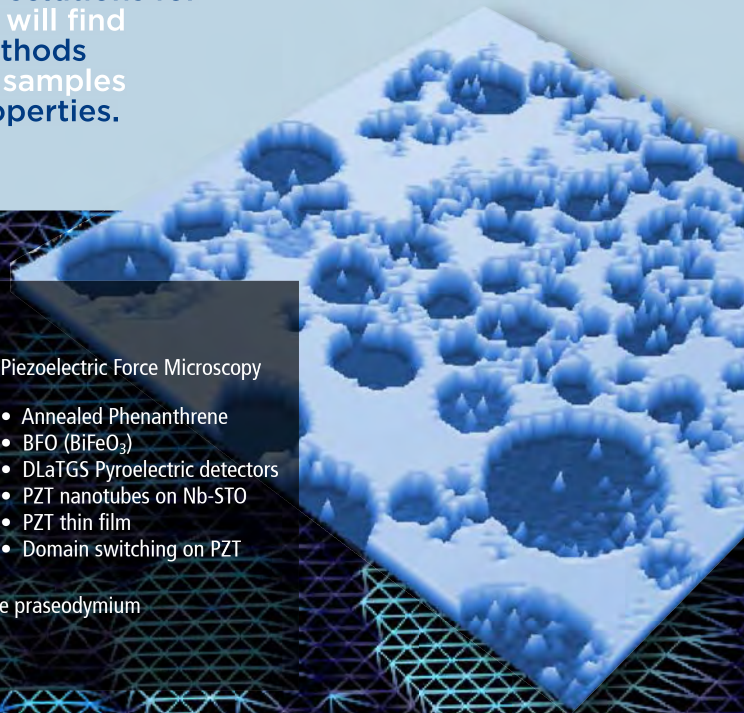
Volume 02

Park Atomic Force Microscopy

IMAGE GALLERY

Here at Park Systems we offer complete imaging solutions for a wide variety of functions and applications. You will find imaging samples created through the various methods including bio SICM and liquid imaging, as well as samples showing mechanical, magnetic, and electrical properties.



Li ion battery electrode p. 35, 36

Topography

- Lithography on Si substrate
- Tungsten coated wafer
- Hydro gel
- Ecoli, Ecoli treated with Cirpofloaxin
- Red Blood Cell
- DNA, DNA Protein
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- Styrene beads
- Copper Foil
- BFO (BiFeO3)
- STO (SrTiO3), Annealed LAO(LaAlO3)
- BiVO4 on treated YSZ substrate

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- PZT nanotubes on Nb-STO
- PZT thin film
- Domain switching on PZT

Electrical mode

- C-AFM
  - Floppy
  - ITO glass
  - CNT Film
- SSRM
  - Li ion battery electrode
- SSRM
  - SiC MOSFET
- STM
  - HOPG Moire
- SCM
  - SiC Device

Magnetic mode

- Magnetic Vortex Core
- Co/Cr/Pt
- Phthalocyanine praseodymium
- NiFe

Mechanical mode

- Phase imaging
  - Polymer on Si
- PinPoint nanomechanical mode
  - Blended Polymer
  - Crystal Facetts
- SThM
  - Si nanowire on glass

Park SYSTEMS

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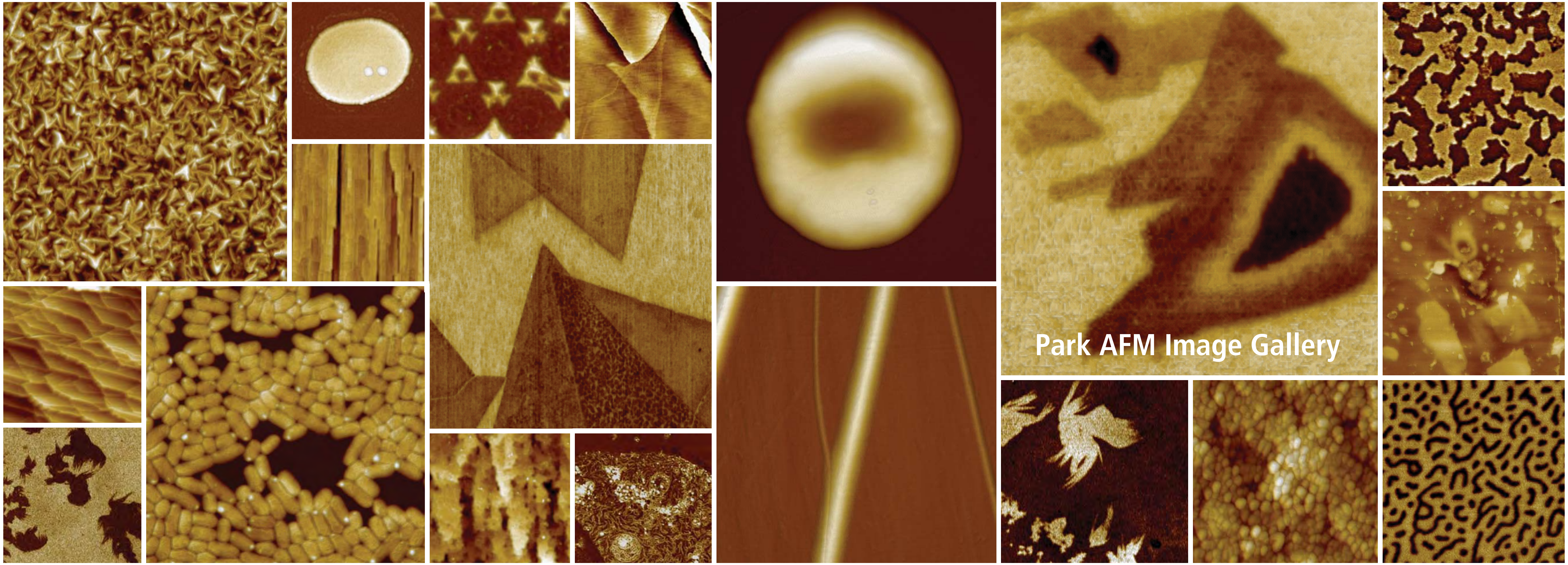

