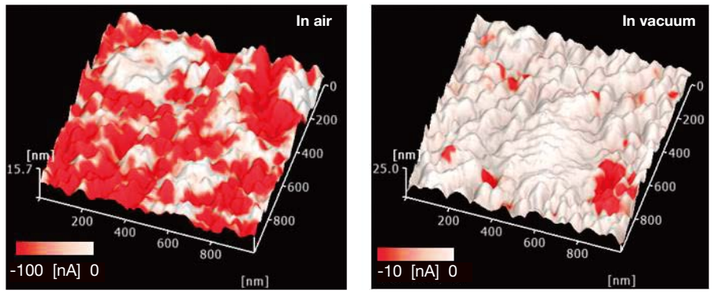
Environment Control Unit

AFM5300E

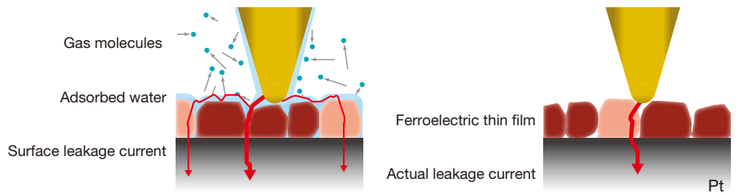
The AFM5300E is a high vacuum scanning probe microscope which provides various measurement conditions, such as air, liquid, vacuum, humidity control, and temperature control. Its vacuum chamber enables clear and high resolution observations of electromagnetic properties and in-situ observations at high and low temperatures.

High Vacuum System

AFM5300E's vacuum chamber meets the demand of advanced environment control needs. Some advanced materials and precise measurements of electromagnetic properties require a vacuum environment where adsorbed water and gas molecules are reduced.
Leakage current observations of a ferroelectric thin film on the right is an example of how vacuum environment can enhance the accuracy of current measurements.



Leakage current observations of a ferroelectric thin film

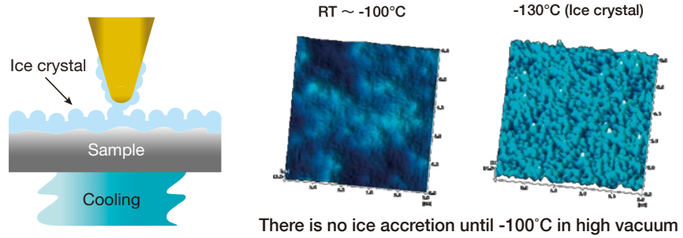


Temperature Control

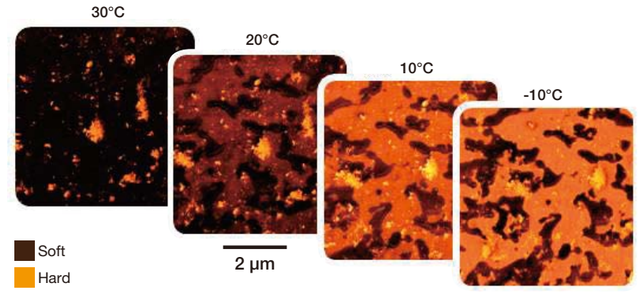
When the temperature in air falls below the dew point, ice will form on the surface. Even with a dried gas that has as little water vapor as possible, ice gradually forms when cooled below 0°C. In a vacuum environment created by the AFM5300E's turbo molecular pump, changes in topography and physical properties can be investigated while cooling down the sample to -120°C.

Cooling of polymer samples can also reveal unique characteristics of polymer nanostructures.
Phase images on the right show thermal behavior of blended polymer at different temperatures. There is no distinctive differences between natural and synthetic rubbers. At -10°C, however, the natural rubber becomes harder than artificial one which visualize the distribution.

Problem of ice accretion in air



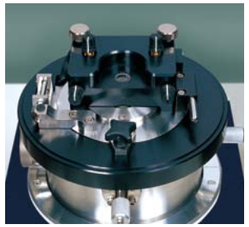
There is no ice accretion until -100˚C in high vacuum

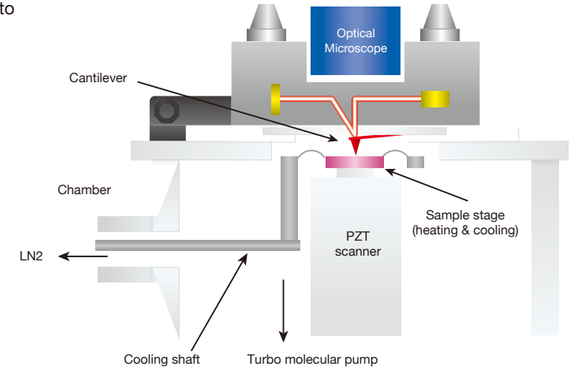


Simple and Easy Operation

A tool-free open-close mechanism is employed. It is not necessary to align the laser after removing and mounting another sample or to exchange the cantilever holder when switching the measurement modes.*

*Except STM and in-liquid imaging.

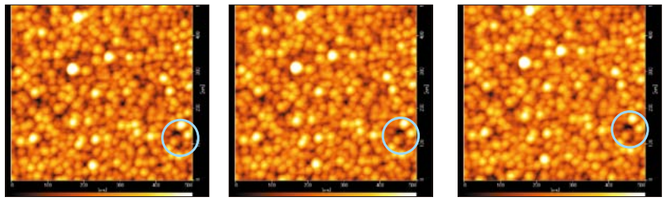




Established Excellent High Performance

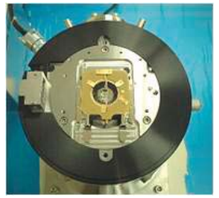
Swing Cancellation Mechanism achieved drastic reduction of drift. This mechanism improves and stabilizes SPM data.

