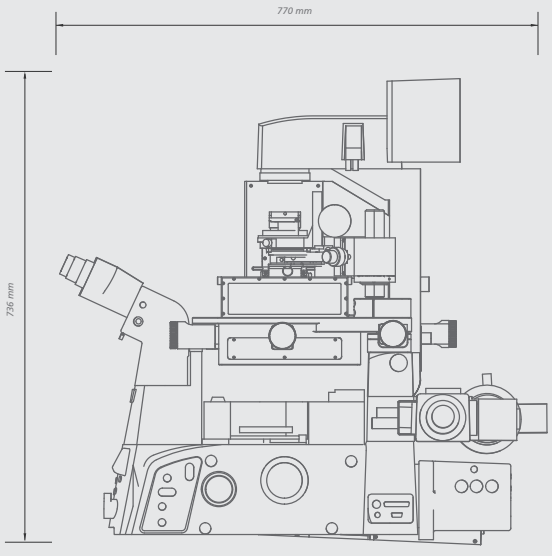
Software

XEP
Dedicated system control and data acquisition software
Adjusting feedback gain, set point in real time
Script-level control through external programs such as LabVIEW (optional)

XEI
SICM & AFM data analysis software (running on windows, Mac OS X, and Linux)
Geographical morphology of biological sample analysis, including height, volume, and surface roughness
3 dimensional SICM/AFM image display

Computer with Dual Monitors

Intel® Core™ i3 or compatible
4 GB RAM, 500 GB Hard Disc Drive
Dual 23 inch LED monitors (1920 × 1080 pixels, DVI)
Graphic Card: ATI Radeon 3450 graphics card or compatible
Operating System: Microsoft Windows 7 Professional 32 bit (English)



Scanner

Decoupled XY and Z-scanner
Single module flexure XY-scanner with closed-loop control
Scan range of XY-scanner: 100 µm x 100 µm
20-bit XY position control and 24-bit XY positioning sensor
Working distance of Z-scanner: 25 µm
Resonance frequency of Z-scanner: 9 kHz

XY Stage

Working range of XY stage: Software-controlled motorized stage for SICM/AFM head positioning
Stage travel range: 14 mm
Stage travel step: 0.1 µm
Working range of Z stage: -14 mm, motorized movement
Sample size:
- 50 mm × 50 mm, 20 mm thick, and up to 500 g
- Petri dish (38 mm)

Accessories for Applications

Environmental control chamber for live cell imaging

Controls temperature, humidity, and pH

Temperature control
- Range: RT - 60 °C
- Heating elements placed at the top and bottom of the chamber to minimize temperature fluctuation

Includes Temperature Controller and Humidifier
Includes covers for AFM head and SICM head
Controls the pH of the Live Cell Chamber by supplying mixed CO2 gas

Universal Liquid Cell

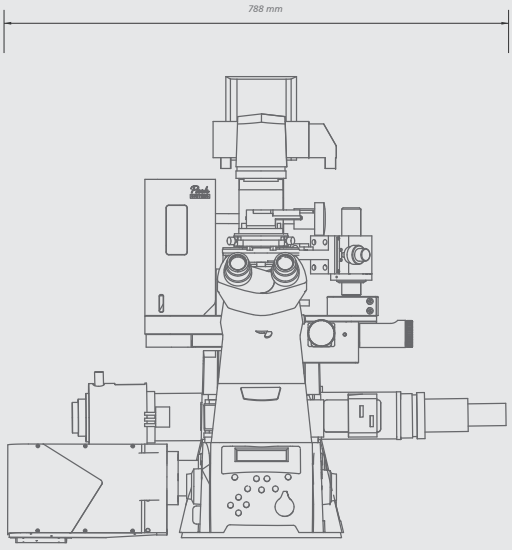
Open/closed-cell environment for liquid imaging
Temperature control

Enhanced Acoustic Enclosure (AE) for NX-Bio

Enhanced Acoustic Enclosure (AE) for NX-Bio
Designed exclusively for the NX-Bio, the Integrated Acoustic Enclosure for SICM/AFM isolates the systems from external acoustic and light noise as well as floor vibration for ultimate performance.
Includes active vibration isolation system with direct velocity feedback to cancel out the floor vibration
Active frequency: 0.7 Hz to 1 kHz
Best solution for high resolution in-liquid imaging
Ergonomic design for a convenient access to the instrument
Dimension: 1,000 × 1,030 × 1,460 mm (outer)
Weight: 661 kg

Optical Configuration for Park NX-Bio

Compatible with inverted microscopes from
- Zeiss (Axio Observer Z.1)
- Nikon (Ti-S, Ti-U, Ti-E)
- Compatible with confocal microscopes and fluorescence technique such as TIRF, STORM TopviewOptics (upright optics) with CCD camera for opaque samples



Park Systems

Dedicated to producing the most accurate and easiest to use AFMs

The global headquarters is located at
Korean Advanced Nanotechnology Center (KANC) in Suwon, Korea.

More than a quarter century ago, the foundations for Park Systems were laid at Stanford University where Dr. Sang-Il Park, the founder of Park Systems worked as an integral part of the group that first developed AFM technology. After perfecting the technology, he then went on to create the first commercial AFM and later Park Systems was born.

Park Systems strives everyday to live up to the innovative spirit of its beginnings. Throughout our long history, we have honored our commitment to providing the most accurate and yet very easy to use AFMs, with revolutionary features like True Non-Contact™ mode, and many automated software tools. We are not simply content to rest on our past success. All of our products are designed with same care and creativity that went into our first, allowing you to focus on getting results without worrying about the integrity of your tools.

www.parkAFM.com

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