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Magnetic mode

Mechanical mode

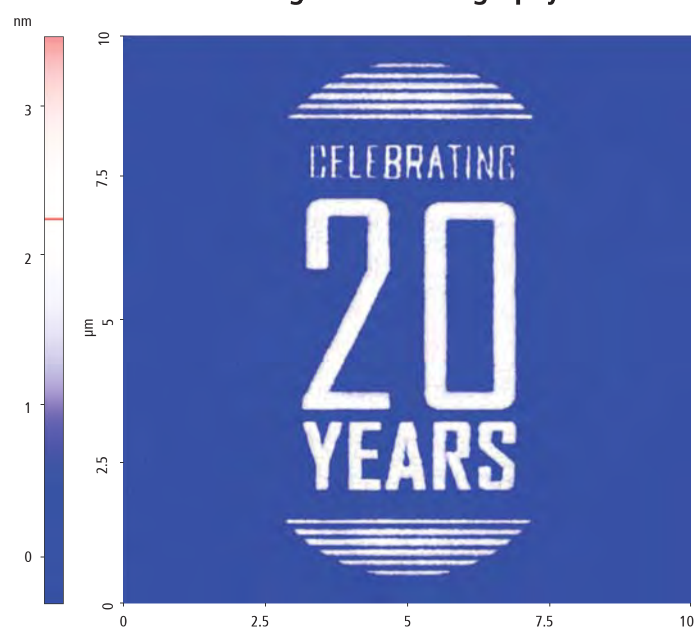
Lithography on Si substrate

Nanolithography

Here, the cantilever is used to intentionally modify the sample surface via mechanical and/or electrical means. To mechanically alter a surface, a specialized, robust cantilever gouges the surface with excessive force.
To electrically alter a surface, a cantilever with a high bias is used to oxidize local surface regions.

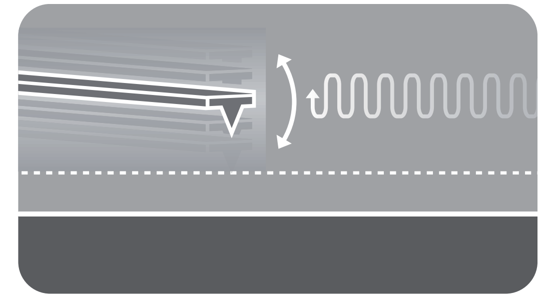
Litho. Design

Height after Lithography



System: Park NX10
Scan Mode: Nanolithigraphy
Litho. mode: Tip bias mode
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 10 µm × 10 µm
Image Resolution: 1024 × 512 pixel
Litho. Tip bias: Black -10V, White 0V
Scan Rate: 1Hz

