

# **di Dimension 3100**

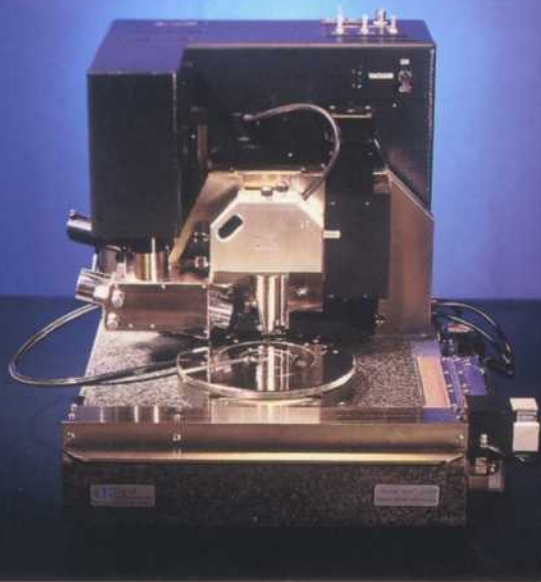
## **Scanning Probe Microscope (SPM) System**



- **Versatile Selection of Scanners and Controllers**
- **Advanced SPM Imaging Modes**
- **Large-Sample Convenience and Flexibility**

# Dimension 3100 SPM

## Superior Research Versatility



The Digital Instruments Dimension 3100 performs all the major scanning probe microscopy techniques and the widest range of standard and advanced characterization applications, making it the world's most multi-functional SPM. The system offers unmatched flexibility through field-upgradable scanner, controller, and image mode options. Precise laser tracking and the ability to change scanning techniques without tools guarantee ease of use and high product throughput. A host of other innovative features and a proven record of reliability have helped the Dimension 3100 to become one of the most sought-after SPM systems in research and industry.

- ▶ Choice of scanners  
**Deliver lowest-noise performance**  
**Tailor positioning system to specific requirements, including imaging nanolithography and nanomanipulation**
- ▶ NanoScope® IV Controller  
**Provides up to ten times faster scanning**  
**Increases functionality, bandwidth, flexibility, and expandability**
- ▶ Multifunctional platform  
**Permits full range of SPM techniques**
- ▶ Large sample stage  
**Guarantees application flexibility and sample-handling convenience**  
**Samples both small and large specimens in liquid and air**

## Maximum Scanning Power and Flexibility

The Dimension 3100 system is offered with a choice of closed-loop, open-loop, and metrology scanning heads. Each of these scanners are constructed of rigid, low-vibration materials that guarantee low-noise specifications while providing superior reliability.

The open-loop head scans up to 90 $\mu\text{m}$  in X-Y and up to 6 $\mu\text{m}$  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.

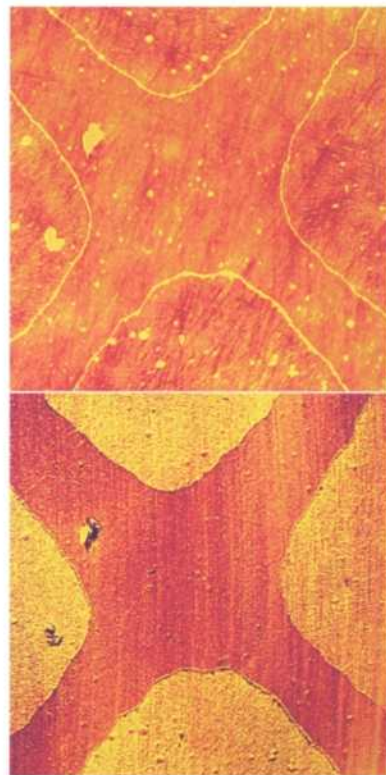
The advanced Dimension CL scanner includes all of the features of the open-loop head and utilizes closed-loop feedback for the lowest-noise performance of any scanner head in its class. This scanner head makes it possible to position and hold the tip in the X-Y plane with nanometer accuracy to perform nanolithography, nanomanipulation, and force spectroscopy, or to probe for electric, magnetic, chemical, thermal, and mechanical responses at any given location.

Phasemaging in water provides material property contrast on hydrogel lens surface. The contrast in the phase image (bottom) depicts a subtle difference in visco/elastic properties that escaped detection by ESCA and FTIR. 50 $\mu\text{m}$  scan.

Dimension closed-loop head



Finally, the Dimension metrology head utilizes proprietary stage designs to ensure each axis of the scanning system is straight and orthogonal. With this design, the X-Y is flat to less than 5 nanometers over the full scanner range, and perpendicular to less than 0.1 degree. The metrology head is ideal for the demanding dimension measurements required in the semiconductor and data storage industries.



