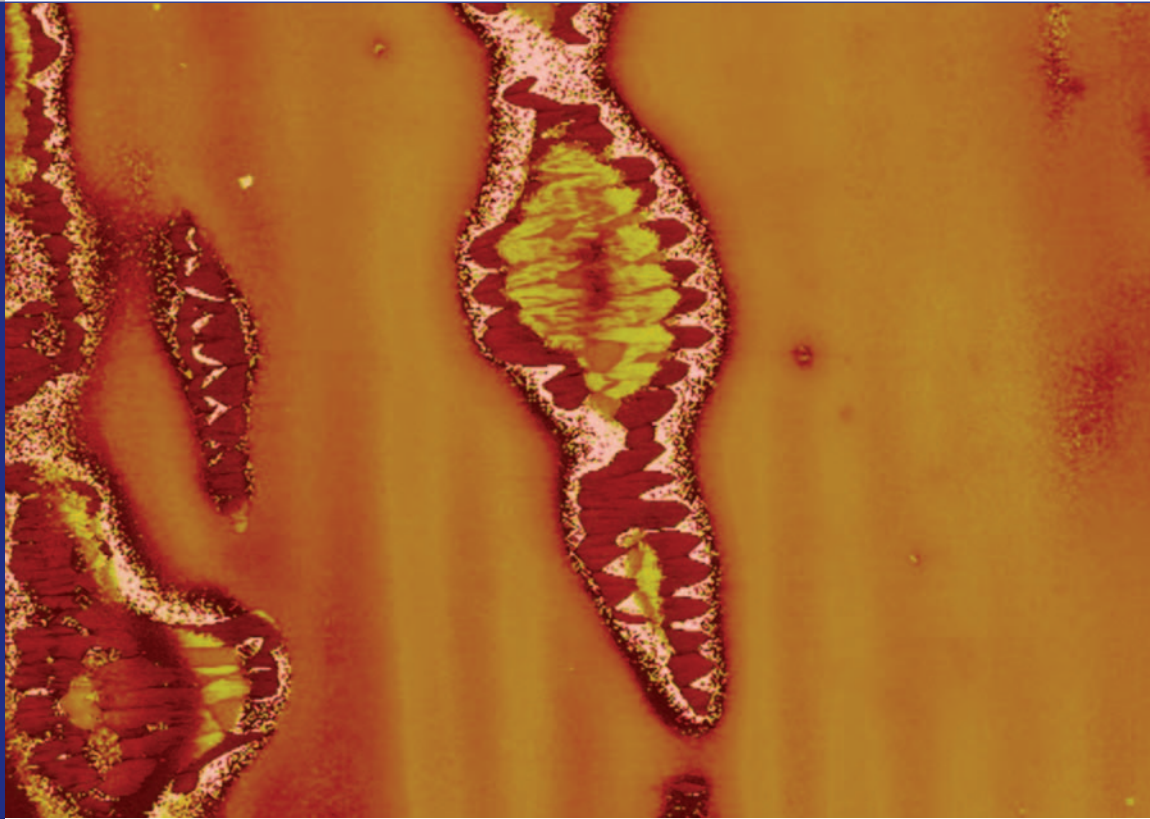


# **diDimension V**

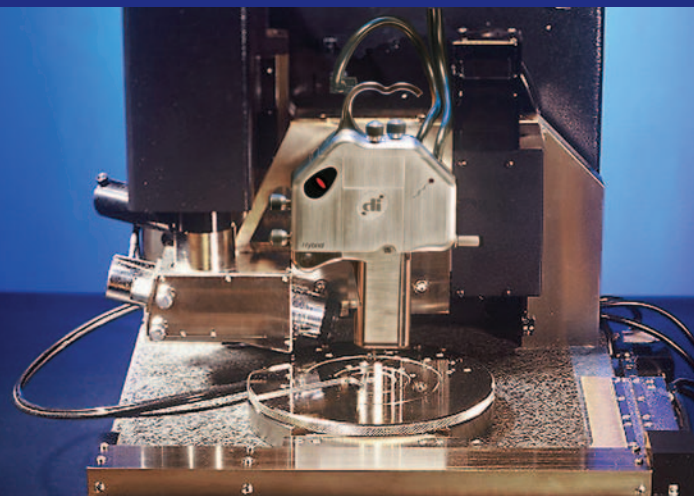
## **Scanning Probe Microscope System**



- **New High Speed Controller**
- **Closed-Loop XYZ Scanner**
- **Large Sample Size Convenience**