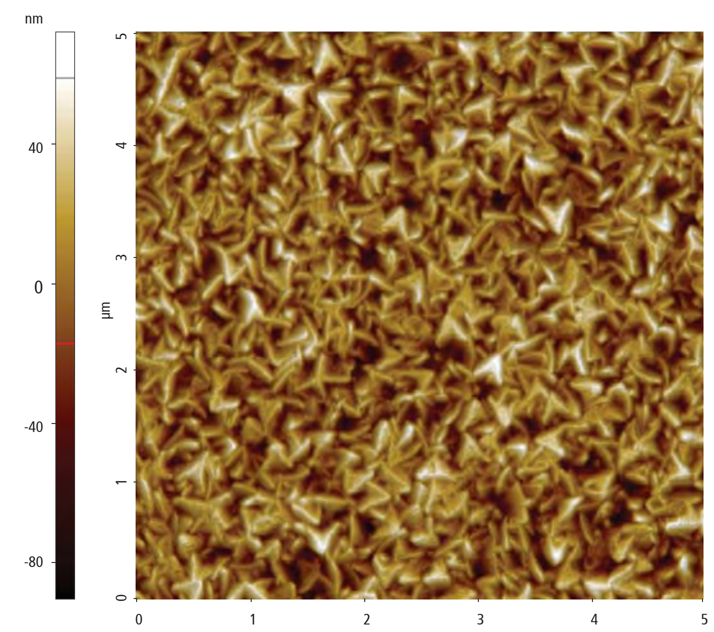
Tungsten coated wafer



True Non-Contact™ Mode

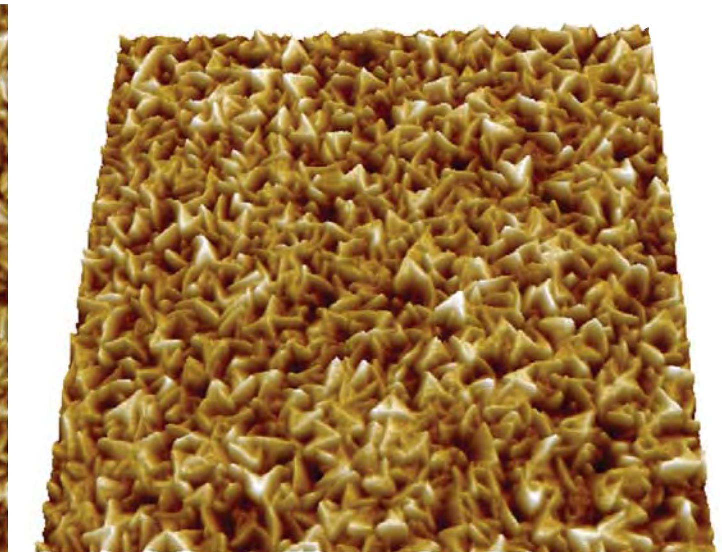
In this technique, the cantilever oscillates just above the surface as it scans. A precise, high-speed feedback loop prevents the cantilever tip from crashing into the surface, keeping the tip sharp and leaving the surface untouched. As the tip approaches the sample surface, the oscillation amplitude of the cantilever decreases. By using the feedback loop to correct for these amplitude deviations, one can generate an image of the surface topography.

Height



Peak to valley: 160nm

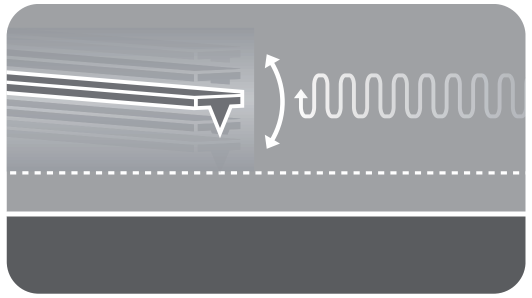
3D



X:Y:Z scale = 1:1:2

System: Park NX10
Scan Mode: Non-contact
Cantilever: NCHR (k=42 N/m, f=300 kHz)
Scan Size: 5 µm × 5 µm
Scan Rate: 0.3 Hz
Pixel: 512 × 512

Hydrogel



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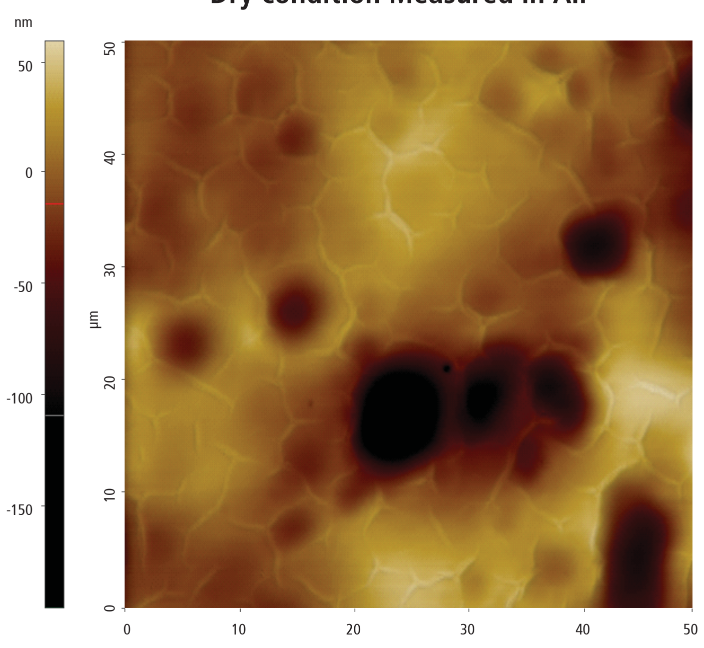
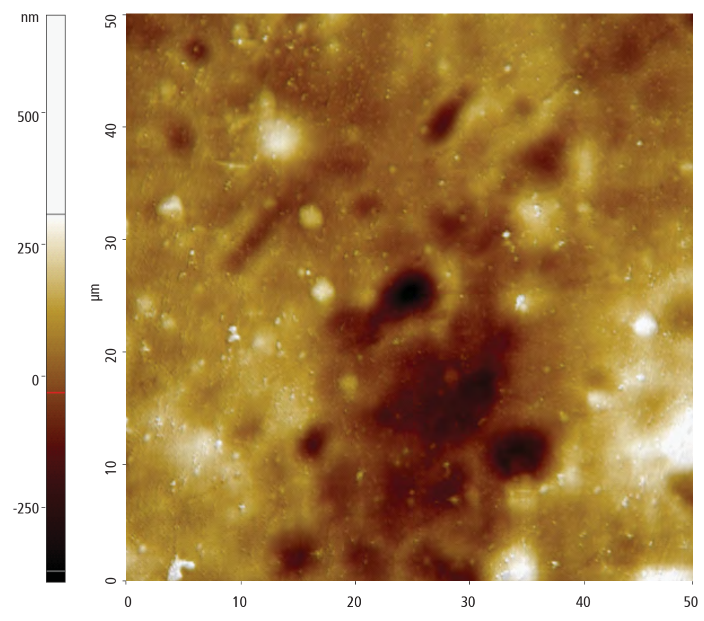
Dry condition Measured in Air



