Agilent PicoTREC

Topography and Recognition Imaging System
for Atomic Force Microscopy

Data Sheet

Features and Benefits

- Identifies molecules and regions involved in binding events
- Screens compounds/molecules by binding interactions
- Generates surface adhesion profiles
- Improves speed and precision of results
- Expedites force-distance spectroscopy studies
- Conducts simultaneous topography and recognition imaging
- Performs label-less detection of molecular binding events

Figure 1. PicoTREC Topography and Recognition Imaging System.

Overview

PicoTREC from Agilent is the first atomic force microscope (AFM) option to give researchers the ability to detect and map molecular binding events while simultaneously generating topographic images in real time.

This molecular recognition tool has been designed for use with Agilent's patented MAC Mode on the 5500 AFM and 5500 inverted light microscope (ILM) systems. The 5500 AFM provides a wealth of unique technological features, including patented top-down scanning, ultra-precision temperature control, and industry-leading environmental control. Agilent's 5500 ILM system combines the power of this high-resolution AFM with the direct optical viewing capability of an inverted optical microscope.

With PicoTREC, researchers can quickly identify molecules that are engaged in molecular binding events. Using PicoTREC and AFM tips that have been modified with specific biochemistries, researchers can rapidly identify areas on samples that are engaged in molecular binding events and generate a molecular recognition map along with a MAC Mode AFM topography image of the sample. Alternatively, the information that is generated with PicoTREC and unmodified AFM tips can often be correlated to adhesion or other nonspecific interactions between the AFM tip and the sample.

PicoTREC's specialized hardware and electronics enable many advanced AFM spectroscopy applications. Force-distance spectroscopy measurements, molecular manipulations, and other AFM applications can be performed easier, faster, and with much greater confidence and precision than ever before. PicoTREC facilitates force-distance spectroscopy studies by pinpointing areas of molecular interaction. In situations where quantitative information is not required, PicoTREC can eliminate the need for slow, tedious force-distance spectroscopy experiments.

PicoTREC received R&D Magazine's R&D 100 Award®, recognizing it as one of the 100 most significant technological innovations in 2004. A breakthrough tool for AFM applications, PicoTREC allows researchers to pursue new avenues of discovery in nanotechnology.

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Applications

Explore the dynamic properties of biological processes such as antibody-antigen, ligand-receptor, drug-receptor, DNA-protein, and DNA-DNA interactions. Compare topography images to molecular recognition maps and adhesion patterns. The possibilities are endless!
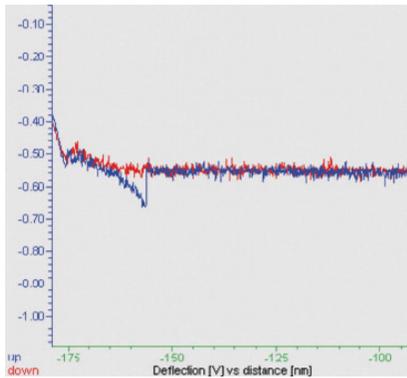

Figure 2. Force-distance profile of a single biotin-avidin unbinding event resulting from the withdrawal of a biotinylated AFM tip from an avidin-coated surface. Acquired on an Agilent 5500 AFM. Force of unbinding (z axis) versus distance (x axis). [CONFIRM AXIS LABELS]
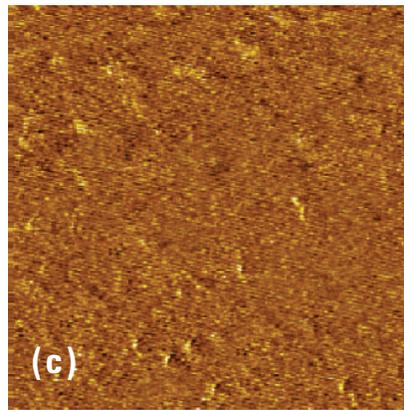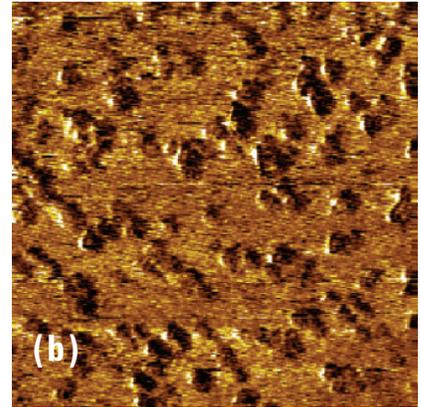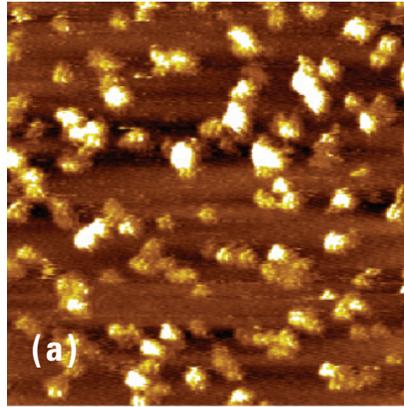

