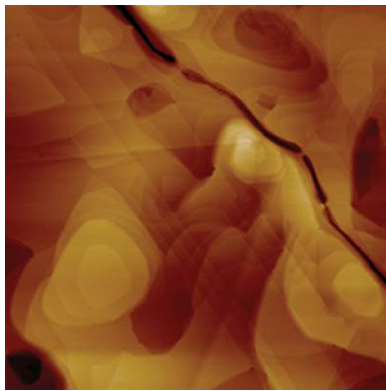


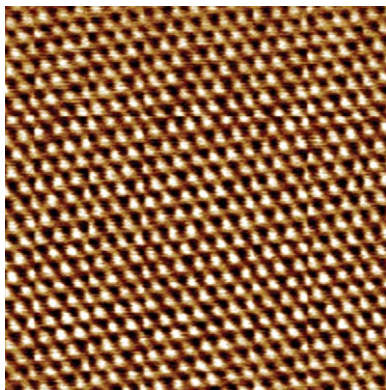
# Agilent 5600LS AFM

## Versatile AFM for Large and Small Samples

Data Sheet



3000 nm x 3000 nm  
Single atomic steps on Au(111).



5 nm x 5 nm  
Atomic resolution of HOPG.

### Features and Benefits

- Fully addressable and programmable 200 mm x 200 mm stage
- Atomic-resolution imaging of a small sample area using AFM or STM scanners
- Allows simple point-and-shoot AFM imaging based on optical view
- Low-noise AFM design guarantees single atomic steps
- Motorized optical focus provides excellent ease of use
- Accurate location mapping (0.5  $\mu\text{m}$  precision) ensures reproducibility

### Applications

- Semiconductor: silicon wafers, devices
- Data storage: CD, DVD, hard drive
- Biological arrays
- Polymers, materials science

### System Overview

The Agilent 5600LS large-stage AFM is ready to deliver atomic-resolution results. The versatile 5600LS is the world's only commercially available AFM that allows imaging of both large samples (in air) and small samples in air, or in liquid under temperature control with a 9 micron scanner.

The 5600LS utilizes a fully addressable 200 mm x 200 mm stage and a new, low-noise AFM design. Samples up to 8" in diameter and 30 mm tall are easily accepted by the 200 mm vacuum chuck. The stage can accommodate a 300 mm wafer with repositioning. The 5600LS provides researchers a perfect tool for many nanotechnology applications, including semiconductor, materials science, and life science studies.

### Small Samples, Too

The 5600LS system's programmable, motorized stage enables fast, accurate probe positioning for imaging and mapping large and small specimens alike. Investigators can precisely locate and identify an area of interest and, with the coordinates stored, automatically reposition the sample quickly and accurately for further



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study. Multiple locations can be programmed into the system. For ultimate flexibility, the stage can accommodate either a single large sample or up to nine small samples with vacuum chuck or more can be held with tape (each of whose locations can be programmed into the system).

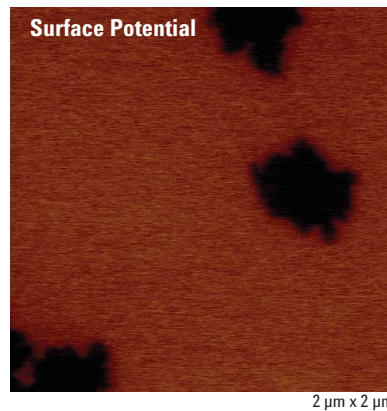
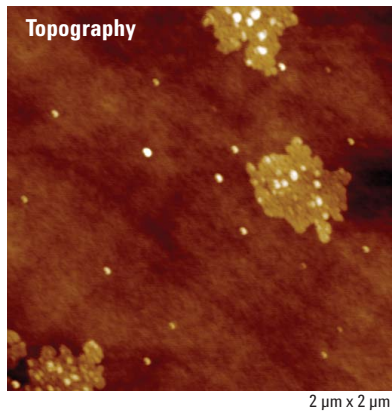
The 5600LS supports Agilent open-loop and closed-loop scanners as well as Agilent STM scanners for atomic resolution. To provide optimized scanning for a diverse set of applications, open-loop and closed-loop multipurpose scanners are available in two scan ranges. Agilent's large scanner can scan areas up to 90  $\mu\text{m}$  x 90  $\mu\text{m}$ , whereas an easy switch to a 9  $\mu\text{m}$  x 9  $\mu\text{m}$  scanner or the 9 x 9  $\mu\text{m}$  STM scanner lets 5600LS users image a very small sample area and see atomic steps.

Furthermore, a special Agilent stage adapter permits the 5600LS to be utilized with a sample plate that facilitates imaging of small samples in liquid. Heating and cooling control is also offered for imaging biological and polymer samples in liquid.