Peak to valley: 260 nm

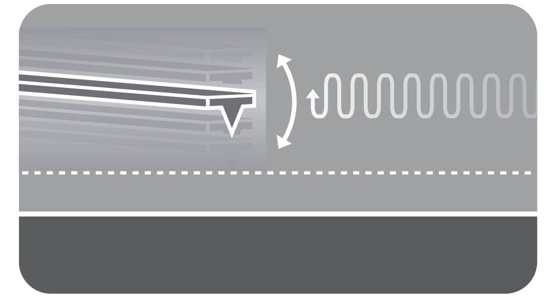
Liquid condition Measured in DI water



Peak to valley: 1077 nm

System: Park NX10
Scan Mode: Non-contact, Liquid
Cantilever: BL-AC40 (k=0.1 N/m, f=110 kHz)
Scan Size: 50 µm × 50 µm
Scan Rate: 1 Hz
Pixel: 512 × 256

Ecoli, Ecoli treated with Cirpofloaxin



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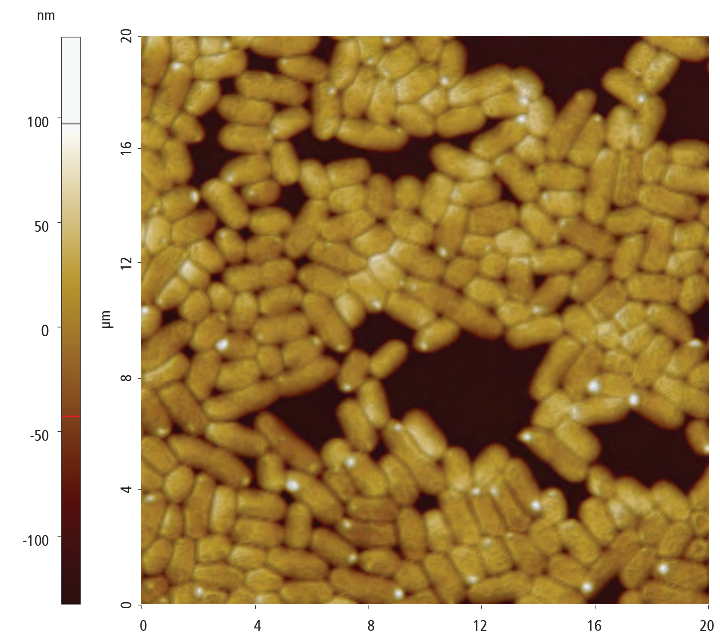
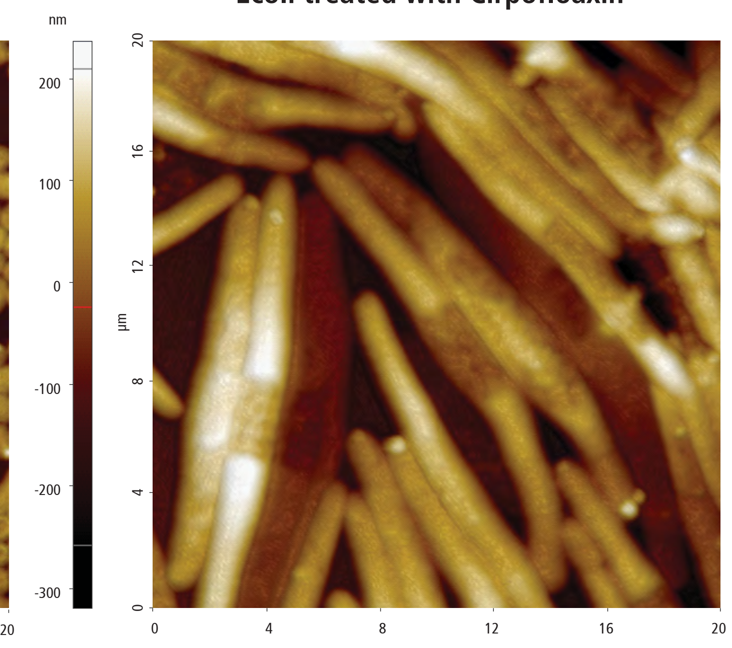
Ecoli