(a)

(b)

(c)

Figure 3. Avidin topography (a) and biotin-avidin recognition (b and c) images of avidin molecules under physiological conditions. Acquired on an Agilent 5500 AFM equipped with PicoTREC, MAC Mode, and a biotinylated AFM tip. (a) is a topography image of avidin molecules represented as white areas and (b) molecular recognition events as revealed in dark areas resulting from specific biotin-avidin interactions. (c) The dark areas are absent because the specific molecular interactions were blocked by the addition of streptavidin. The blocking experiment demonstrates the specificity of the molecular interactions. Scan size: 1µm x 1µm.
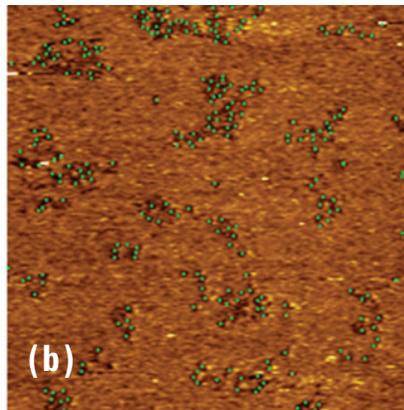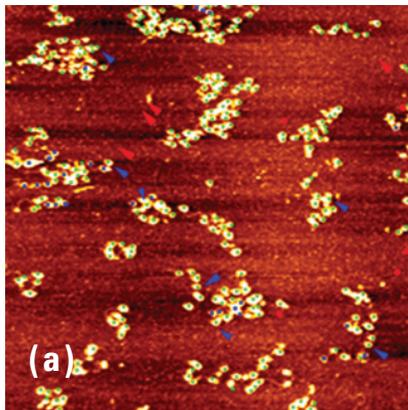

(a)

(b)

Figure 4. Accuracy and reproducibility using PiocTREC- Anti His3 on AFM and Chromatin on glutaraldehyde mica.

When compared to force volume mapping, PicoTREC can repeat the experiment in a matter of minutes. Image (a) Blue indicates misses and Red indicates false hits. On image (b) green indicates hits. There was five minutes between scans and number of hits went down on the rescan (96% to 92%) and the false positive rate was 2.8%.

Images courtesy of Dr Stuart Lindsay based on results generated in his lab by Dr Hongda Wang at ASU.
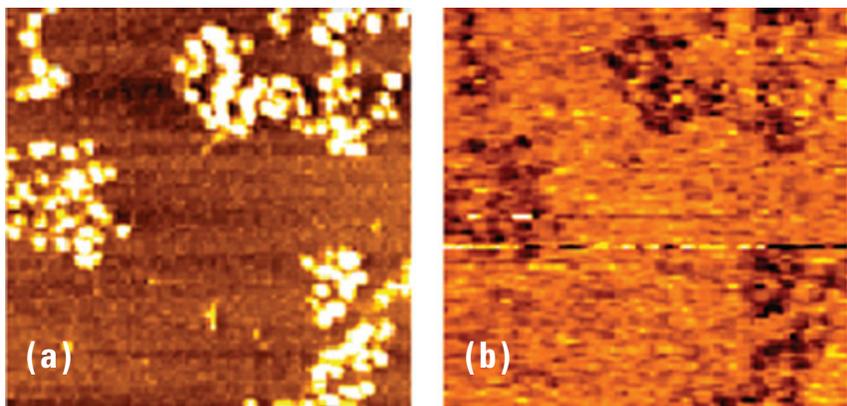
Figure 5. PicoTREC Topography and RECognition image of MMTV chromatin (DNA and histone protein complex) covalently attached to mica. (a) Topography image is individual chromatin molecules. (b) RECognition image of single molecule binding events between antihistone antibody, which has been attached to the AFM tip, and histone molecules on the surface. Scan size 500 nm x 500 nm.

Images courtesy of Dr Stuart Lindsay based on results generated in his lab by Dr Hongda Wang at ASU

Specifications

Compatibility: Requires Agilent MAC Mode

Compatible with the Agilent 5500 AFM and 5500 ILM

Applicable to specific and nonspecific molecular interactions (e.g., biomolecular recognition, ligand-receptor interactions, single-molecule binding events, adhesion)

Dimensions: 10cm (H) x 25cm (W) x 24cm (D), 1kg

Power: Supplied by PicoScan® controller

AFM Instrumentation from Agilent Technologies

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