BioScope Resolve
The Most Advanced AFM for Life Science Research

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Senior Life Sciences Applications Scientist
Bruker Series of AFMs for Life Science

- Multiple Bruker AFM Platforms being used in leading biological research and biotechnology industry.

**MultiMode® 8**
Highest resolution AFM for molecular imaging

**Dimension FastScan Bio™**
High-speed imaging of biomolecular and cellular dynamics.

**BioScope Catalyst™**
True functional integration of AFM and optical microscopy
Bruker BioScope Resolve™ BioAFM
Unrivalled BioAFM Imaging Resolution and Biomechanics
Enabled by PeakForce Tapping®

- **Most Comprehensive Package for Cell & Molecular Mechanics**
  - New PeakForce QNM® on Live Cells for the fastest, highest resolution nano-mechanics
  - New FASTForce Volume™ capabilities that extend the speed & sensitivity of force measurements with new property channels

- **Highest Available Resolution on a BioAFM**
  - Most routine high resolution imaging of molecular structures
  - ScanAsyst Imaging of whole live cells with no imaging artifacts

- **Full Integration of AFM & Optical Microscopy to enable advanced correlated studies.**
  - Fully integrated, synchronized imaging of AFM & optical techniques
  - Automated measurement capabilities for high throughput data generation
  - Excellent biological sample handling and environmental control for advanced live cell studies
BioScope Resolve – Accessories for Complete Bio Experiments

- Petri dish, glass slide and coverglass support with easy access to sample.
- EasyAlign Probe Loading station
- Micro Volume cell (60µL)
- Sample Heater
- Perfusing Stage Incubator (PSI)
- Top View Optics

Unrivalled open design for easy sample access

New EasyAlign platform for Easy Probe Loading

Micro Volume cell (60µL)

Top View Optics with stand
MIROView™ - New Overlay GUI
Quickly Find Feature of Interest & Scan

- Single view to control AFM operation based on optical data
- Seamless mode switching between imaging, force volume, and single ramps
- Set up scan and automated measurement sequence
- Continuous data capture for no loss of data
- User Rating system for captured data
- Data History for easy organization of multiple scan areas/data points
Most Complete Set of Force Measurement Capabilities

BioScope Resolve is designed to take full advantage of PeakForce Tapping Technology

- **PeakForce QNM**
  - Operating frequencies of 125Hz-2kHz.
  - Unique petri dish sample holder.
  - New PeakForce QNM dedicated probes for soft bio-samples.

- **FASTForce Volume**
  - Operating frequencies 0.1Hz-300Hz.
  - Raster scanning-based imaging mode.
  - 3 Ramp channels & 4 Data channels now available.

- **Force Spectroscopy**
  - Operating frequencies 0.1Hz-300Hz.
  - Low force triggering (~50pN).
  - 3 Ramp channels now available.
PeakForce QNM & Imaging on Live Cells
Repeatable Data, High Resolution Mechano-Biology

• PeakForce QNM property mapping of live cells provides:
  • Fast acquisition of high-resolution mechanical property maps (up to 1kHz in fluid)
  • Quantitative and highly repeatable modulus/adhesion measurements

• Achieved Through:
  • Unique instrument design including very stable sample clamping
  • Bruker PeakForce QNM Live cell probe (17µm tip, k \sim 0.08N/m)

PeakForce QNM topography image (left) and corresponding modulus image (right) of living MDCK cells. Cell structures corresponding to actin fibers show higher modulus (lighter) while cell surface features, believed to be microvilli, appear softer (darker) than the cell membrane itself.
## PeakForce QNM
Quantitative and Repeatable Data

<table>
<thead>
<tr>
<th>Sample: 1.25% Agarose Gel</th>
<th>PFT -1kHz (kPa)</th>
<th>PFT -500Hz (kPa)</th>
<th>PFT - 250Hz (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average*</td>
<td>24.2</td>
<td>13.1</td>
<td>15.2</td>
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<tr>
<td>STD</td>
<td>3.1</td>
<td>3.5</td>
<td>1.8</td>
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### 2.5% Agarose Gel

<table>
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<tr>
<th>Average</th>
<th>283</th>
<th>180</th>
<th>120</th>
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<tbody>
<tr>
<td>STD</td>
<td>51</td>
<td>27</td>
<td>24</td>
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</table>