Peak to valley: 274 nm

Ecoli treated with Cirpofloaxin

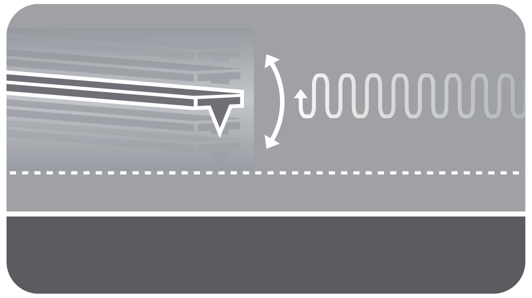


Peak to valley: 557 nm

Sample courtesy: Dr. Ananth Suresh, Monisha M, IISC Bangalore, India

System: Park NX10
Scan Mode: Non-contact
Cantilever: ACTA (k=40N/m, f=300kHz)
Scan Size: 20µm×20µm, 20µm×20µm
Scan Rate: 0.8Hz, 0.5Hz
Pixel: 256×256, 256×256

Red Blood Cell



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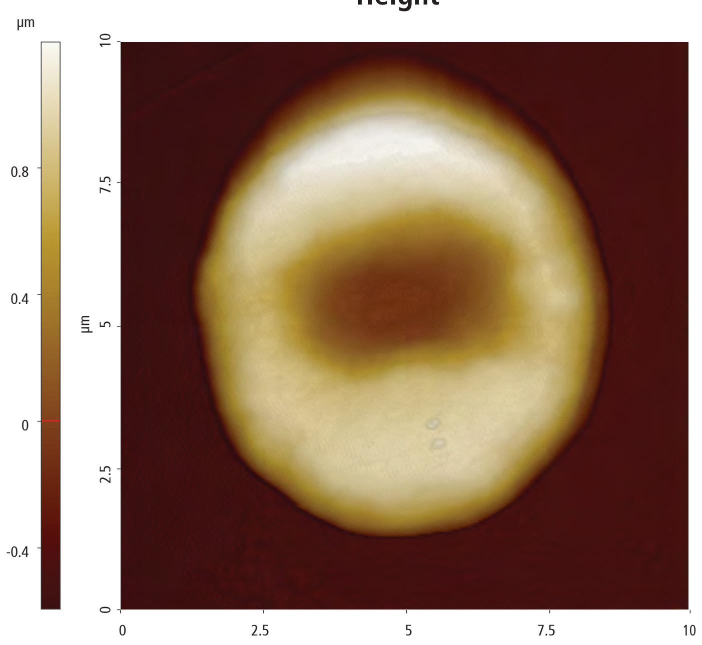
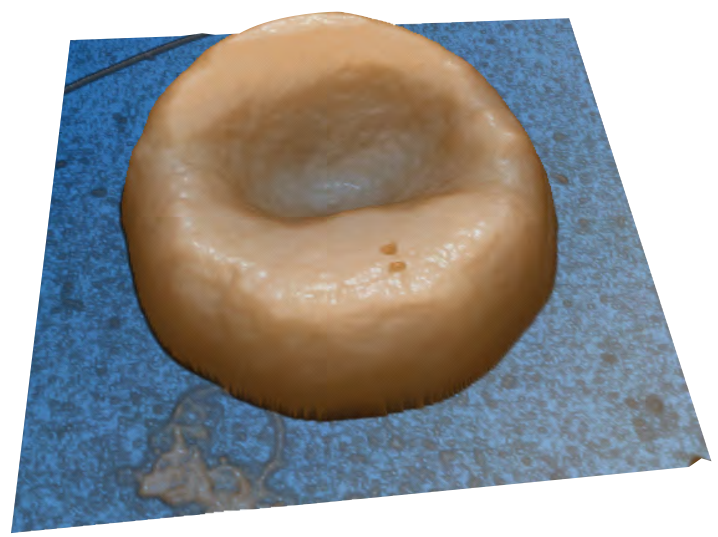
Height



Peak to valley: 1.18 µm

3D (Edge Enhanced color)

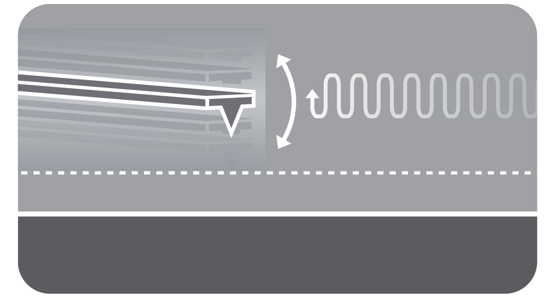


X:Y:Z scale=1:1:1

Sample courtesy: Dr. Ananth Suresh, Monisha M, IISC Bangalore, India

System: Park NX10
Scan Mode: Non-contact
Cantilever: ACTA (k=40 N/m, f=300 kHz)
Scan Size: 10 µm × 10 µm
Scan Rate: 0.5 Hz
Pixel: 256 × 256

