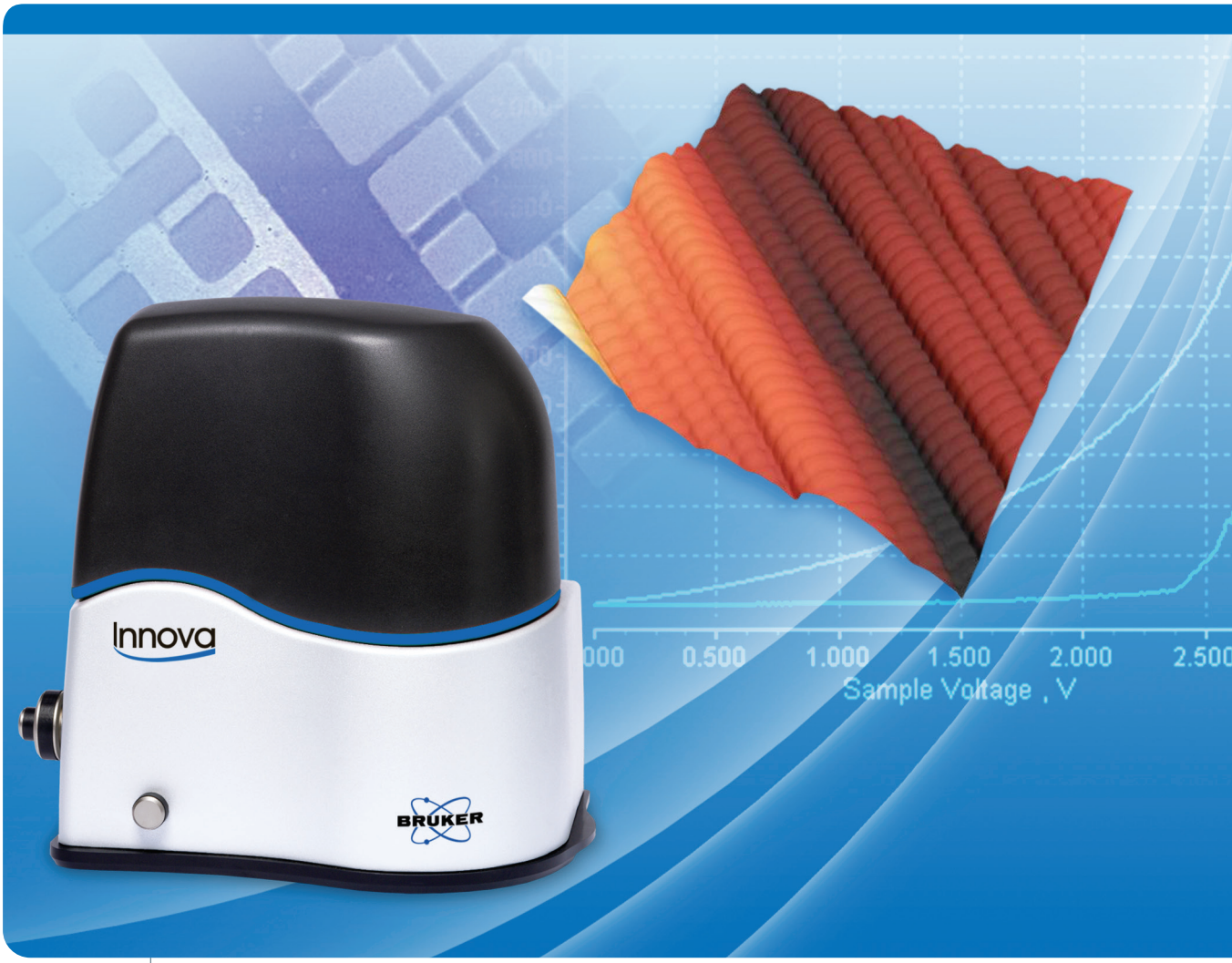


Innova

- Superior AFM Research Performance and Versatility

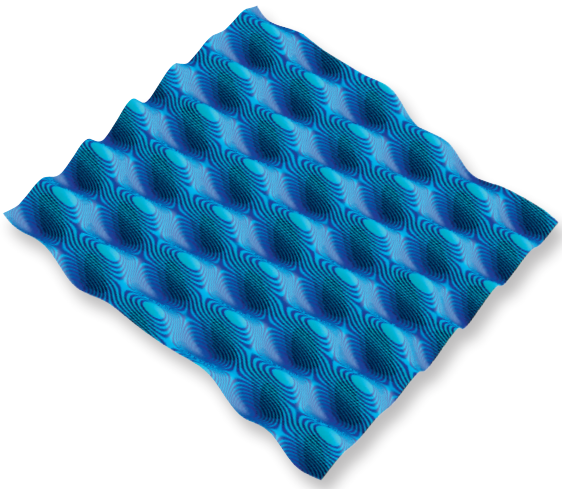
Innovation with Integrity

Atomic Force Microscopy

Innova

Best Place to Start Your AFM Research

The Innova® Atomic Force Microscope (AFM) delivers application flexibility for the most demanding scientific research at a moderate cost. Its unique closed-loop scan linearization system ensures accurate measurements and noise levels approaching those of open-loop operation. Innova delivers atomic resolution and scans up to 90 microns in closed-loop without the need to change scanner hardware. The integrated, high-resolution color optics, open stage, and software experiment selector make setting up each new experiment fast and easy. With its highly customizable feature set, Innova offers the utmost value for high-resolution imaging and a wide range of functionality in physical, life, and material sciences research.



