Asylum Research AFM Modes

Measurement modes from the technology leader in AFM

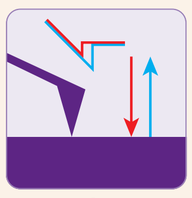
Basic

Tapping Mode / AC Mode

One of the most popular AFM imaging modes, tapping mode can be used to measure topography on a variety of samples. The cantilever is driven at or near resonance and its amplitude is maintained constant during the scan.

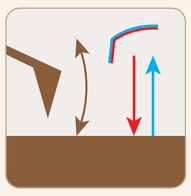
Contact Mode

Contact mode can be used to image sample topography by keeping the tip in contact with the sample at a constant force. The cantilever is raised or lowered as needed during the scan to keep the cantilever deflection constant.



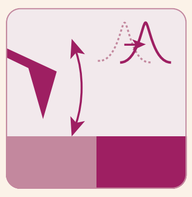
Force Curves – Contact

During a force curve measurement, the cantilever is ramped toward and then away from the sample surface while the forces that it experiences are recorded. Phenomena such as protein unfolding, adhesion, and sample viscoelasticity can be studied.



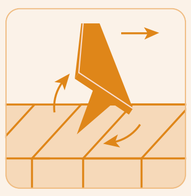
Force Curves – Tapping Mode

During a force curve measurement in tapping mode, the cantilever is ramped toward and then away from the sample surface while both the amplitude and phase are recorded. This can be used to study the dynamics of a tapping tip relative to the long and short range forces of the sample.



Frequency Modulation

In Frequency Modulation (FM-AFM), the cantilever is always driven on resonance and its frequency shift is maintained constant by raising or lowering the cantilever tip, thereby tracking topography.



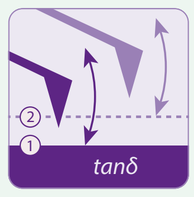
Lateral Force Microscopy

Lateral Force Microscopy (LFM) can be used to study nanotribology and operates in contact mode with the tip scanning orthogonal to the long axis of the cantilever. Torsional bending of the cantilever will result in a change in the lateral signal.

NanomechPro™

AM-FM Viscoelastic Mapping*

AM-FM is an imaging mode used for viscoelastic mapping. The cantilever is driven simultaneously at two separate resonance modes. For the higher mode, changes in frequency are related to sample stiffness and elasticity, whereas changes in amplitude are related to sample dissipation and loss.



Loss Tangent Imaging

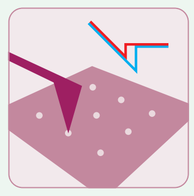
This technique maps the sample's loss tangent, which is the ratio of the energy dissipated to the energy stored as the cantilever taps the surface.

Contact Resonance Viscoelastic Mapping*

Contact Resonance provides quantitative imaging of elastic and loss modulus. The cantilever is scanned in contact while simultaneously being excited at the tip-sample contact resonance. This resonance is tracked with various techniques.

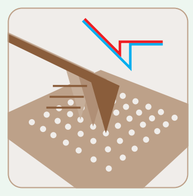
Bimodal Dual AC™

In Bimodal Dual AC, the cantilever is driven simultaneously at two separate resonance modes. This technique often provides enhanced and even unique contrast related to material properties.



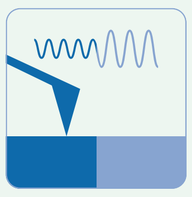
Force Maps

A Force Map is simply an array of force curves. Quantities like sample height, sample modulus, and tip-sample adhesion can be extracted from this array of force curves, in addition to a number of other preset and even custom calculated quantities.



Fast Force Mapping*

Fast Force Mapping is simply an array of force curves taken at high speed. Quantities like sample height, sample modulus, and tip-sample adhesion can be extracted from this array of force curves, in addition to a number of other preset and even custom calculated quantities.

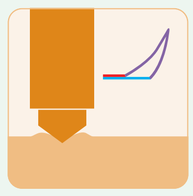


Force Modulation

In Force Modulation, the cantilever is driven below resonance while the tip is in contact with the sample. The amplitude response of the cantilever is indicative of the sample stiffness.

Cantilever Indentation

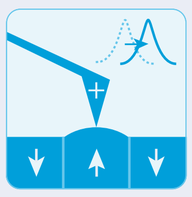
The cantilever can be used to indent the surface for qualitative mapping of the sample's mechanical properties. While various mechanical models can be applied, the results are only qualitative due in part to the lateral movement of the tip while in contact.



Instrumented Nanoindentation*

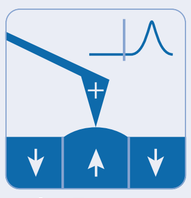
Instrumented indentation provides quantitative mechanical characterization of the sample at the nanoscale.

Piezoresponse Force Microscopy



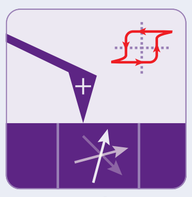
Resonance PFM‡

Resonance PFM is used to image the electromechanical response of a material. The cantilever is driven on resonance with an AC bias applied to the tip which induces a mechanical response from appropriate samples.