DNA, DNA Protein



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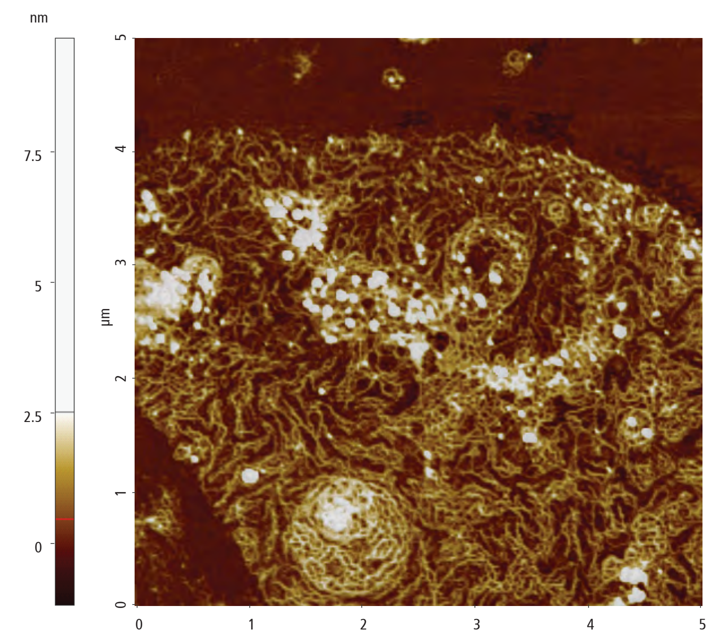
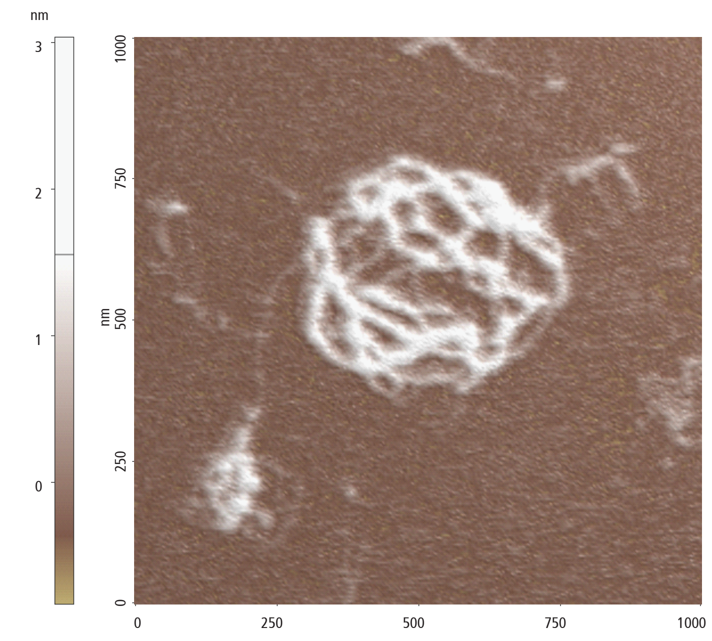
DNA



Peak to valley: 10 nm

DNA Protein

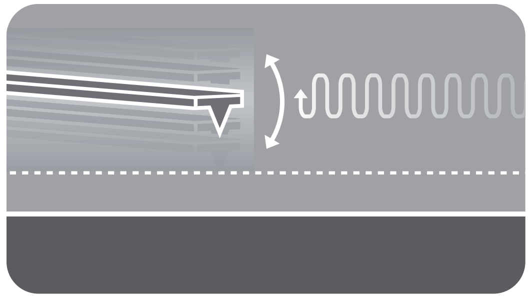


Peak to valley: 3.6 nm

Sample courtesy: Dr. Ananth Suresh, Monisha M, IISC Bangalore, India

System: NX10
Scan Mode: Non-contact
Cantilever: ACTA (k=40N/m, f=300kHz)
Scan Size: 5 µm × 5µm, 1 µm × 1 µm
Scan Rate: 0.5 Hz, 0.8 Hz
Pixel: 256 × 256, 256 × 256

Polyaniline (PANI)