# diDimension V SPM

## Superior Research Versatility



The Digital Instruments Dimension™ V performs all the major scanning probe microscopy techniques and the widest range of standard and advanced characterization applications, making it the world's most multifunctional SPM. Dimension V offers unmatched flexibility via a high-speed controller, choice of closed-loop XYZ and open loop scanners, and numerous imaging mode options. Precise laser tracking and the ability to quickly change scanning techniques guarantees ease of use and high throughput. A host of other innovative features and outstanding reliability make the Dimension series one of the most sought-after SPM systems in research and industry.

- ▶ New NanoScope® V controller  
**Offers high-speed data capture (50MHz)**  
**Captures up to eight images simultaneously**  
**High-pixel-density images, 5000 x 5000**
- ▶ New Hybrid XYZ scanner  
**Delivers low Z noise performance**  
**Controls tip movement**
- ▶ Multifunctional platform  
**Permits wide range of SPM techniques**
- ▶ Large sample stage  
**Application flexibility and sample-handling convenience**  
**Images small and large specimens in liquid or air**

### Maximum Scanning Power with the Hybrid XYZ Head

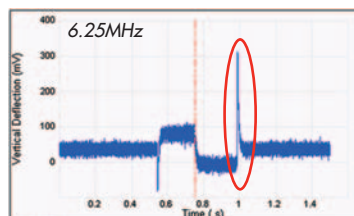
The Dimension V system is offered with a choice of the Hybrid XYZ Head or the standard Dimension open-loop head. Each of these scanners is constructed of rigid, low-vibration materials that guarantee low-noise specifications while providing superior reliability.

The Dimension Hybrid XYZ scanner offers lower Z sensor noise and combines the benefits of the industry-leading tube scanner technology with a uniquely designed sensed Z scanner to deliver revolutionary performance in a three-axis closed-loop scanner. These advanced capabilities make it possible to perform highly accurate force curves, nanoindenting, and “pulling” techniques, while still delivering high-resolution images. A patented design combines the low mass and high speed of a tube scanner with an integral flexure, ensuring that the Z-axis remains orthogonal to the XY plane. Closed-loop feedback provides precise X/Y control for nanomanipulation, with linear scans that are accurate and independent

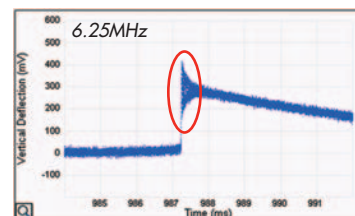
of X-Y offset and scan size/angle. In addition, due to the scanner's unique engineering, the enhanced Z height accuracy requires less frequent and extensive calibration than other scanners. The natural resonant frequency of the cantilever driven by Brownian motion determines the spring constant of the cantilever by using a thermal tuning feature.

The sensor-controlled Z-axis scanner offers excellent performance for biological “pulling” techniques and similar applications.

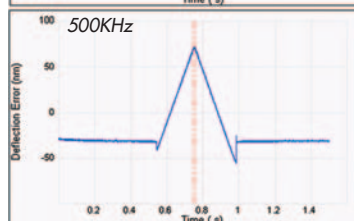
The Dimension open-loop head scans up to 90µm in X-Y and up to 6µm in Z. This scanner includes a piezoelectric tube scanner, a laser, and a quadrature optical detector. It uses advanced laser tracking to ensure that the laser beam reflects off the same spot on the cantilever throughout raster scans, maintaining a constant, low tip-sample force over the entire scan area. This head also maintains the low noise levels necessary for resolving single atomic steps on epitaxial thin films, or measuring sub-Angstrom surface roughness on ultrasmooth surfaces.