Atomic-resolution STM image of highly oriented pyrolytic graphite (HOPG). Image size 1.3 nm.

Routine High-Resolution Imaging

- Utilizes an innovative design optimized for lowest closed-loop noise and drift
- Ensures accurate measurements at all scales and in all dimensions
- Delivers highest resolution results with great ease

Fast Setup for Every Experiment

- Provides fastest hardware setup via ergonomic, open stage
- Ensures fast and precise region of interest identification with software-controlled, high-NA optics
- Distills decades of AFM expertise into preconfigured experiment selector
- Enables seamless workflow and operation, from survey to atomic resolution

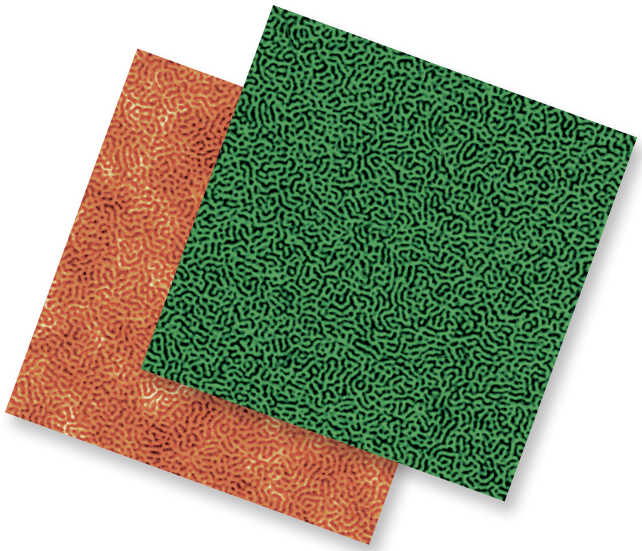
Powerful Research Flexibility

- Addresses all advanced measurements with full range of SPM modes
- Customizes research with configurable signal access and physical access to tip-sample junction
- Offers nano-optics with TERS-enabled AFM-Raman integration

