

# Agilent 5400 AFM/SPM

## Data Sheet

### Introducing The Agilent Technologies 5400 Scanning Probe Microscope (SPM)



Figure 1. The NEW Agilent 5400 AFM/SPM

### Features and benefits

- Scientific-grade instrument delivers atomic resolution
- Cost-effective platform offers simple upgrade path
- Intelligent design provides excellent ease of use
- Excellent educational instrument with course curriculum
- Modular options enhance AFM/SPM flexibility

### Applications

- Materials science
- Polymers
- General surface characterization
  - Adhesion
  - Elasticity
  - Friction
- Nanolithography

### Overview

The new Agilent 5400 SPM/Atomic Force Microscope (AFM) is a high-precision instrument engineered to provide superb ease of use and versatility. This scientific-grade microscope delivers atomic-scale resolution at a remarkably affordable price, making it an outstanding choice for education as well as research.

In fact, the Agilent 5400 offers educators an unprecedented opportunity to introduce their students to powerful AFM techniques. The microscope will be delivered with an undergraduate course curriculum with samples for teaching labs. Furthermore, the Agilent 5400 provides a simple upgrade path to the sophisticated Agilent 5500 AFM.

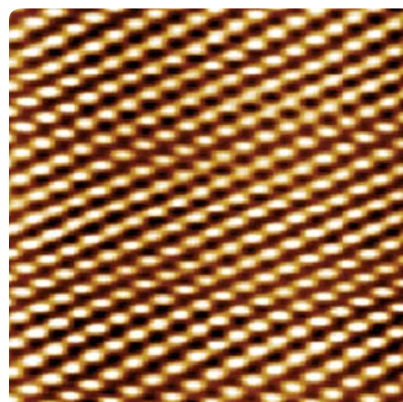


Figure 2. Atomic resolution of Mica.  
Scan size 14 nm



## System components

The Agilent 5400 AFM/SPM microscope is a modular laboratory solution that includes an open-loop X-Y & Z scanner (two scan ranges available: 9- $\mu\text{m}$  or 90- $\mu\text{m}$ ), a controller, contact mode, acoustic AC mode, phase imaging, a computer, and two monitors.

For a lower mechanical noise floor, the Agilent 5400 is built with rigid materials and a rigid frame. Its compact scanner employs a patented balanced-pendulum design to minimize X-Y coupling, significantly reducing creep and hysteresis. The scanner can also be repositioned in Z to accommodate larger samples up to 21-mm in thickness.

The Agilent 5400 utilizes a low-coherence laser with a small spot size for low-interference imaging. The positioning of the laser on the scanner ensures that the laser is always focused on the same spot on the cantilever, providing absolute accuracy in very sensitive measurements (e.g., force measurements) and helps eliminate imaging artifacts.

The microscope's controller uses state-of-the-art electronics and an advanced design to minimize noise and optimize functionality. The controller has two 32-bit DSPs, five 24-bit DACs for X-Y & Z scan-axis positioning, ten 16-bit data acquisition channels, and four 24-bit DAC outputs.

## Software

Agilent's new 32-bit Windows®-based PicoView is a highly stable software package that offers real-time 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.

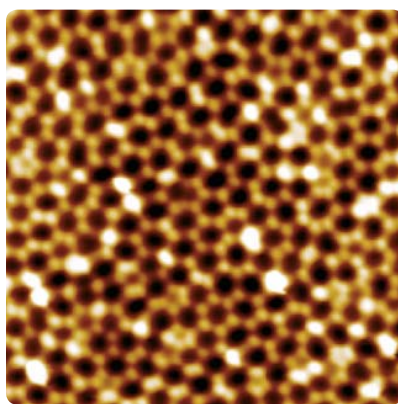
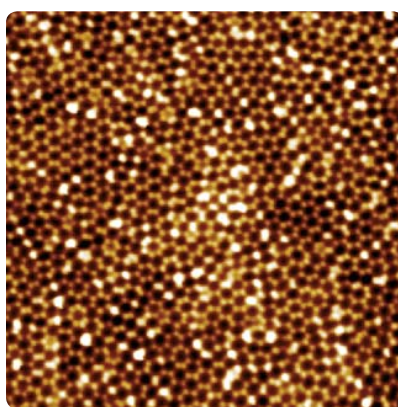


Figure 3. A thin film of porous aluminum consists of hexagonal hollow cells formed by vertical partitions. The cell pitch is around 100-nm in size. This surface nanostructure can be readily revealed from high-resolution imaging using Agilent's 5400 under a contact mode.