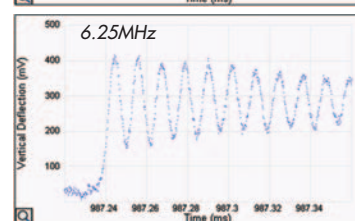
a.



b.

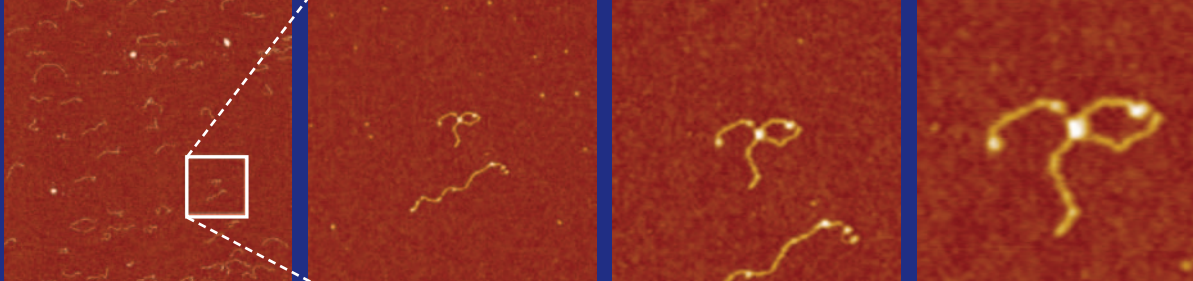


d.



c.

The new high-speed data capture allows the user to monitor tip-sample interactions during a force pulling experiment in a time scale that was not possible before. Figure b is a detail of the area circled in graph a. Figure c is further detail of the circled area in graph b.



5120 x 5120 pixel DNA image and successive offline zooms. 5μm original scan. Zoom areas 1μm, 500nm, and 250nm. Sample courtesy of Jason Reed, UCLA.

## World's Best Controller Technology

The Dimension V SPM system includes the NanoScope V controller, which utilizes advanced high-speed electronics, along with A/D and D/A converters operating at 50MHz, to deliver reliable, high-speed data capture. This new controller allows researchers to record and analyze tip-sample interactions (e.g., at pull-off in force spectroscopy) that probe nanoscale events at timescales previously inaccessible to SPM. The NanoScope V enables up to eight images to be simultaneously displayed in real-time (and captured for analysis) with outstanding signal-to-noise ratio. The controller incorporates three independent lock-in amplifiers, two at up to 25MHz, one at up to 250kHz, and provides thermal tune measurements of cantilever resonances (e.g., for spring constant calibration) up to 2MHz.

High-pixel-density images, up to 5000 x 5000, improve "time to results" by reducing the need to capture several images at lower pixel densities as well as eliminating the requirement for offset adjustments to correlate information from multiple images. The high pixel density also allows observation of large structures and small features in the same image. The controller affords easy access to most input and output signals through front-panel BNCs.

In addition, the NanoScript™ open-architecture option provides a growing list of functions to control the SPM for custom experiments and nanoscale research (e.g., nanomanipulation in X,Y, and Z; automated scanning; nanolithography with different tip-sample interactions). These functions

can also be called from any programming language that can act as a client of Microsoft's Component Object Model (COM), including LabView, MATLAB™, Visual Basic, Ruby, Python, C++/MFC, Excel®, and Word®.

## Easy-AFM, Remarkable Simplicity

For streamlined simplicity, Easy-AFM™ ease-of-use feature offers an intuitive, easy-to-follow graphic user interface for new or infrequent SPM users. Easy-AFM reduces the time for initial setup (including probe, laser, and detector alignments), engaging the sample with the probe (in air), adjusting the scanning parameters, and obtaining high-quality, useful TappingMode™ images in air on most samples with minimal user intervention.

