5500 EC AFM for Electrochemistry

Data Sheet

Features and Benefits

- The only scientific-grade AFM system designed specifically for electrochemistry
- Built-in environmental chamber offers complete control of gaseous environments
- Choice of STM scanners for EC-STM or 8 µm scanner for EC-AFM
- Head electronics box with built-in potentiostat
- Liquid cell sample plate simplifies loading and cleaning
- Industry-leading, high-precision temperature control

Key Options

- Exclusive MAC Mode III technique allows KFM on dry samples
- Glove box further enhances level of environmental control

Primary Applications

- Fuel cells and energy storage (e.g., lithium ion batteries)
- Visualization of electrochemical metallization
- Organic photovoltaics
- Corrosion studies
- Semiconductors
- Nanofabrication

Engineered for Electrochemistry

The Agilent 5500 is the only commercially available scientific-grade AFM system specifically engineered from the ground up for advanced electrochemistry at the nanoscale (sub-10-nm resolution). Indicative of our singular EC-STM heritage, Agilent now boasts more published papers relating to electrochemistry than any other SPM company — over 1,000 and counting.

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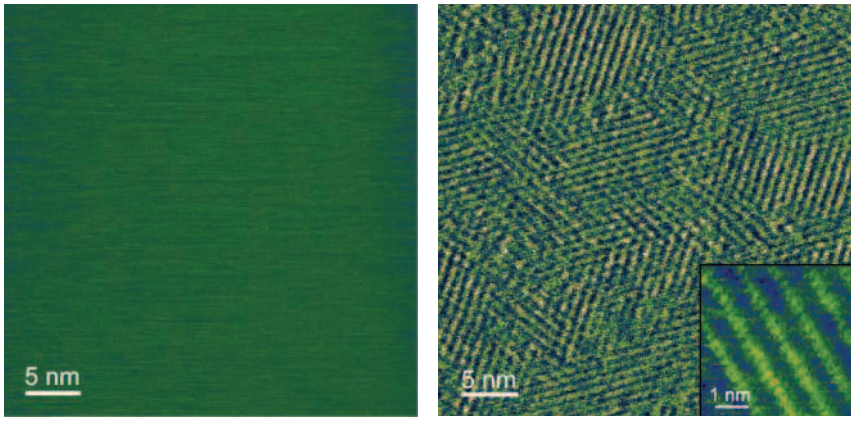
Environmental chamber.



A. **0V** **B.** **0.27V**

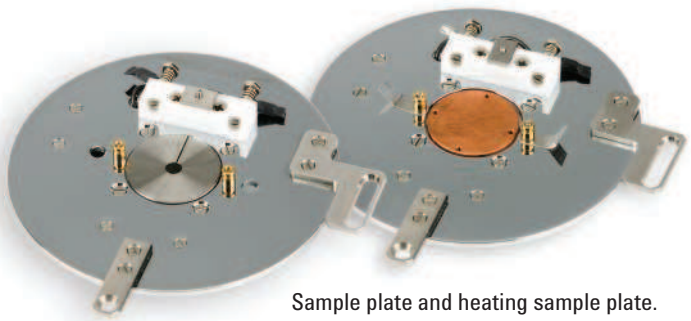
Potential-induced phase transition of 2,2′ bipyridine molecules on Au(111) surface imaged *in situ*. A. At 0V (versus Ag/Ag+), randomly and loosely bound molecules were not observed. B. At 0.27V, molecules were strongly bound to the surface and packed in ordered rows along the three distinct directions of the underneath [Au] atomic lattice. (B. insert) High-resolution of closely packed individual bipyridine molecules at 0.27V. 4.6nm x 4.6nm. Scan size: 37nm x 37nm.

Unlike other AFM systems, which offer environmental chambers as add-on components, the modular Agilent 5500 platform design incorporates a true built-in environmental isolation chamber to give researchers comprehensive control of gaseous environments for in situ electrochemistry experiments. Eight ports permit the flow of many different gases into or out of the built-in chamber's sealed sample compartment. Humidity levels can be controlled, oxygen levels monitored and controlled, and reactive gases easily introduced into and purged from the chamber.

