

# Atomic Force Microscopy

## AFM – Agilent 5500 & NanoTA2

### Overview

Atomic force microscopy (AFM) probes the surface of a sample with a sharp tip, a couple of microns long and less than 100Å in diameter. Forces between the tip and the sample surface cause the cantilever to bend, or deflect, producing a map of surface topography. AFMs can be used to study insulating and semiconductor materials as well as electrical conductors.

The Agilent 5500 is a research grade AFM that can accommodate samples of all sizes due to its “top-down” design in which the scanner and tip are mounted above the sample. The instrument is capable of performing all standard modes of AFM as well as scanning tunnelling microscopy (STM) and is fitted with a hot stage (ambient temperature to 250°C), a potentiostat for electrochemistry experiments, and Anasys Instrument’s nano-TA2 Thermal Imaging and Analysis accessory.

The nano-TA2 is an accessory (comprising hardware, software and probes) that enables the AFM to perform nano Thermal Analysis (nano-TA: analogous to macro-scale thermomechanical analysis), Heated Tip AFM (HT-AFM) and Scanning Thermal Microscopy. Unlike conventional Scanning Thermal Microscopy, nano-TA can be used with both contact and tapping mode imaging, so is applicable to soft samples such as polymers, elastomers and composites.

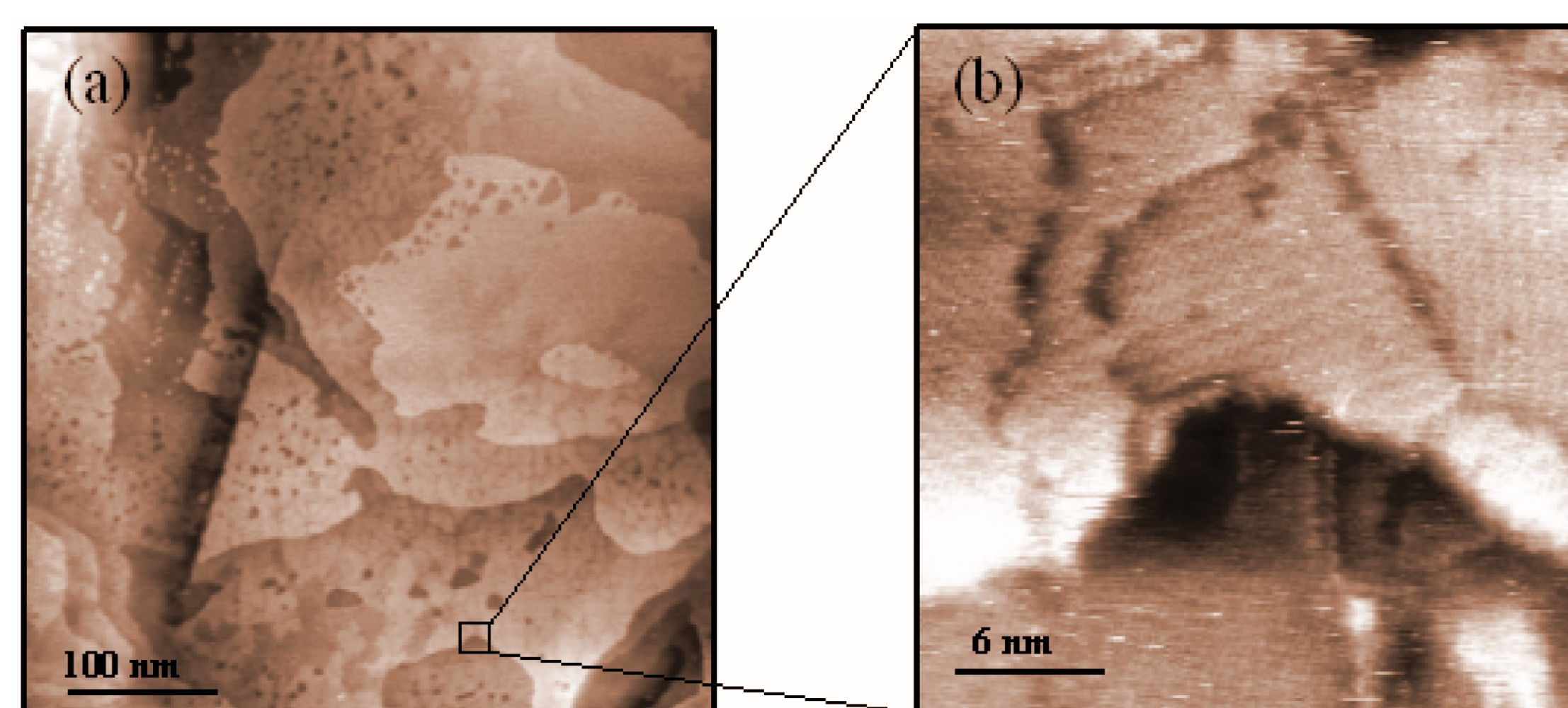
### Technical Specification

#### Series 5500 AFM/SPM System c

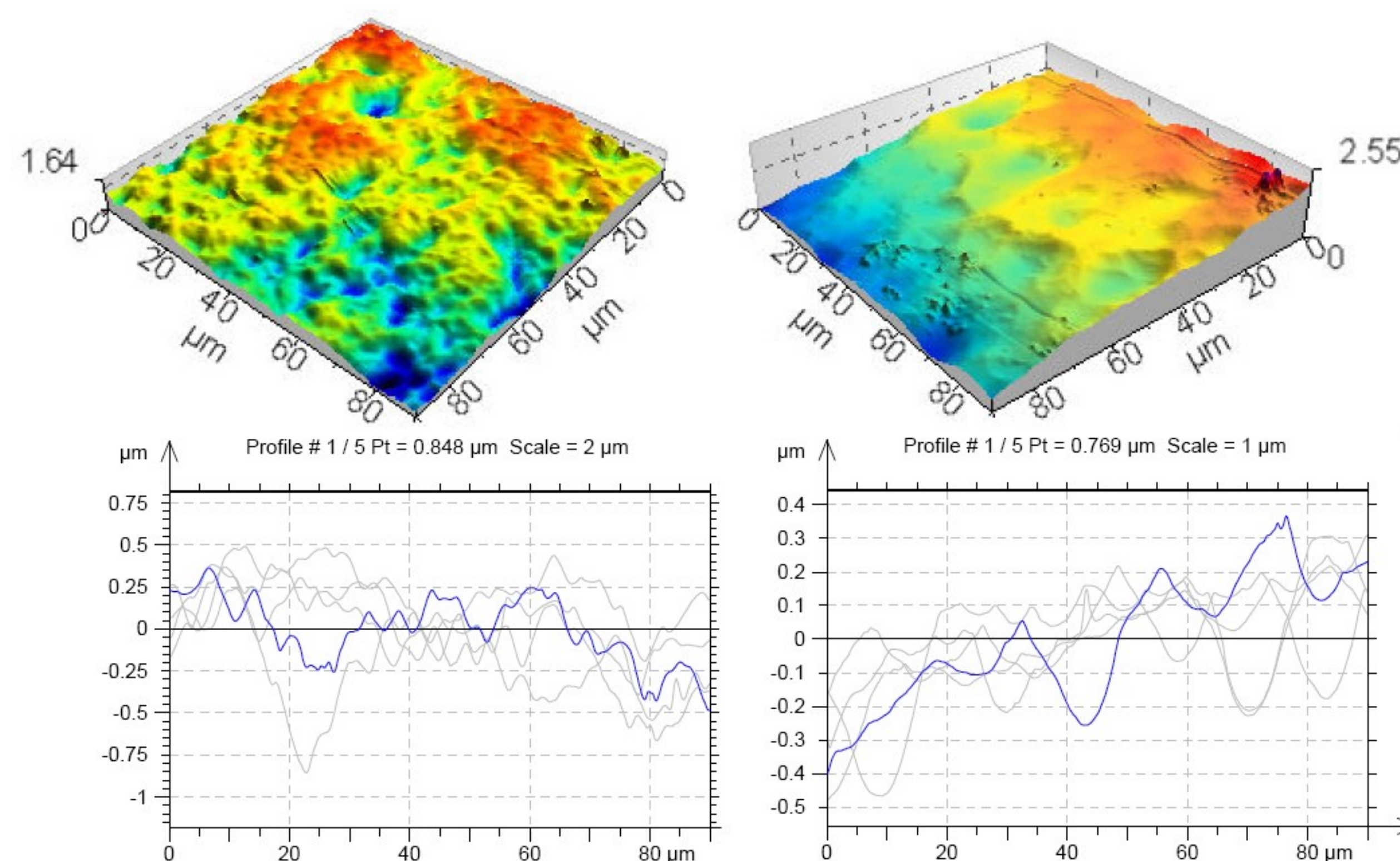
- Closed loop, with triple lock-in AC controller (AAC)
- Multi-purpose scanners, 9 x 9 µm (open loop operation) and 90 x 90 µm (closed or open-loop operation)