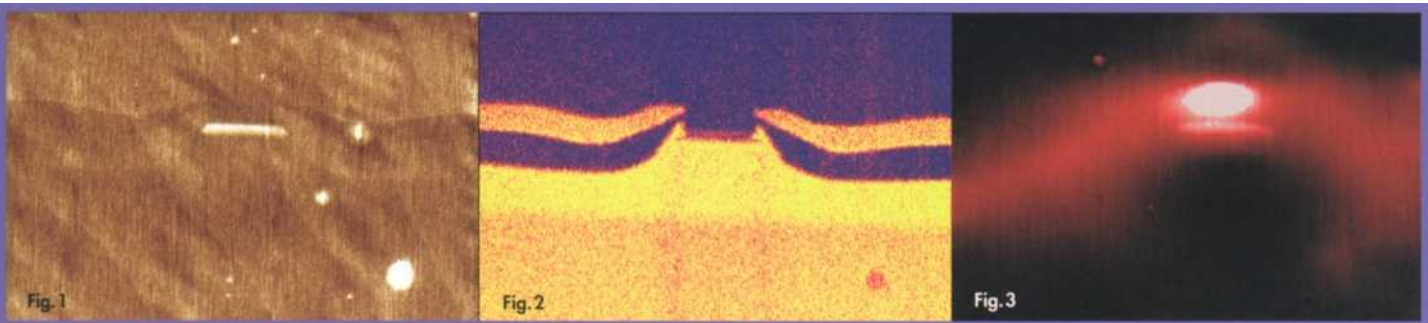


Fig. 1 AFM (topography), Fig. 2 SCM (dopant concentration), Fig. 3 SThM (thermal) maps of a micrometer-scale semiconductor laser. 10 $\mu$ m scan.

## World's Best Controller Technology

For even greater flexibility, the Dimension 3100 offers a choice of high-performance NanoScope<sup>®</sup> Controllers. The world-class NanoScope IIIa Controller combines advanced analog and digital circuit designs with premium software and hardware to precisely control the SPM. It can scan from the maximum scan size to a few nanometers with full, 16-bit resolution on all scan waveforms and on each axis. The superior performance and utility of the NanoScope IIIa Controller has led to more publications than all other SPM controllers combined.

The next-generation NanoScope IV Controller incorporates all of the same features, as well as up to ten-times-faster scanning, increased functionality, bandwidth, flexibility, and expandability, making it the most advanced SPM controller in the world. The NanoScope IV incorporates Quadrex<sup>™</sup> technology with lock-in detection and advanced signal routing to enable the patented Phasemaging<sup>™</sup> technique, which goes beyond topographical data to detect variations in composition, adhesion, viscoelasticity, and other properties by mapping the phase of the cantilever oscillation during a scan.

For utmost value, the Dimension 3100 can also be controlled with the NanoScope E, which features streamlined scanning performance, proven productivity, and convenient upgrade options. Or, for unsurpassed critical metrology results, the NanoScope M Controller maintains a low noise floor, and, together with the metrology scanning head, provides the most stringent performance specifications.

## Widest Application Suitability

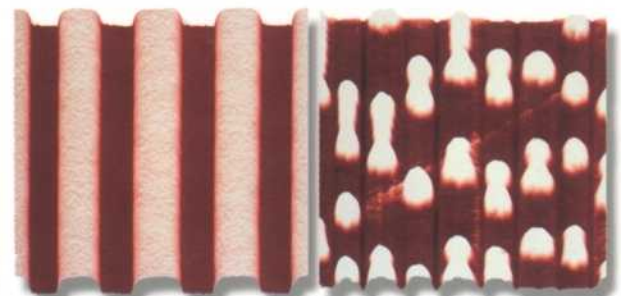
In addition to superior scanning controller flexibility and performance, the Dimension 3100 utilizes many other innovative, multifunctional design features. A large sample stage permits scanning specimens up to 8 inches in diameter and 4 inches thick. It has the ability to scan in air or liquid and offers a host of add-on image modes. The Dimension 3100 has proven measurement and analysis reliability for a vast range of applications in life sciences, physical sciences, and materials research, as well as in industrial product development, off-line process monitoring, and quality control such as:

- Electronic materials
- Advanced materials
- Thin films
- Tribology
- MEMS/NEMS
- Biotechnology
- And many more