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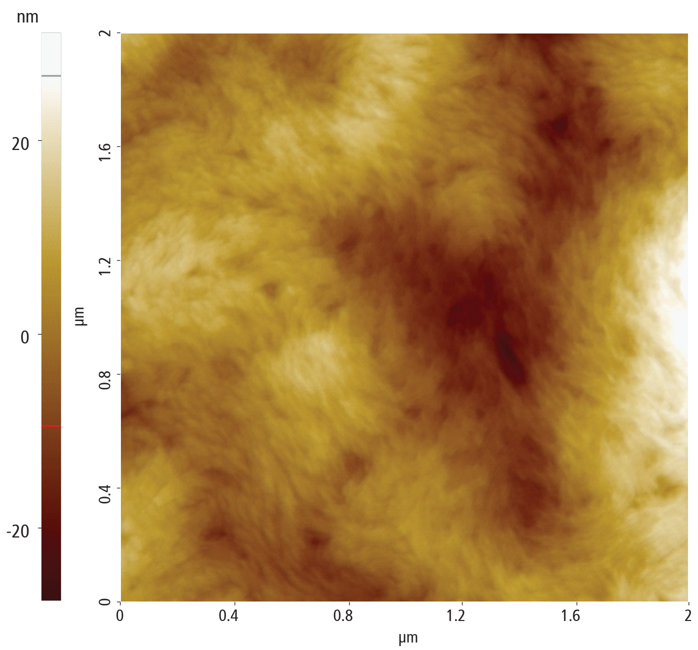
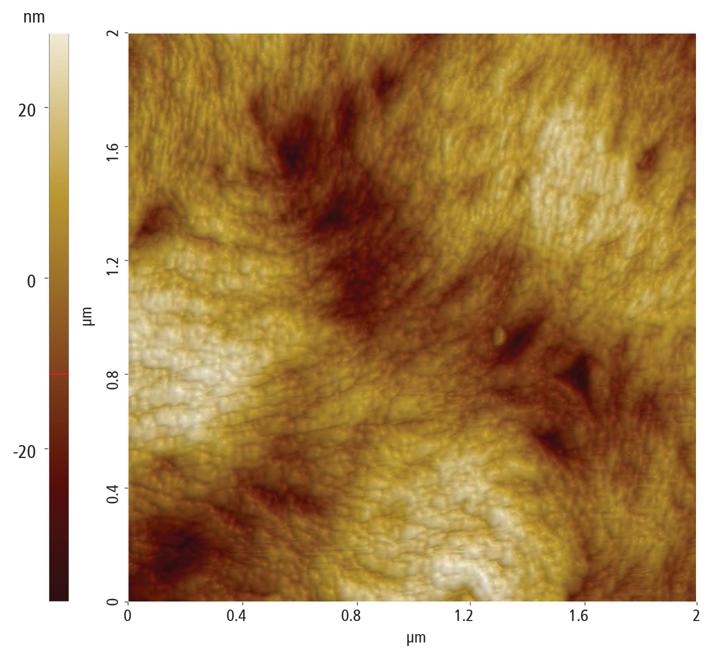
Chloroform 0%



Peak to valley: 60 nm

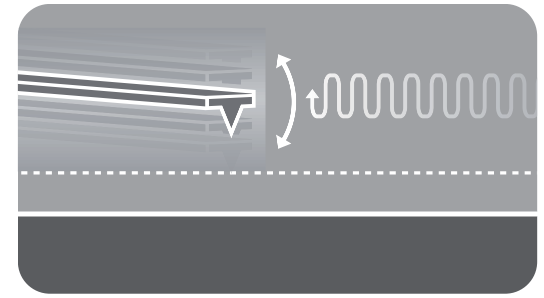
Chloroform 20%



Peak to valley: 66 nm

System: XE7
Scan Mode: Non-contact
Cantilever: NCHR (k=42 N/m, f=300 kHz)
Scan Size: 2 µm × 2 µm
Scan Rate: 0.5 Hz
Pixel: 512 × 512

Styrene beads



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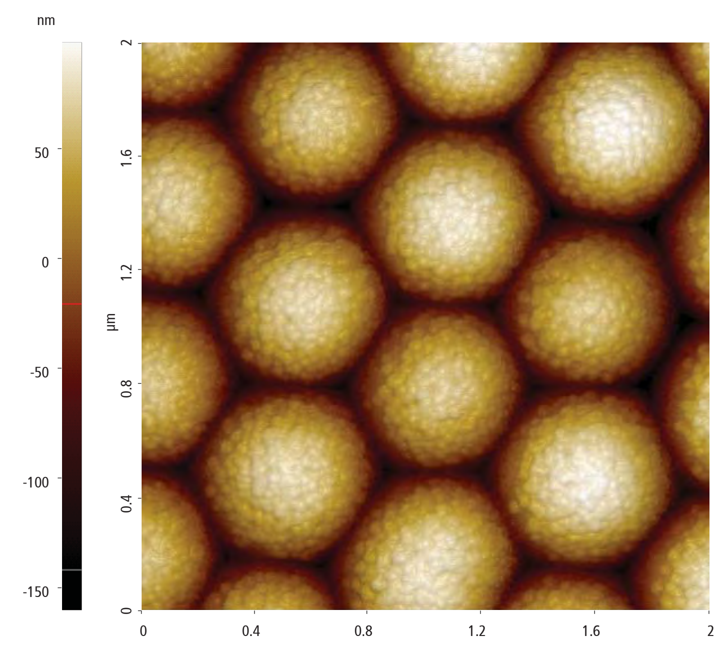
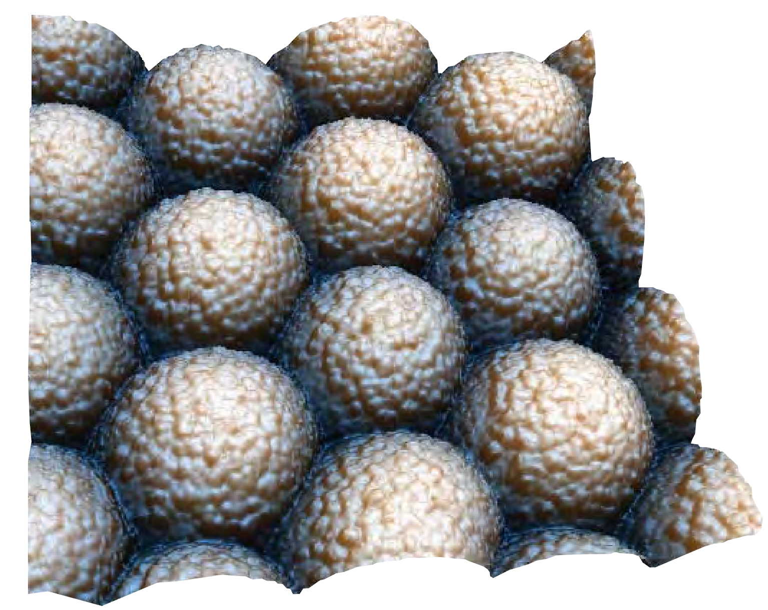
Height