• Providing Complete AFM Capabilities

Routine High-Resolution Imaging

All aspects of the Innova electromechanical design have been optimized, from the rigid microscope stage with a short mechanical loop and low thermal drift to the ultralow-noise electronics. The result is a unique combination of high-resolution performance and closed-loop positioning. Innova uses Bruker's proprietary ultralow-noise digital closed-loop scan linearization for accurate measurements in all dimensions, regardless of size, offset, speed, or rotation in air and liquid. With closed-loop noise levels approaching those of open-loop operation, superior image quality is achieved from the full 90-micron scan range down to submicron images on any sample, whether it is a semiconductor, a soft and nanostructured material, or DNA. In addition, closed-loop scan linearization can be activated and deactivated on the fly. This incredible flexibility allows zooming down to atomic resolution on any selected portion of a full size scan, without changing scanner hardware and without withdrawing the probe from the surface.



High-resolution topography (orange) and phase image (green) reveal the microphase separation in a poly(styrene-b-butadiene-b-styrene) (SBS) triblock copolymer. 1k x 1k unfiltered raw data.Image size: 2 µm. Closed-loop scan linearization active.

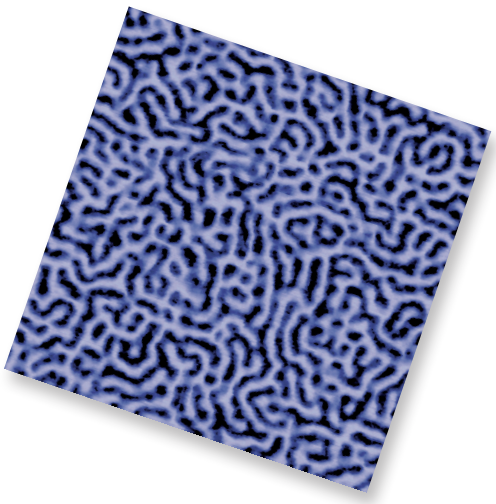
Fast Setup for Every Experiment

Accurate Region of Interest Identification

The patented top-down optics of the Innova integrate seamlessly with all imaging modes. With software-controlled optical zoom, they provide a broad range of magnification, allowing for a direct view of the cantilever and sample with better than 1-micron resolution to identify the smallest sample features and ensure precise probe positioning. With the optics positioned entirely inside the protective instrument cover, probe and sample can be viewed at any time while insolating the instrument from the environment. The ergonomic integration of the optics with the microscope also contributes to the ease and accuracy of tip exchange and laser alignment. The user can simply drop in a new tip and swing the optics back into place. The pre-aligned cantilever will always remain in focus.

Streamlined Software

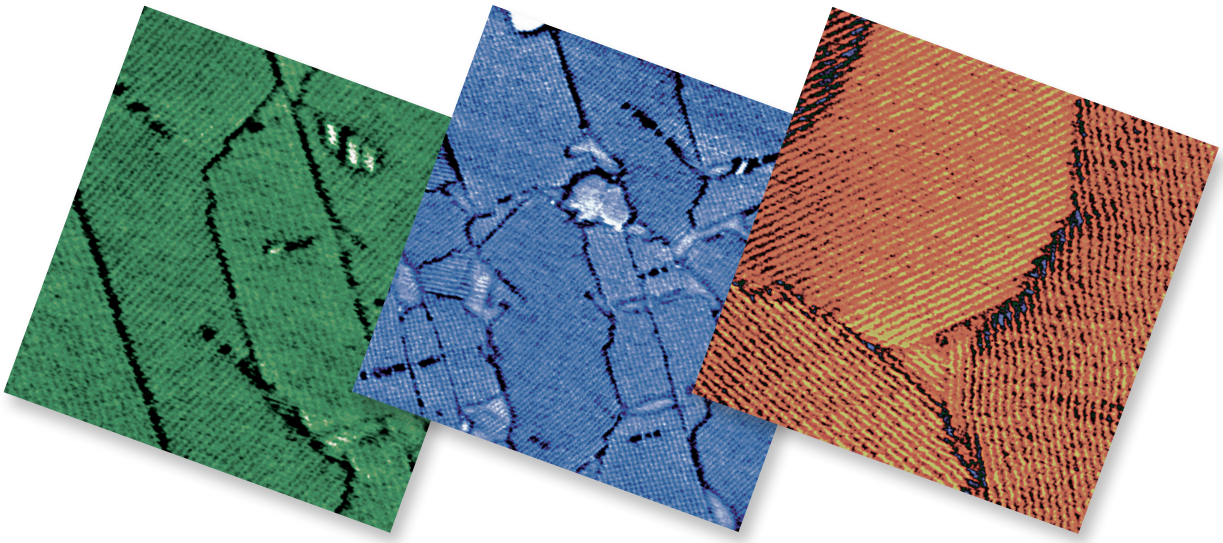
Innova now enables research-quality results even faster, thanks to all new NanoDrive™ software. Through the Experiment Selector user interface, the system configures itself instantly for any targeted application. From there it is a short, intuitive path to the acquisition of optimized high-resolution images with up to eight different simultaneous channels, followed by immediate analysis of partial data without interrupting ongoing acquisition. Real-time navigation is fast and efficient with an AFM canvas overlaying acquired images. Innova comes standard with a complete NanoScope® Analysis software module that is completely independent of the real-time control, yet is integrated seamlessly with single-click data transfer.