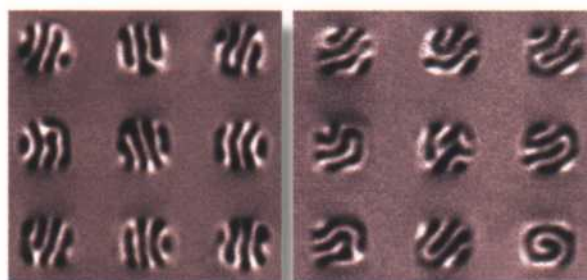
## Full Range of SPM Techniques

The Dimension 3100 provides researchers the ultimate, expandable platform for both standard and advanced SPM scanning modes:

- Contact Mode
- Tapping Mode
- Phasemaging
- Lateral Force Microscopy (LFM)
- Magnetic Force Microscopy (MFM)
- Force Modulation
- 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)
- Scanning Thermal Microscopy (SThM)
- And many more

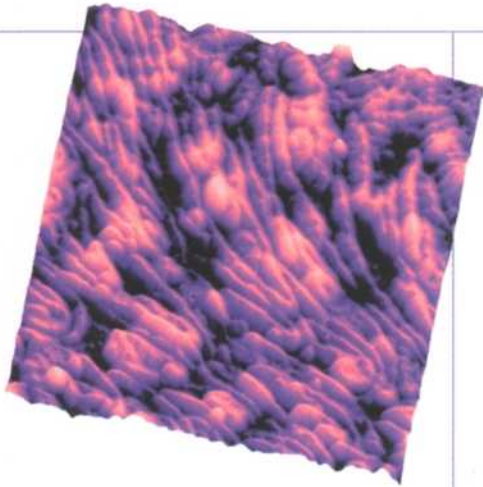


Topography (left) and Surface Potential images (right) of a CD-RW. The Surface Potential image locates the actual position of the bits. 5 $\mu$ m scan.



Applied-field-induced magnetic domains. External field direction is parallel to edge (left), and diagonal to edge (right) of the square-shaped dots. 2 $\mu$ m scan. Image courtesy of Michel Hehn and Kamel Ounadjela.

(Front cover image) Dimension® 3100 SPM topography image of highly ordered thin film of organic semiconductor para-sexiphenyl grown by Hot Wall Epitaxy on crystalline KCl substrate. 5µm scan imaged in TappingMode™, courtesy of A. Andreev, Linz Institute for Organic Solar Cells (LIOS), University of Linz, Austria.



Teflon film coating near razor's edge.  
3.5µm scan.

## D3100 Specifications

<b>Noise:</b>	<0.5Å RMS in vertical (Z) dimension with acoustic/vibration isolation
<b>Open-Loop head:</b>	~90µm square X-Y imaging area; ~6µm Z range Lateral accuracy typically within 1%, maximum 2% Provides full 16-bit resolution on all axes for all scan sizes and offsets
<b>Closed-loop head:</b>	~90µm square X-Y imaging area; ~6µm Z range; ≤1% lateral non-linearity (2% max.); full 16-bit resolution on all axes for all scan sizes and offsets
<b>Metrology head:</b>	~75µm square X-Y imaging area; ~7µm Z range; ±0.3% lateral accuracy; <0.1° X-Y non-orthogonality; full 16-bit resolution on all axes for all scan sizes and offsets
<b>Sample size:</b>	≤150mm diameter (≤200mm with optional chuck); ≤12mm thick (adapters available for thicker samples)
<b>Sample holders:</b>	150mm vacuum chuck for hard disks, semiconductor wafers, and other samples; interchangeable adapters for centering hard disks (std.); removable wafer-locating pins (std.); vacuum pump (std.); magnetic holder for samples ≤15mm diameter and 6mm thick (std.); 200mm vacuum chuck for 150mm and 200mm wafers (optional); fluid cell for immersing microscope head in fluid ≤7mm deep (optional)
<b>Stage:</b>	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
<b>Tip/cantilever holders:</b>	Tapping/contact modes (std.); force modulation/STM holders (optional); tip holder for operation in fluids (optional)
<b>Microscope Optics:</b>	150µm to 675µm viewing area; motorized zoom and focus; ~1.5µm resolution; computer-controlled illumination; video image capture
<b>Tip viewing:</b>	On-axis, real-time via microscope optics
<b>Vibration isolation:</b>	Silicone vibration pad (std.); vibration isolation table (optional)
<b>Controller:</b>	NanoScope E, M, IIIa, or IV
<b>Power requirements:</b>	700W; 100, 120, or 240V single-phase; 50 or 60Hz
<b>Microscope weight:</b>	~150lb (68kg)

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