Scanners utilized with the 5500 system reside outside the environmental isolation chamber, so they are protected from contamination, harsh gases, solvents, caustic liquids, and other damaging experimental conditions. Agilent's 8µm x 8µm scanner offers outstanding linearity, accuracy, and ease of use for EC-AFM. This top-down scanner is ideal for imaging in fluids or in air, as well as under controlled temperature and environmental conditions. Alternatively, Agilent's low-current and ultra-low-current STM scanners deliver excellent results on a variety of conducting materials, providing stable imaging at pico-ampere and sub-pico-ampere currents to resolve individual atoms and molecules.

The 5500 AFM system for electrochemistry also includes a built-in potentiostat; a temperature controller (250°C to -30°C) that utilizes a patented thermal insulation and compensation design to provide the industry's most precise and stable heating and cooling; and an easy-to-clean liquid cell sample plate that enables faster, more convenient sample loading and handling.

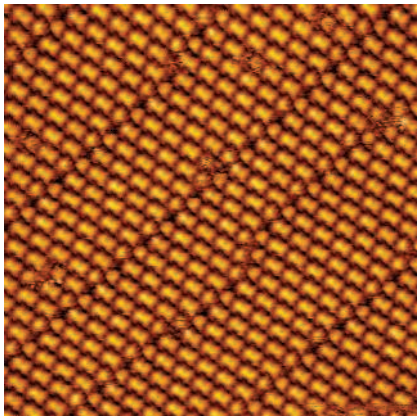
Among the many electrochemistry applications of the 5500 are fuel cells and energy storage (e.g., lithium ion batteries); visualization of electrochemical metallization; organic photovoltaics; corrosion studies; semiconductors; and nanofabrication.



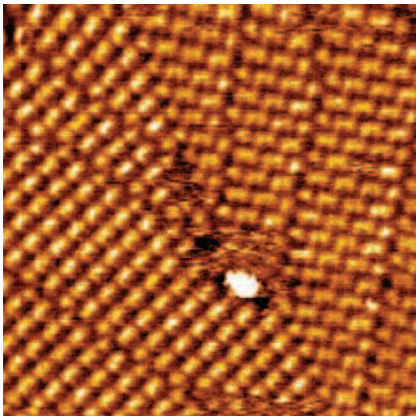
Sample plate and heating sample plate.

Software for EC

The 5500 system utilizes Agilent's PicoView and Pico Image, a post process imaging and analysis software package. PicoView allows complete control of all scanning parameters and provides the flexibility required for more complex EC-AFM and EC-STM experiments. Our EC-friendly version of PicoView provides an easier-to-use interface, a greater number of control parameters (with expanded ranges), and cyclic voltammetry (CV) using tip or sample.



A.



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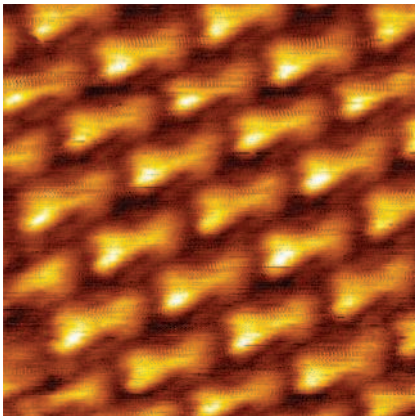

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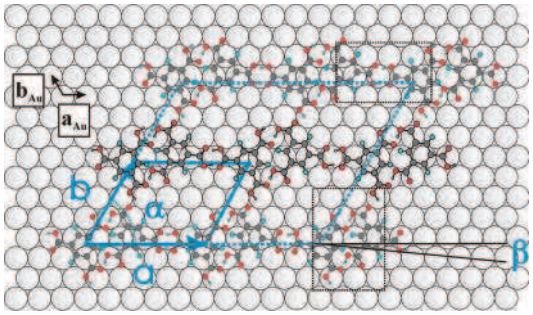


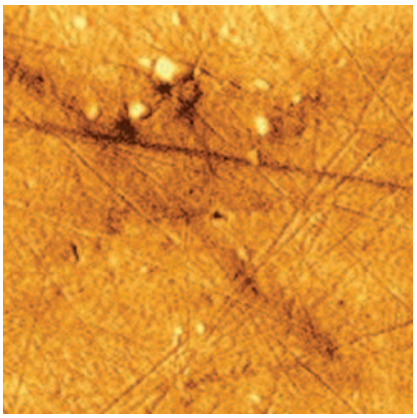
D.