High-resolution phase image reveals the microphase separation in a poly(styrene-b-butadiene-b-styrene) (SBS) triblock copolymer. Image size: 750 nm. Closed-loop linearization active.

Fast and Easy Tip and Sample Exchange

Innova has been specifically designed to provide quick and easy tip exchange and alignment. The Innova head rests kinematically on three independently controlled motors that allow height, pitch, and tilt adjustments relative to the sample, and user-defined positions can move the head in sub-micron increments. In addition, the system comes complete with a universal chip carrier that accepts almost any unmounted cantilever.

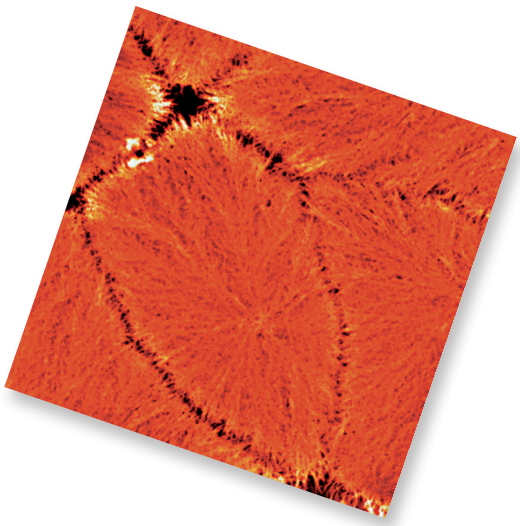


High-resolution phase image of $C_{60}H_{122}$ alkane on graphite. Image size: 420 nm (green image), 700 nm (blue image), 380 nm (red image). Closed-loop scan linearization active. Note the clear lamellar structure with its approximately 7.5 nm periodicity proving outstanding force control and closed-loop performance.

Powerful Research Flexibility

Innova's advanced electronics not only provide exceptionally low noise and outstanding closed-loop performance, but also enable a full suite of AFM modes. All modes offer single-point spectroscopies, where the precise spatial targeting enabled by low noise and drift is critical. Two integrated configurable digital lock-in amplifiers enable advanced SPM modes such as scanning capacitance microscopy (SCM), Kelvin probe force microscopy (KPFM), electric force microscopy (EFM), piezo response microscopy without the need for external hardware or third-party software. Innova's advanced modes come with unique features that offer true applications solutions. For example, KPFM comes in two implementations to provide the highest sensitivity for small potential variations yet also eliminate topographic artifacts for large potential variations.