### 5% Agarose Gel

<table>
<thead>
<tr>
<th>Average</th>
<th>485</th>
<th>258</th>
<th>213</th>
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<tbody>
<tr>
<td>STD</td>
<td>75</td>
<td>26</td>
<td>12</td>
</tr>
</tbody>
</table>

* Average represents 2 users, alternating with 3 probes and 3 samples on many sites to perform measurements

- Measurements by multiple users, multiple probes and multiple samples
- Demonstrates good consistency of PeakForce QNM in broad frequency range

Bruker Nano Surfaces Division
New FASTForce Volume Capabilities
Increased flexibility & productivity for force mapping

- Fast FV ramp rate increased from 10Hz to 300 Hz
- FV Ramp channels increased from 1 to 3
  - Save Z-sensor during ramp so closed loop Z not needed
- Rectangular, bidirectional scanning
- New FV View shows selectable Ramp plot and 4 property images
  - Adhesion, force modulus, stiffness, & height
- High resolution FV = more pixels in X, Y, Z
  - (256x256)x256 increased to (256x256)x2048
  - Max pixels now (956x956)x256
- Improved analysis
  - “Real Height”, More ways to slice
  - Density plot, Contour plot, etc.
Most Comprehensive Package for Biomechanics
Easy comparison of Force Volume & PeakForce QNM

- Extend frequency range and close gap between Force Volume and PeakForce QNM
  - Decrease PeakForce QNM minimum frequency to 125Hz and increase FV to 300Hz
- Improves productivity and makes high-resolution FV maps practical
- Allows investigation of time dependent material property maps
PeakForce Tapping Imaging
Accurately Measuring the Diameter of DNA

- The low imaging forces and precise force control enabled by PeakForce Tapping (~70pN for these DNA images) allow for accurate measurement of the ~2nm diameter of B-DNA.
Highest Resolution Imaging Obtained by an AFM on an Inverted Microscope

- BioScope Resolve ScanAsyst-HR probe ($k \sim 0.4N/m$, <2nm tip diameter).

Submolecular resolution of the major and minor grooves of the DNA Double Helix. Image obtained on an inverted microscope.

Lattice structure of Bacteriorhodopsin (bR) taken on an inverted optical microscope. Inset showing a single particle averaging of the bR trimer. Green circle showing a single lattice defect. Blue circle showing the lattice substructures. Z scale 0.6nm.
PeakForce Tapping Imaging of Live Cells

- Imaging of entire cell structure without artifacts.
  - XY-Scan range of $\geq 100\mu m$; Z-Scan range of $\geq 15\mu m$
  - Bruker PeakForce QNM Live cell probe (17$\mu m$ tip, $k \sim 0.08N/m$)
  - New ScanAsyst mode for cell imaging
Bioscope Resolve with PeakForce Tapping now enables high-resolution imaging of microvilli on living cells

- 1kHz PeakForce Tapping images of live MDCK cells obtained by Dr. Hermann Schillers, University of Muenster.

SEM image of MDBK cells at 2400x mag.
MIROView Optical Synchronization
Seamless Integration Between Optical Microscopy & AFM

- Acquisition and automatic import of registered optical images is fully integrated with transmitted light and advanced fluorescence techniques (through CCD camera and confocal microscope).

- Optical images can be acquired at:
  - each AFM scan line
  - each AFM image
  - each force curve (approach or retract)

- AFM and optical data are fully registered for post-processing and presentation. Optical data can be played back in Nanoscope MovieMaker.

Synchronization of AFM and Confocal Imaging of MDCK cells. Actin fibers are fluorescently labeled with Alex Fluor® 546 Phalloidin. Confocal images showing deliberate photobleaching of the dye are captured every 25s during continuous AFM imaging of the cell structure.
Bruker BioScope Resolve BioAFM
Unrivalled BioAFM Imaging Resolution and Biomechanics Enabled by PeakForce Tapping

- **Most Comprehensive Package for Cell & Molecular Mechanics**
- **Highest Available Imaging Resolution on a BioAFM**
- **Full Integration of AFM & Optical Microscopy to enable advanced correlated studies.**