## Widest Application Suitability

In addition to superior scanning, electronics, and performance, the Dimension V utilizes many other innovative, multifunctional design features. A large sample stage permits scanning specimens up to 8 inches in diameter and optionally 4 inches thick. It has the ability to scan in air or liquid and offers a host of add-on imaging modes. The Dimension V has excellent measurement and analysis reliability for a vast range of applications:

- Electronic materials
- Advanced materials
- Thin films
- Tribology
- MEMS/NEMS
- Biotechnology
- ...and many more!

## Wide Range of SPM Techniques

The Dimension V provides researchers the ultimate, expandable platform for both standard and advanced SPM scanning modes:

- Contact Mode
- TappingMode
- Phasemaging™
- Lateral Force Microscopy (LFM)
- Magnetic Force Microscopy (MFM)
- Force Modulation
- Force Distance (Force Spectroscopy)
- Electric Force Microscopy (EFM)
- Scanning Capacitance Microscopy (SCM)
- Scanning Spreading Resistance Microscopy (SSRM)
- Tunneling Atomic Force Microscopy (TUNA)
- Conductive Atomic Force Microscopy (CAFM)
- Scanning Tunneling Microscopy (STM)
- Torsional Resonance Mode (TRmode)
- ...and many more!

## Dimension V Specifications

### With Dimension

#### Hybrid XYZ head:

- X-Y scan range: ~90µm square;
- Z range: Imaging mode 8µm min., 10µm typical;  
Force Curve mode 7µm min., 9µm typical;
- vertical noise floor: <0.05nm RMS (open loop in appropriate environment);
- integral X-Y nonlinearity: <1% typical;
- integral Z nonlinearity: <1% typical;
- X-Y noise level: Closed-loop feedback activated: <1.8nm RMS;
- X-Y Sensor noise level: Open-loop: <1.2nm Adev (R<sub>G</sub>);
- Z Sensor noise level: Force Curve bandwidth of 0.1 Hz – 5KHz, 0.1nm RMS max.;  
Typical Imaging bandwidth 0.06nm RMS max.

### With Dimension

#### Open-Loop head:

- X-Y scan range: ~90µm square;
- Z range: ~6µm;
- lateral accuracy typically within 1%, max. 2%;
- provides full 16-bit resolution on all axes for all scan sizes and offsets

#### Sample size:

- ≤150mm diameter (≤200mm with optional chuck);
- ≤12mm thick (adapters available for thicker samples)

#### Sample holders:

- 150mm vacuum chuck for hard disks, semiconductor wafers, and other samples;
- interchangeable adapters for centering hard disks;
- removable wafer-locating pins;
- vacuum pump;
- magnetic holder for samples 15mm diameter and 6mm thick;
- 200mm vacuum chuck for 150mm and 200mm wafers (optional);

#### Stage:

- Enhanced motorized positioning;
- 125mm x 100mm inspectable area;
- 2µm resolution;
- 3µm repeatability unidirectional (10µm max.);
- 4µm repeatability bidirectional for X-axis, 6µm for Y-axis

#### Tip/cantilever holders:

- Tapping/contact modes;
- force modulation/STM holders (optional);
- fluid cell and tip holder for working with liquid, 7mm deep

#### Microscope Optics:

- 150µm to 675µm viewing area;
- motorized zoom and focus;
- ~1.5µm resolution;
- computer-controlled illumination;
- video image capture

#### Tip viewing:

- On-axis, realtime via microscope optics

#### Vibration isolation:

- Silicone vibration pad;
- vibration isolation table (optional)

#### Controller:

- NanoScope IIIa, or V

#### Power requirements:

- 700W; 100, 120, or 240V single-phase; 50 or 60Hz

#### Microscope weight:

- ~150lb (68kg)

Note: Performance specifications are typical and subject to change without notice.

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