Beyond providing advanced modes for carrier profiling or conductivity mapping, Innova incorporates Bruker's Dark Lift function. Building on LiftMode™, Dark Lift performs electrical measurements while the AFM feedback diode is turned off. Only Dark Lift can truly ensure photoelectric artifacts are eliminated, rather than relying on model predictions.



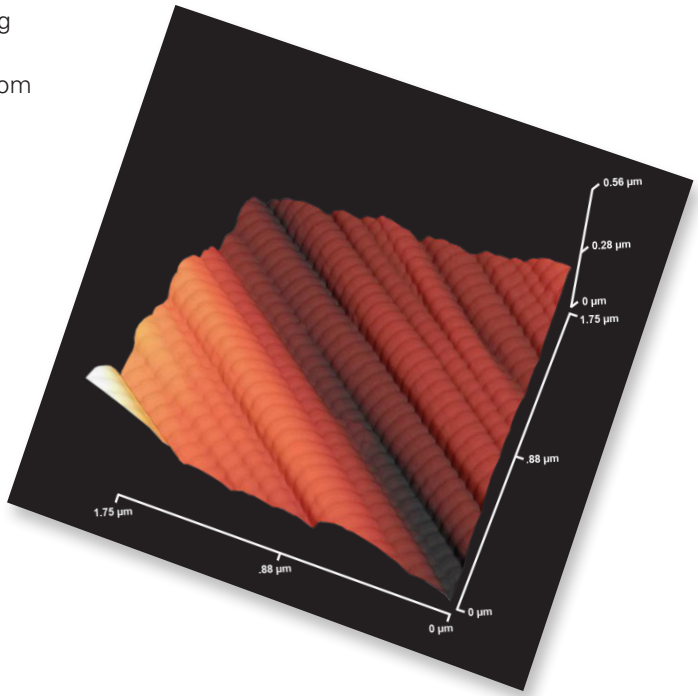
Topography of syndiotactic polypropylene shows fibrillar fine structure within large spherulites. 35 µm image.

Full Range of SPM Modes Available

The Innova offers a full complement of SPM techniques, making it ideal for applications ranging from photovoltaics to energy storage, from surface science to device characterization, and from biomolecules to semiconductors.

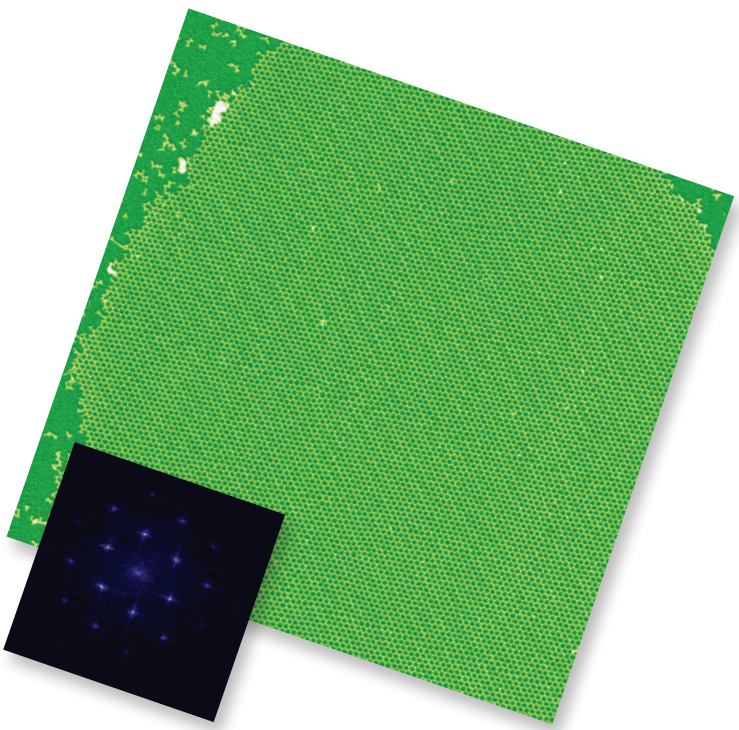
A host of standard and optional scan modes provides complete surface characterization of samples in both air and liquid:

- Contact Mode
- TappingMode™
- PhaseImaging™
- LiftMode
- Dark Lift
- Nano-Indentation
- Nanolithography
- Piezo Response Microscopy
- Magnetic Force Microscopy (MFM)
- Electrostatic Force Microscopy (EFM)
- Force Modulation Microscopy (FMM)
- Scanning Tunneling Microscopy (STM)
- Low-Current Scanning Tunneling Microscopy (LC-STM)
- Electrochemical Scanning Probe Microscopy (ECSPM)
- Single and dual-pass Kelvin Probe Force Microscopy (KPFM)
- Conductive Atomic Force Microscopy (CAFM)
- Scanning Capacitance Microscopy (SCM)
- TERS-enabled AFM-Raman integration (IRIS™)
- Nano Thermal Analysis (VITA™)



Rat tail collagen clearly shows the characteristic 67 nm banding. 1.75 µm closed-loop image.

Individual triangular self-assemblies of origami-DNA on mica imaged in liquid reveal individual strands and fine structure at the connection points. 250 nm closed-loop image.
(Sample courtesy of P. Rothemund, Caltech.)



1k x 1k pixel image of an engineered DNA network. The fine detail visible due to the absence of noise or damage readily reveals the high symmetry and small but finite defect density. Individual building blocks can be discerned at the edge. The Fourier Transform (inset) shows the complete absence of distortion or drift. 3 µm closed-loop image. (Sample courtesy of A. Koyfman, UCSB.)

Design Features

Customizable with Open Access

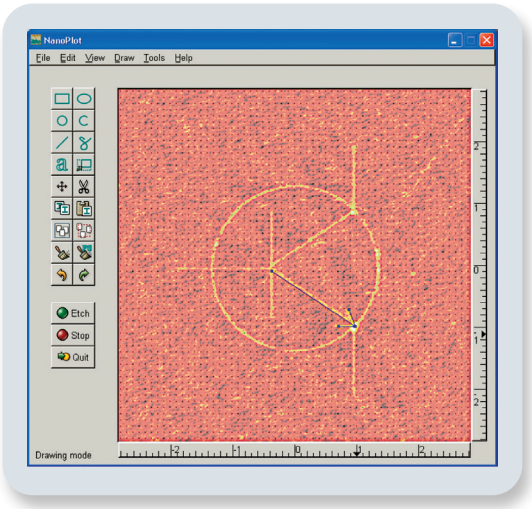
The Innova SPM provides excellent sample access, even when the microscope head is in place, without compromising the rigidity of the mechanical design. The physically open design provides flexibility for custom experiments, for example, by allowing the easy insertion of electrodes for electrical and electrochemical sample characterization. The Innova control electronics provide built-in user access to I/O signals and software-configurable signal routing and processing.

Ready for Nano-Optics

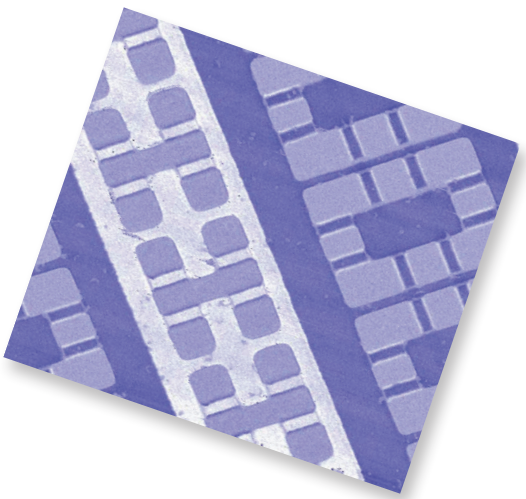
The open head also provides completely unobstructed optical access to the tip-sample junction, making Innova an ideal platform for near-field based nano-optics, including tip-enhanced Raman scattering (TERS). The optional Innova-IRIS accessory additionally provides an AFM head with even further increased optical access to the front of the AFM probe, optimizing the proven (opaque sample) off-axis TERS configuration, while also providing a near infrared feedback diode to eliminate spectral interference with Raman spectroscopy. Leveraging Innova's modular software, Innova-IRIS provides a handshaking communication protocol, enabling real-time point-and-shoot system control and data transfer with leading Raman spectrometers.