- Standard and AAC AFM nose-cones for multi-purpose scanners
- All standard AFM imaging modes available
- Accepts all standard AFM probes (custom probes required for nano-TA)
- Noise and vibration isolation chamber
- PicoImage software suite
- Potentiostat/galvanostat functionality
- Cantilever spring constant calibration module, 500kHz for point spectroscopy
- Standard sample plate
- Controlled temp sample plate, ambient to 250 °C
- Temperature controller; 0.025K accuracy

#### Anasys Instruments nano-TA2

- Measurement Mode: Single or Dual Probe (software selectable)
- Ramp Modes: Voltage, Power (single), Delta Power (dual)
- Imaging Modes: Contact Mode / Intermittent Contact Mode
- Software can record up to 4 independent channels including the following options:
  - Deflection, Resistance, Power, Vs, Vi, Vs-Vr, Delta Power, Vheat, and FbOut)
- Temperature Ramp Rate: Up to 600,000°C / min
- Max. Probe Temperature: 500°C (dependent on probe used)
- Probe Spring Constant: ranges from 0.1 N/m to 5 N/m
- Probe Resonant Frequency: ranges from 20 to 80 kHz
- Tip Radius: 20-30 nm / Tip Height: 1-5 microns / Cantilever Length: 200 or 300 µm



(a) 425 nm<sup>2</sup> STM image of alkanethiol self-assembled monolayer on Au{111} terraces. (b) 25 nm<sup>2</sup> region highlighted in (a) showing molecular scale domain boundaries and ordered alkanethiol molecule arrangement on Au{111} terraces. (Courtesy; C. O’Dwyer)



Optimisation of a silicon etching process: topography & line profiles after (left) 10 minutes and (right) 30 minutes etching time. (Courtesy: E. Chadwick, D. Tanner & G. Armstrong)

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