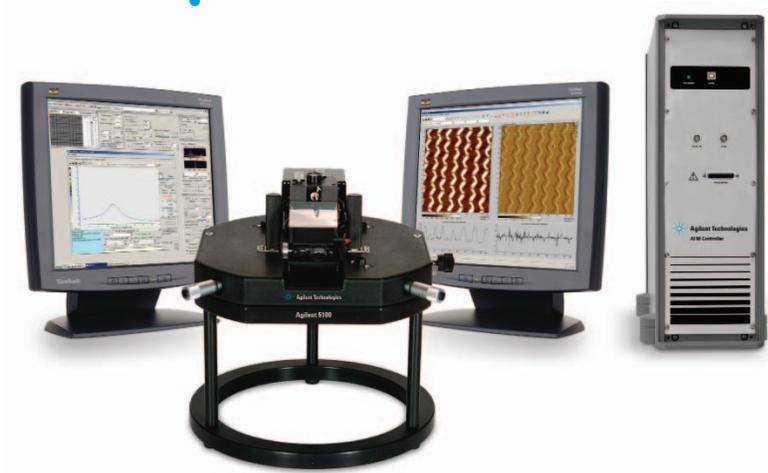


# Agilent 5100 AFM/SPM Microscope

Data Sheet



## Features and Benefits

- High-performance atomic force microscope designed for multi-user labs and educational environments
- Cost-effective, modular solution offers easy upgrade path
- Single multipurpose scanner with interchangeable nose cones makes setting up and switching imaging modes quick and simple
- Open-top scanner affords easy video access
- On-line training available to assist new users
- Unobstructed optical view of the cantilever facilitates tip-sample alignment
- Rigid mechanical design provides low noise floor for subnanometer resolution
- Several sample-handling plates available to simplify sample preparation

## Overview

The Agilent 5100 AFM/SPM microscope is a high-resolution system that provides excellent imaging capabilities in an easy-to-upgrade package. The 5100 offers researchers many of the same features as Agilent's sophisticated 5500 AFM/SPM microscope at an entry-level price. Since user requirements often grow, the Agilent 5100 is fully upgradeable to the 5500.

The Agilent 5100 AFM/SPM microscope delivers atomic-scale resolution as well as direct video access to the scan area. The 5100 comes with Agilent's multipurpose scanner (Figure 1), offering a highly versatile system for a diverse set of applications. This modular scanner gives researchers the ability to

switch atomic force microscopy (AFM) imaging modes simply by exchanging nose cones. Two scanner options are available, covering the range from atomic resolution to almost a tenth of a millimeter.

The standard nose cone performs contact mode AFM and LFM (lateral force microscopy). Other imaging modes, such as Agilent's patented MAC Mode®, acoustic AC (AAC) mode AFM, CSAFM (current sensing AFM), and STM (scanning tunneling microscopy), are accomplished by simply changing to the appropriate nose cone. Each scanner has an open top, allowing unobstructed viewing with a video microscope (Figure 2). The advanced 5500 microscope uses the same multipurpose scanner as the 5100, thus minimizing the cost of an upgrade.



Agilent Technologies

Agilent is committed to providing upgrade paths for all of its instrumentation users. Not only can the 5100 be upgraded to the 5500, the Agilent 4500 microscope can be upgraded to the Agilent 5100. Feel free to contact Agilent for more details.

Whether starting a new lab or looking to expand the capabilities of an existing one, the Agilent 5100 AFM/SPM microscope may be the perfect solution right now — and it will certainly provide a solid foundation for the future.



Figure 1. Agilent multipurpose scanner with nose cones.

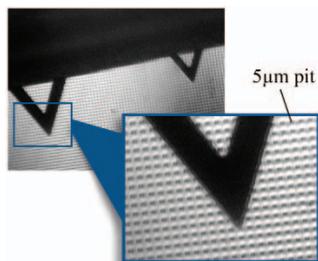


Figure 2. Open-top design allows high-resolution video microscopy straight down the optical axis.



Figure 3. Agilent 5100 AFM/SPM microscope with Agilent 5500 FlipStand and environmental control upgrades.