Au grains (500 nm²)



Right after approaching | After 20 minutes | After 40 minutes

The AFM5300E supports various environments including in air, vacuum, liquid, temperature control, and humidity control.



In liquid

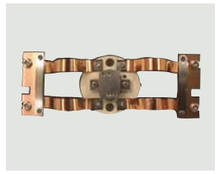
Unlike most conventional UHV systems, AFM53000E supports in-liquid imaging by mounting the cantilever holder expansion block and exchanging the cantilever holder.

Temperature Control

AFM5300E enables wide range of temperature control from -120°C to 300°C/ from room temperature to 800°C. Its vacuum system helps temperature control to be stable.

Temperature Controller

Heating and Cooling Temperature Control Module
-120°C ～ 300°C

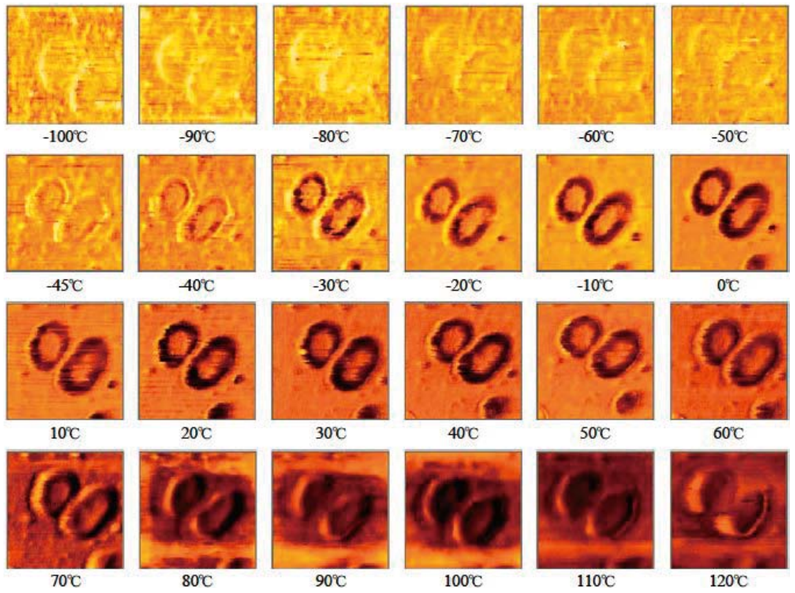


High Temperature Sample Stage
RT ～ 800°C

VE-AFM image of polypropylene block copolymer

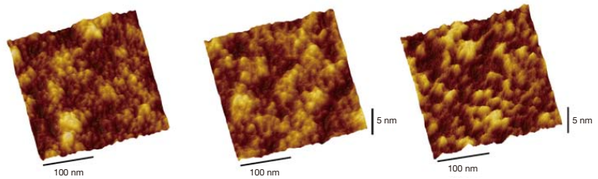
Soft

Hard



Humidity Control

Observations of solid polymer electrolyte membrane for fuel cell in dry condition, high humidity and liquid.



Dry condition (10%)

High humidity (80%)

In pure water

Air Protection Sample Holder Unit

Some materials are prone to oxidation or changing chemical/physical state under atmospheric conditions. The AFM5300E with optional Air Protection Sample Holder Unit offers imaging without exposure to the atmosphere. This unit has a vacuum enclosure that is sealed in situ allowing for safe and easy transfer to the SEM*/ the Ion Milling System** within a inert or vacuum environment.

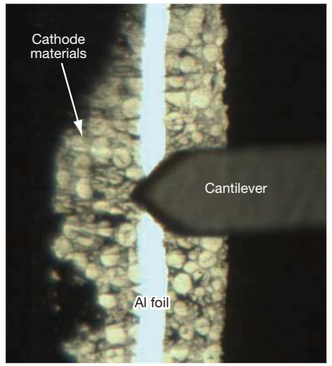
*Compatible with Hitachi FE-SEM with Air Protection Specimen Exchange Chamber.
**Compatible with Hitachi IM4000 Ion milling System with Air Protection Holder Unit.

Sample Holder

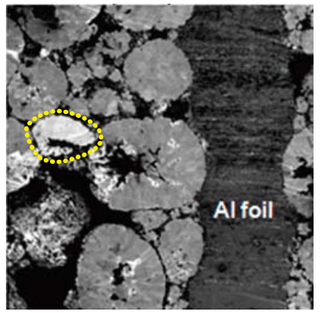
Observation of the same milled area of Li-ion battery cathode materials with FE-SEM and SSRM

- The electric resistance distribution of highly conductive Al foil and various cathode materials (micro-cathode active materials, a conductive assistant, and resin binders) on both sides are clearly observed in the SSRM image.
- The correlation between SSRM and FE-SEM images is shown in Figure 2. The active material, indicated by the dotted circles on (b) and (c), exhibits a brighter contrast on the SEM image and lower resistance on the SSRM image.
- The image (a) is captured by the metallurgical microscope's video camera attached to the AFM5300E. The top-view and high-magnification optical microscope significantly enhances the ease of use and enables SEM-SPM measurements of the same area.

(a) Ion Milling



(b) FE-SEM (1keV)



(c) High Vacuum SSRM