## Ease of use

The open access to the scanner (Figure 4) and sample plates (Figure 5), and easy alignment of optics simplify use of the Agilent 5400 AFM/SPM microscope. The scanner mounts easily and is held into place with a clamp closure. In addition, the scanner's easy-to-load nose cones mean that switching imaging modes is quick and convenient. These nose cones are made from PEEK polymers, have low chemical reactivity, and can be used in a wide range of solvents. Their straight-forward interchangeability provides tremendous flexibility.

The Agilent 5400 scans at speeds up to 48-Hz and can scan as many as 8 images simultaneously (4096 x 4096 pixels). USB standard connectivity allows the microscope to be run from a laptop computer.



Figure 4. Easy to mount scanners

## Options

Several performance-enhancing options are available for the Agilent 5400 microscope, including a closed-loop X-Y & Z scanner that provides optimum control over the position of the AFM/SPM probe. For high-resolution imaging in liquid, Agilent's patented magnetic AC mode (MAC Mode) is offered. MAC Mode, an extraordinarily gentle non-contact AFM imaging technique, enables electric force microscopy (EFM), magnetic force microscopy (MFM), and force modulation. To meet the requirements of intricate experiments, precision temperature control can be added. Scanning tunneling microscopy (STM) and current sensing AFM are also offered.



Figure 5. Open access to sample plates

## High-resolution imaging of polymer Celgard (isotactic polypropylene PET composite), AAC mode

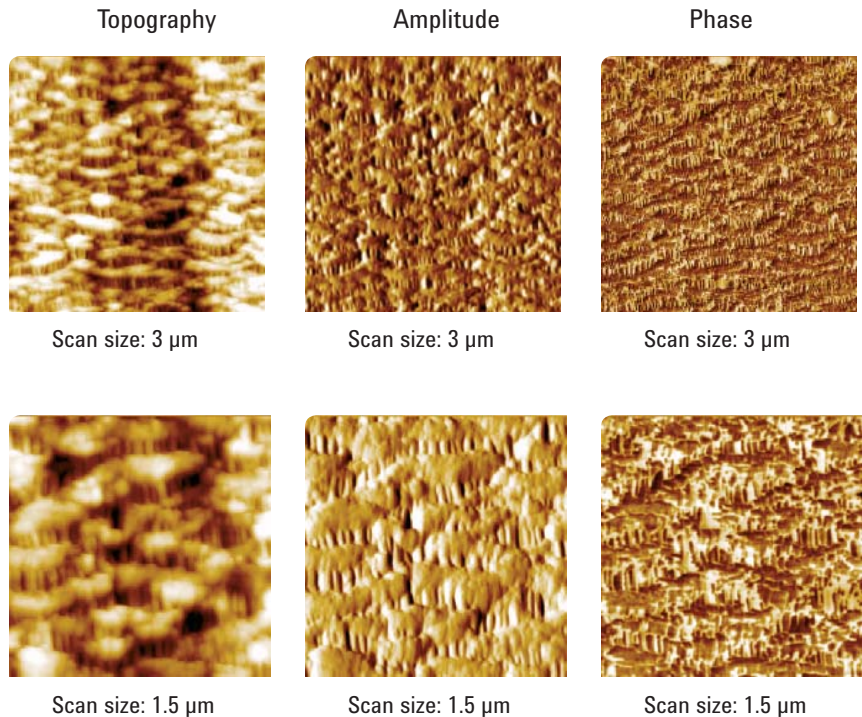


Figure 6. AFM has been widely used as a powerful characterization tool in material science by imaging surface structures with a superior spatial resolution. Isotactic polypropylene usually exhibits a fiber structure with its chains stretched out straight and lined up next to each other. Although the sizes of the fibers in this delicate sample are at the nanometer scale, the individual ones have been clearly resolved from Agilent's 5400 under an AAC mode in topography, amplitude and phase images. (The simple use of RMS as the feedback loop signal instead of amplitude from a lock-in amplifier, the 5400 still maintains the capability to achieve high resolution.)

## Specifications

Noise	0.16 Å
Scan range	90 µm x 90 µm x 8 µm

## Scanners

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

Large multi-purpose scanner	
Scanning range	90 µm x 90 µm
Z range	8 µm
Vertical noise	0.5 Å RMS
Small scanner	
Scanning range	9 µm x 9 µm
Z range	2 µm
Vertical noise	< 0.2 Å RMS

## Controller

Input	Ten 16-bit channels
Drive	5 channels ± 215 V, 24-bit
Output	Four 24-bit channels, ± 10 V
Interface	USB
Power	100 - 120 V AC or 220 - 240 V AC 1A; 50 - 60 Hz

## Facilities specifications

Acoustic noise	Less than 75 dBc
Temperature variation	Does not exceed ± 2° F
Humidity variation	Does not exceed ± 20% RH

## AFM instrumentation from Agilent Technologies

Agilent 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 are dedicated to the timely introduction and optimization of innovative and easy-to-use AFM technologies.

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