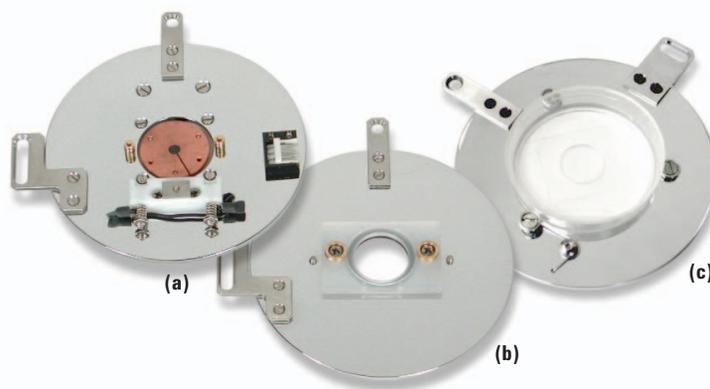


Figure 4. Sample stages: (a) Hot MAC Mode, (b) cover slip with liquid cell, and (c) Petri dish.

### High-Quality Video Access

The open-top design of the multipurpose scanner allows high-resolution video microscopy straight down the optical axis. The Agilent 5100 AFM/SPM microscope can be used with a standard high-performance video microscope without compromising the quality of results. Many video options are available for high-quality color imaging of the scan area. Combined with Agilent's unique microtranslation, the 5100 becomes a state-of-the-art video microscope and micropositioner.

### Environmental Control

The hermetically sealed Agilent environmental isolation chamber allows high-resolution imaging of oxygen-sensitive materials, such as lithium film for battery research. The environmental control provided by the EIC is also an essential requirement when working with a reactive gas, such as hydrogen in fuel cell research. When working with polymers, control of environmental parameters like humidity is key to achieving results. Furthermore, SPM studies that demand constant buffer concentration and an oxygen-free environment are important for research in electrochemistry (Figure 3)

Additionally, the Agilent EIC is excellent for dry gas environments that remove moisture, prevent contamination, and reduce adhesion from capillary effects (as in force

measurement studies of proteins). In temperature-dependent studies, the EIC is crucial for condensation control. With the Agilent EIC, users are able to control vapor saturation and eliminate evaporation from solvents such as non-aqueous buffer.

### Temperature Control

Agilent's temperature controller uses a patented thermal insulation and compensation design to deliver precise temperature control for high-resolution scanning probe microscopy (SPM). It allows imaging during temperature changes and is fully compatible with all imaging modes.

The unique Agilent sample plates have built-in temperature control and offers excellent thermal stability for SPM imaging. The temperature controller provides a rapid settling time, thereby allowing the sample plate to reach temperature quickly and hold constant temperature for long periods of time.

Agilent's temperature control design isolates the sample plate from the rest of the SPM system. An insulated ceramic fixture protects the surrounding apparatus from the effects of heating or cooling, thus providing the most precise, stable temperature control available for SPM (Figure 4).

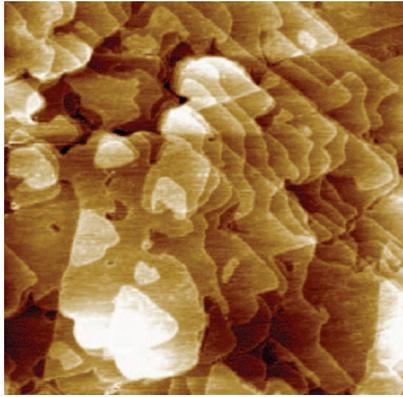


Figure 5. AFM image of Au(111) surface showing monolayer terraces.  $2\mu\text{m} \times 2\mu\text{m}$ .

### Flexible Controllers

The Agilent 5100 AFM/SPM microscope works with Agilent's state-of-the-art controllers. The controller design includes a modular structure that allows simplified maintenance as well as streamlined future upgrades of the controller electronics via plug-in board modules.

The 5100 AFM/SPM standard controller provides:

- Five 24-bit scan drives for high resolution and accuracy
- Two 24-bit output channels for controlling imaging parameters
- Five 16-bit input channels for data acquisition
- Two 32-bit DSPs for scan & data
- Built-in USB link for fast and reliable data transfer
- Modular structure for easy addition of new capabilities

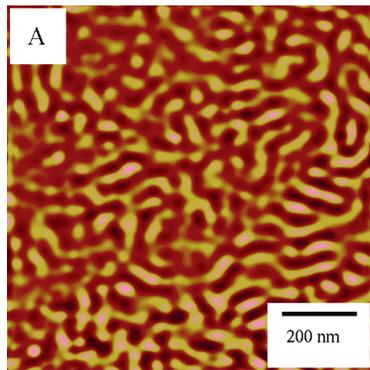
Figure 7. (a) Height and (b) Friction Images of Polystyrenepolybutadiene-polystyrene (PS-PB-PS) block copolymer. z range: 20 nm.