Flexible and Versatile Acquisition Software

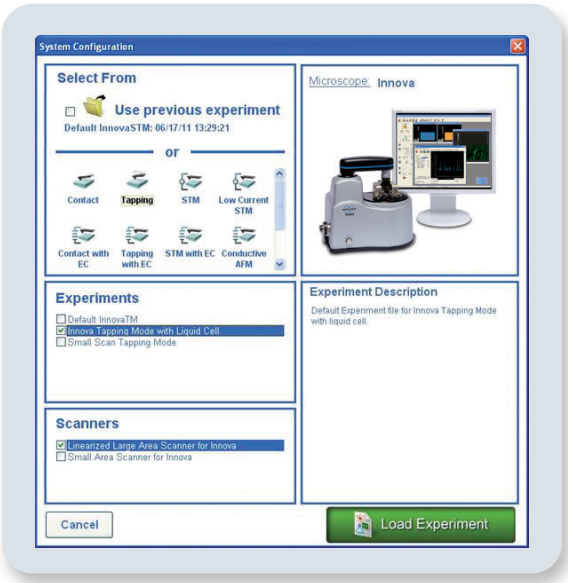
The NanoDrive software incorporates a host of features to ensure real world productivity even in challenging experiments. Direct and intuitive access to all important scan and feedback parameters is combined with extensive real-time signal diagnostics and processing options to accelerate the scan-optimization process. The interactive, closed-loop, point-and-shoot positioning enables precisely targeted single-point spectroscopy, making it an ideal tool for semiconductor fault isolation as well as such novel experiments as the examination of local phase changes associated with electrical switching behavior.



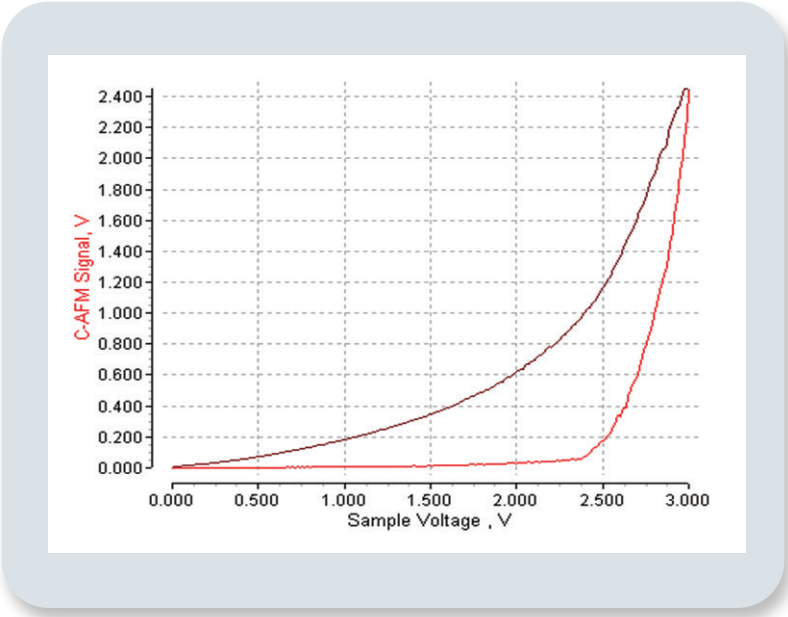
Anodic oxidation on silicon nanolithography with the new NanoPlot package.