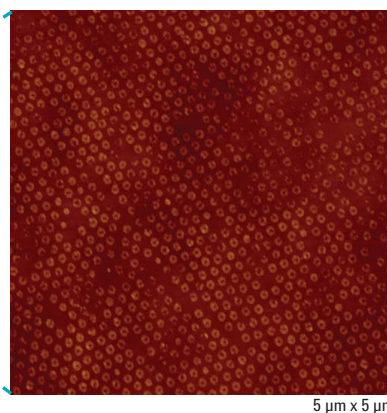
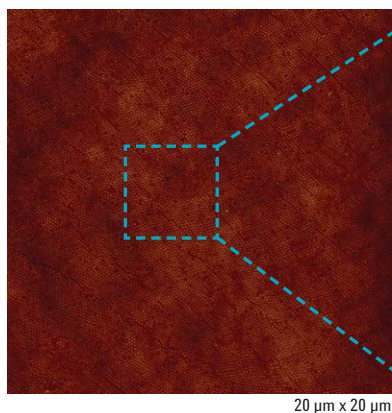
## Innovative Design

The 5600LS combines stable, low-noise AFM imaging with high-speed, very flat, easily reproducible displacement over the entire movement range. The automated tip approach feature of the Agilent atomic force microscope minimizes damage to delicate sample structures. Motorized optical zoom and focus capabilities facilitate the automatic pre-approach, simplifying setting the initial tip-sample separation.

The 5600LS also allows researchers to perform simple, software-driven, point-and-shoot AFM imaging of an area of interest based on an optical view. AFM images can even be stitched together using Agilent's Pico Image Advanced software package (optional).



AFM studies of fluorinated alkanes adsorbed on silica using KFM. The aggregates exhibit a different surface potential with respect to the substrate.



AFM characterization of ordering and surface structures of organic thin film of PEG-terminated silane on silicon via a particle-based and template-directed growth methodology.

The 5600LS system includes a stage, an atomic force microscope, a scanner, a controller, and a computer.

### Imaging Modes

The 5600LS is compatible with contact mode, acoustic AC mode, phase imaging, STM, LFM, EFM, MFM, force modulation, current sensing, and Agilent's MAC Mode III — a gentle, nondestructive technique for imaging delicate samples in air and liquid. Patented MAC Mode III provides three user-configurable lock-in amplifiers, affording researchers virtually limitless application possibilities and unprecedented speed. It also provides two expansion slots.

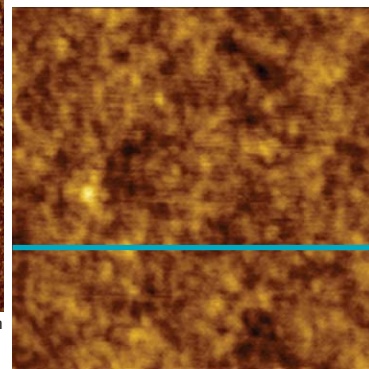
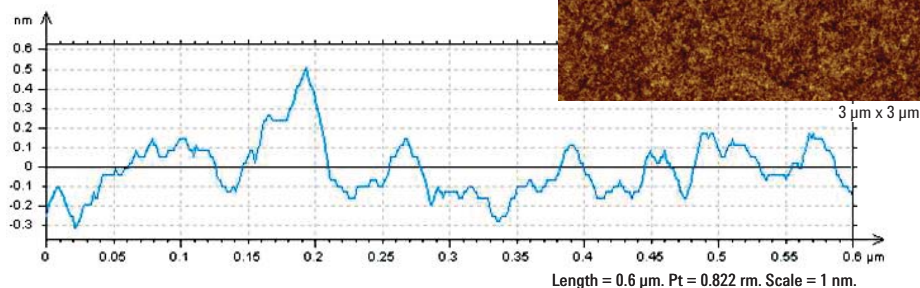
MAC Mode III has been designed to allow single-pass imaging concurrent with KFM/EFM. Simultaneous, high-accuracy topography and surface potential measurements are enabled by a servo-on-height cantilever

approach that is not susceptible to scanner drift. KFM/EFM is especially useful for measuring dielectric films, metal surfaces, piezoelectrics, and conductor-insulator transitions.

MAC Mode III also lets researchers perform vertical or lateral modulation studies and delivers a unique plot of the oscillating amplitude vs. frequency in contact. This capability allows easy optimization of the detection sensitivity for a broad range of cantilever spring constants.

In addition to KFM/EFM and piezo force, MAC Mode III allows the use of higher resonance modes of the cantilever. Higher harmonic imaging provides contrast different from that seen with fundamental amplitude and phase signals. This technique can be utilized to collect additional information about mechanical properties of the sample surface.