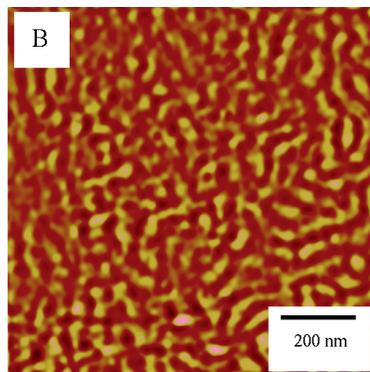
Figure 6. AFM image of mica atoms at 200°C (FFT filtered).  $16\text{nm} \times 16\text{nm}$ .

### Software

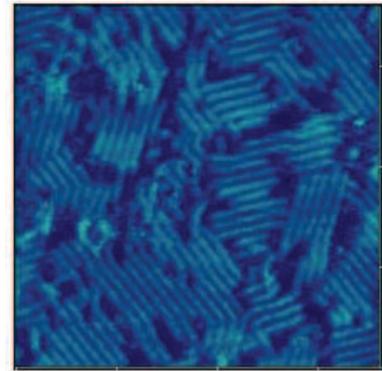
Agilent's new 32-bit Windows®-based PicoView™ is a highly stable software package that offers 3D rendering capabilities. PicoView, along with user-level scripting (C++, Microsoft® Visual Basic®, National Instruments LabVIEW™), allows complete control of all scanning parameters and provides the flexibility required for more complex experiments. An integrated script editor and sample scripts are also included.



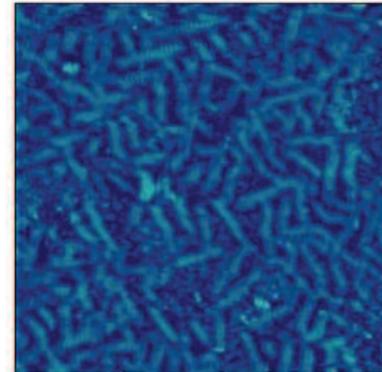
(a)



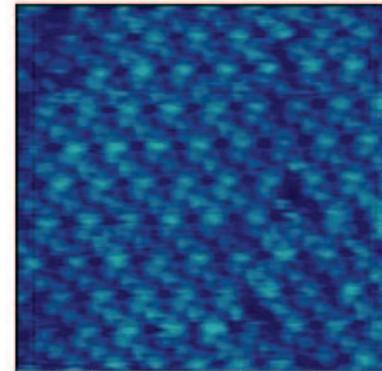
(b)



(a)



(b)



(c)

Figure 8. Surface charge induced order-disorder transition in an organic monolayer. Scan Size  $40\text{nm} \times 40\text{nm}$

Courtesy of: F Cunba, Nongjian Tao, Florida International University.

## Specifications:

### Scanners

Note: Specifications shown are for open-loop operation. Closed-loop scanners are also available.

#### Large multi-purpose scanner

Scanning range 90 $\mu$ m x 90 $\mu$ m

Z range 8 $\mu$ m

Vertical noise 0.5 Å RMS

#### Small scanner

Scanning range 9 $\mu$ m x 9 $\mu$ m

Z range 2 $\mu$ m

Vertical noise < 0.2 Å RMS

#### Sample plate sizes

Kinematic mount translatable plate 4mm x 4mm

#### Controller

Input Five 16-bit channels

Two 32-bit DSPs for scan & data

Drive 5 channels  $\pm$  215 V, 24-bit

Output 2 24-bit channels,  $\pm$  10 V

Interface USB

Power 100 - 120 V AC or 220 - 240 V AC 1A; 50 - 60 Hz

#### Facilities specifications

Acoustic noise Less the 75dBc

Temperature variation Does not exceed  $\pm$  2° F

Humidity variation Does not exceed  $\pm$  20% RH

## AFM Instrumentation from Agilent Technologies

Agilent Technologies offers high-precision, modular AFM solutions for research, industry, and education. Exceptional worldwide support is provided by experienced application scientists and technical service personnel. Agilent's leading-edge R&D laboratories ensure the continued, timely introduction and optimization of innovative, easy-to-use AFM technologies.

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