Single Frequency PFM‡

Single Frequency PFM is similar to Resonance PFM with the difference being that the tip is excited at a fixed frequency. The tip-sample resonance is not tracked.

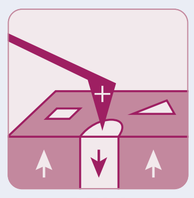


Switching Spectroscopy PFM‡

Switching Spectroscopy PFM (SS-PFM) is a quantitative measurement where the sample's polarization can be switched while measuring the sample's electromechanical response, revealing quantities such as the coercive bias, and the remanent and saturation responses.

Vector PFM‡

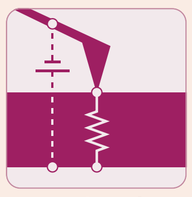
Vector PFM uses three separate PFM passes to reconstruct the complete electromechanical response vector from three components: one vertical and two in-plane.



PFM Lithography‡

PFM Lithography is used to modify and reverse a sample's domain polarization locally through the application of a bias on the tip. Geometric shapes, freehand drawings, and imported images can be used to define the lithography.

Electrical

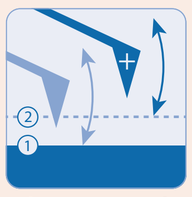


Conductive AFM*

Conductive AFM (ORCA™) scans in contact mode while measuring any current flowing through the sample into the conductive tip. Additionally, this mode allows for localized I-V measurements which can be made at specific user-defined points.

Scanning Kelvin Probe

Scanning Kelvin Probe Microscopy (SKPM) is a two-pass imaging mode where a conductive tip images the surface in tapping mode in the first pass, and then lifts above the surface by a constant height to acquire a quantitative measure of the sample's potential.

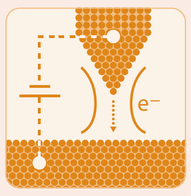


Electrostatic Force Microscopy

Electrostatic Force Microscopy (EFM) is a two-pass imaging mode where the sample's longer-range electrostatic forces are qualitatively imaged in a secondary pass after an initial surface pass. Variations in trapped charge, potential, or the sample's conductivity or permittivity can be imaged.

Fast Current Mapping*

Fast Current Mapping is a mode that collects current continuously during an array of force curves taken at high speed. Current maps of the sample can be generated with the benefit of minimal tip-wear since the tip is not scanning the surface.



Scanning Tunneling Microscopy*

Scanning Tunneling Microscopy (STM) provides tunneling current imaging at constant current or constant height, and I-V measurement capability.

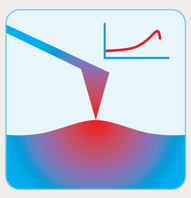
Scanning Microwave Impedance Microscopy*

Scanning Microwave Impedance Microscopy (sMIM) is a near-field technique that uses a microwave source to distinguish local sample variations in resistance, capacitance, as well as dC/dV and dR/dV responses. It can be operated in contact or tapping mode.

Nano Time Dependent Dielectric Breakdown*

Nanoscale Time Dependent Dielectric Breakdown (NanoTDDB™) is a point measurement mode that is used to study dielectric breakdown at the nanoscale. A high voltage bias ramp is sent to the tip until the breakdown event in the sample occurs.

Thermal



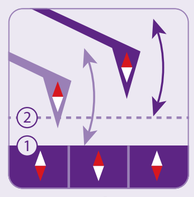
Local Thermal Analysis*

Local Thermal Analysis (Ztherm™) is a nanoscale thermal measurement of local melting and glass transition points. The temperature of the tip is ramped up while the cantilever is in contact with the sample, causing the sample to thermally expand and then melt.

Scanning Thermal Microscopy*

Scanning Thermal Microscopy (SThM) is a mode used to measure the temperature of the sample. For isothermal samples, SThM can alternatively be used to map variations in the sample's thermal conductivity.

Miscellaneous

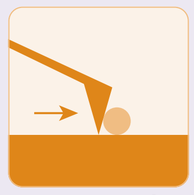


Magnetic Force Microscopy

Magnetic Force Microscopy (MFM) is a two-pass imaging mode where a magnetized tip images the surface in the first pass, and then lifts above the surface by a constant height to image the longer-range magnetic forces in a second pass.

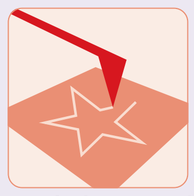
Electrochemical Strain Microscopy‡

Electrochemical Strain Microscopy (ESM) is used to study electrochemical processes and ionic transport in solids. The cantilever is driven at its contact resonance through the application of an AC bias, inducing ionic transport which in turn causes surface deformation in the appropriate sample, thereby driving the cantilever.



Nanomanipulation

Nanomanipulation is a capability in which the tip is used to push and position objects at the nanoscale.



Nanolithography

Nanolithography is a capability in which the tip is used to scratch or write on the sample surface. Geometric shapes, freehand drawings, and imported images can be used to define the lithography.

*Optional mode. Additional hardware required.

‡ Standard voltage range limited to 10 V. Optional hardware allows for higher maximum voltage (MFP-3D: 220 V, Cypher: 150 V).

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