TMA on AU (111)
in electrolyte.
A. Transitional domain boundry;
B. Rotational domain boundry;
C. High resolution image;
D. Structual model.

Extending EC Capabilities

Agilent's patented MAC Mode III option 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 on dry samples. Simultaneous, high-accuracy topography and surface potential measurements are enabled by a servo-on-height cantilever approach that is not susceptible to scanner drift.

Other 5500 system options include a salt-bridge sample plate (for very accurate reference potential) and a glove box (for precisely loading air- or moisture-sensitive samples on the microscope without ever exposing them to the external atmosphere).



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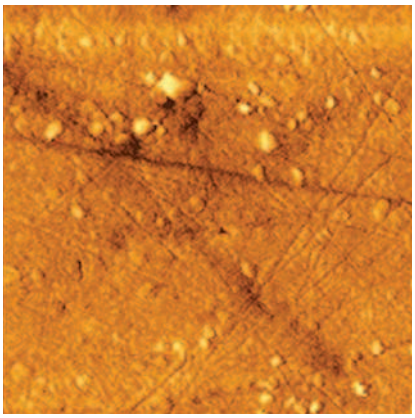

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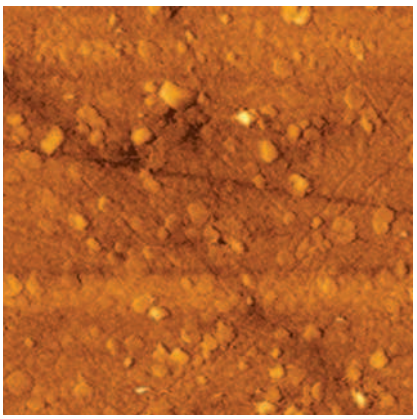

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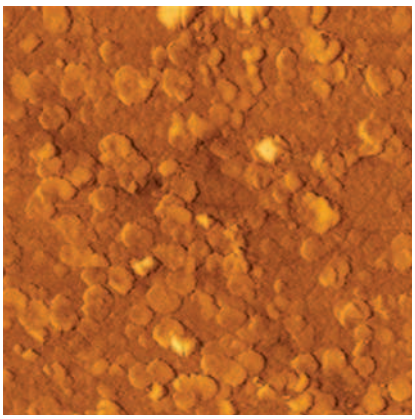

D.

Corrosion study of a polished metal surface: A. rest potential, B. after two cycles, C. after three cycles, and D. after six cycles.

5500EC Specifications

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

Large Multi-Purpose Scanner	
Scanning Range	90µm x 90µm
Z Range	8µm
Vertical Noise	0.5ÅRMS
Small Scanner	
Scanning Range	8µm x 8µm
Z Range	2µm
Vertical Noise	<0.2ÅRMS
STM Scanner	
Size	1µm x 1µm x 0.7µm
Noise Level	<0.06ÅRMS x <0.06ÅRMS
Sensitivity	0.1nA/V, 1nA/V (standard), or 10nA/V
STM Probe	0.25mm Pt-Ir or W wire
Sample Plate Sizes	Kinematic mount translatable plate
Optics	Navitar video camera
Controller	
Input	Ten 16-bit channels
Drive	5 channels ± 215V, 24-bits
Output	Four 24-bit channels, ± 10V
Interface	USB
Power	100–120VAC or 220–240VAC 1A; 50–60Hz
Facilities Specifications	
Acoustic Noise	<75dBc
Temperature Variation	Does not exceed ± 2° F
Humidity Variation	Does not exceed ± 20% RH

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

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Published in USA, August 30, 2013
5990-9273EN Rev.A

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