Line profile of 800 nm image of Angstrom level measurements of a bare silicon wafer.



Angstrom level measurements of a bare silicon wafer.

### SMM Mode

The 5600LS is also compatible with Agilent Technologies' unique scanning microwave microscopy (SMM) mode, which combines the complex, calibrated electrical measurement capabilities of a performance network analyzer (PNA) with the outstanding spatial resolution of an atomic force microscope. SMM Mode outperforms traditional AFM-based scanning capacitance microscopy techniques, offering far greater application versatility, the ability to acquire quantitative results, and the highest sensitivity and dynamic range in the industry.

SMM Mode is particularly useful for semiconductor test and characterization. In addition to enabling complex impedance (resistance and reactance) measurements, SMM Mode can be used to acquire calibrated capacitance and dopant density measurements. SMM Mode works on all major semiconductor types and does not require an oxide layer.

As well as its ability to work on semiconductors, glasses, polymers, ceramics, and metals, the technique lets 5600LS users perform high-sensitivity investigations of ferroelectric, dielectric, and PZT materials. Studies of organic films, membranes, and biological samples can also benefit from the use of SMM Mode.

### Scanners

Each of Agilent's unique top-down scanners utilizes interchangeable nose cones that enable users to switch imaging modes quickly and conveniently. To deliver high-resolution imaging results, a patented pendulum scanner design eliminates artifacts in the image by keeping the relative position of the laser spot fixed in relation to the cantilever throughout the scan cycle. The open-top design of these scanners allows an unobstructed optical view of the cantilever and sample without sacrificing sample handling. A variety of robust, easy-to-use sample plates are offered in order to facilitate experiments in air, in liquid, or with electrochemistry.

Agilent's STM scanners deliver outstanding results on a variety of conducting materials. These low-current and ultra-low-current STM scanners provide stable imaging at pico-ampere and sub-pico-ampere currents to resolve individual atoms and molecules. STM scanners take advantage of the extreme distance sensitivity of the tunneling current between two conducting electrodes. By measuring the tunnel-current variations as a probe is scanned over a sample's surface, STM is able to deliver the highest-resolution SPM images.

### Temperature Control

The 5600LS is compatible with Agilent's industry-leading temperature control options. A patented thermal insulation and compensation design enables precise temperature control with excellent stability ( $\pm 0.1^\circ\text{C}$  or  $\pm 0.025^\circ\text{C}$ ; from  $4^\circ\text{C}$  to  $250^\circ\text{C}$ ) for high-resolution AFM imaging.

### Software

The 5600LS utilizes Agilent's PicoView 1.6 imaging and analysis software package to let users precisely program the system's stage and perform simple point-and-shoot AFM imaging of an area of interest based on an optical view.

For additional interactive post-processing capabilities, Agilent's easy-to-use Pico Image Basic imaging and analysis software package includes all of the features and functions required to build a basic surface analysis report on multi-layer measurement data that is input from the 5600LS. The document consists of a set of frames containing surfaces, profiles extracted from surfaces, the results of applying filters and other operators, analytical studies, and 2D and 3D parameters. A measurement identity card, screen notes, and illustrations can be added to each document.



## Specifications

<b>Large multi-purpose scanner</b>	
Scanning range	90 $\mu\text{m}$ x 90 $\mu\text{m}$
Z range	8 $\mu\text{m}$
Vertical noise	0.5 $\text{\AA}$ RMS
<b>Small scanner</b>	
Scanning range	9 $\mu\text{m}$ x 9 $\mu\text{m}$
Z range	2 $\mu\text{m}$
Vertical noise	< 0.2 $\text{\AA}$ RMS
<i>Note: Specifications shown are for open-loop operation. Closed-loop scanners are also available.</i>	
<b>Programmable stage</b>	
Sample size	Up to 200 mm x 200 mm
Sample thickness	30 mm
Repeatability	<500 nm accuracy and 500 nm bidirectional repeatability
Software	Programmable
Vacuum chuck	Stainless steel
Sample adaptor	For small samples
<b>Optics</b>	
Built-in video	2M pixel resolution; 2.5 $\mu\text{m}$ optical resolution
Temperature variation	Does not exceed $\pm 2^\circ\text{F}$
Humidity variation	Does not exceed $\pm 20\%$ RH
<b>Vibration isolation</b>	Available
<b>Controller</b>	
Input	Ten 16-bit channels
Drive	5 channels $\pm 215\text{ V}$ , 24-bit
Output	Four 24-bit channels, $\pm 10\text{ V}$
Interface	USB
Power	100–120 V AC or 220–240 V AC 1A; 50–60 Hz
<b>Facilities specifications</b>	
Acoustic noise	< 75 dBc
Temperature variation	Does not exceed $\pm 2^\circ\text{F}$
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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