Scanning capacitance data of a silicon DRAM cell. The 2D dopant profile provided by dC/dV measurements allows the visualization of device defects and the extraction of critical parameters, such as gate lengths. This image was acquired in SCM/Dark Lift mode, ensuring accurate and artifact-free dopant mapping. 25 µm closed-loop image.



The Experiment Selector completely preconfigures the system for a wide range of selectable experiments. Ideal for multi-user settings, the predefined experiments offer beginners a fast path to expert results, while allowing advanced users to define and save custom configurations.



Line graph shows results of closed-loop probing of material phase changes with possible memory applications. Comparison of the ramp up (red) and ramp down (brown) curves reveals the field-induced change in electrical properties. Current signal is output of 10^4 V/A amplifier, 5kΩ resistor in series. (Sample courtesy of Prof. Wright, University of Exeter.)

Designed from the ground up as modular code, the real-time control software offers many optional extensions, including an easy to use nanolithography package (NanoPlot), spectrometer control for AFM-Raman experiments (Innova-IRIS), as well as general-purpose device synchronization. Innova also comes with the stand-alone NanoScope Analysis package, which provides extensive analysis, processing, and display options for images and single-point spectroscopy curves. It also delivers a seamless link into real-time control. Data from partially acquired images can be fully analyzed at any time during the acquisition process without interrupting ongoing image acquisition.

Piezoforce lithography on thin PZT film.

Innova Specifications

Sample Size	45 mm x 45 mm x 18 mm
Motorized Z Travel	18 mm, with pitch and tilt capability
Closed-Loop, Large-Area Scanner	XY >90 µm, Z >7.5 µm
Open-Loop, Small-Area Scanner	XY >5 µm, Z >1.5 µm
Z Noise Floor	<50 pm RMS, typical imaging bandwidth
Closed-Loop XY Noise	<1.2 nm RMS, typical imaging bandwidth
Z Linearizer Noise	<200 pm RMS, typical imaging bandwidth
Open-Loop XY Drift	<1 nm/min
Closed-Loop WY Drift	<3 nm/min
Open-Loop Warm-Up Time	15 min
Electronics	20-bit DAC scan control, 8 ADCs (100 kHz ±10V); Digital force and position feedback, programmable/controllable via external signals; Integrated software-configurable signal access and routing; 2 full-digital lock-ins
Optics	On-axis, 1.1 mm FOV; Up to 8x zoom; 10x objective (50x optional); <2 µm resolution (0.75 µm resolution with 50x)
System Software	NanoDrive real-time control and NanoScope Analysis included
AFM Modes	Standard: Contact Mode, TappingMode, PhaseImaging, LiftMode, Magnetic Force Microscopy (MFM), Electrostatic Force Microscopy (EFM), Dark Lift, Lateral Force Microscopy, Nano-Indentation, Force Spectroscopy Optional: Scanning Tunneling Microscopy (STM), Low-Current Scanning Tunneling Microscopy (LC-STM), Force Modulation Microscopy (FMM), Piezo Response Microscopy, Electrochemical Scanning Probe Microscopy (ECSPM), Single- and dual-pass Kelvin Probe Force Microscopy (KPFM), Conductive Atomic Force Microscopy (CAFM), Scanning Capacitance Microscopy (SCM), Nanolithography, Nano Thermal Analysis (VITA)
Weights and Measures	Microscope: 14" H x 14" W x 10" D (35.5 cm x 35.5 cm x 25.5 cm); 26.5 lb (12 kg); Add 4" (10 cm) in rear for cables Controller: 23" H x 13.5" W x 21" D (58.5 cm x 34.5 cm x 53.5 cm); 73 lb (33 kg); Add 4" (10 cm) in rear for cables
EH&S Compliance	CE and UKCA
Class 3R Laser Product	

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