Peak to valley: 267 nm

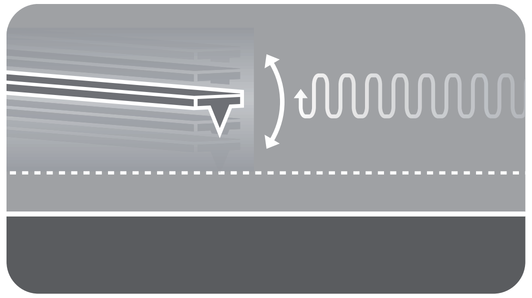
3D (Edge Enhanced color)



X:Y:Z scale = 1:1:1.5

System: Park NX10
Scan Mode: Non-contact
Cantilever: AC160TS (k=26 N/m, f=300 kHz)
Scan Size: 2 µm × 2µm
Scan Rate: 0.5 Hz
Pixel: 512 × 512

Copper Foil



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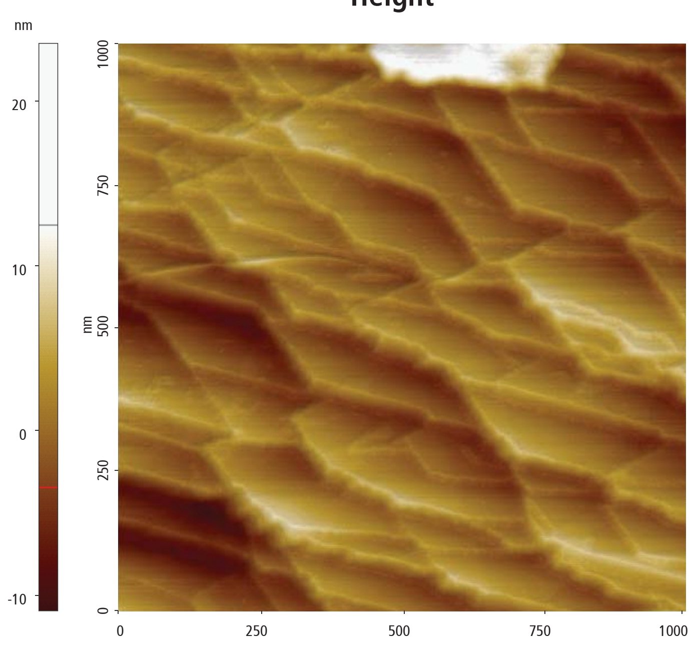
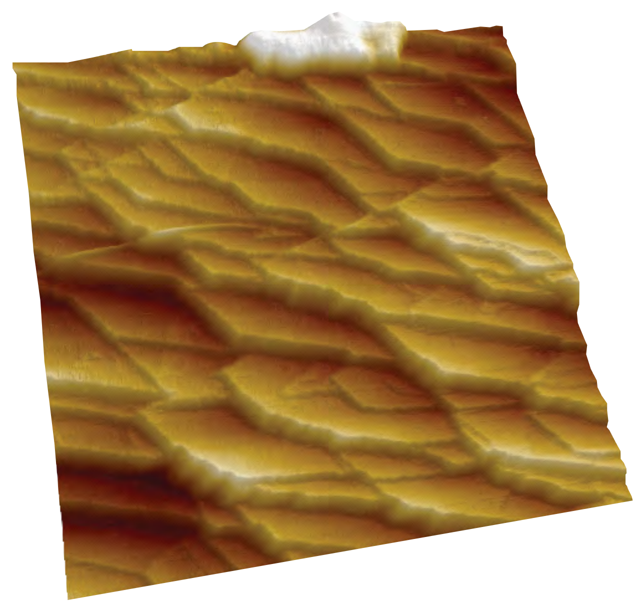


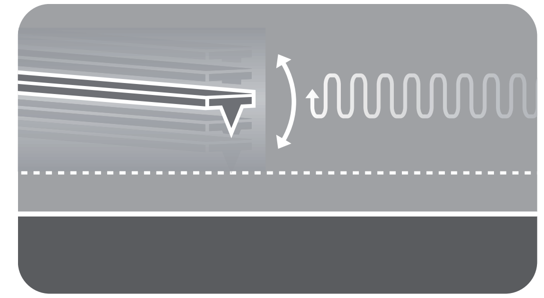
Peak to valley: 34 nm



X:Y:Z scale = 1:1:4

System: Park NX10
Scan Mode: Non-contact
Cantilever: AC160TS (k=26 N/m, f=300 kHz)
Scan Size: 1 μm × 1 μm
Scan Rate: 0.5 Hz
Pixel: 512 × 512

BFO ($BiFeO_3$)



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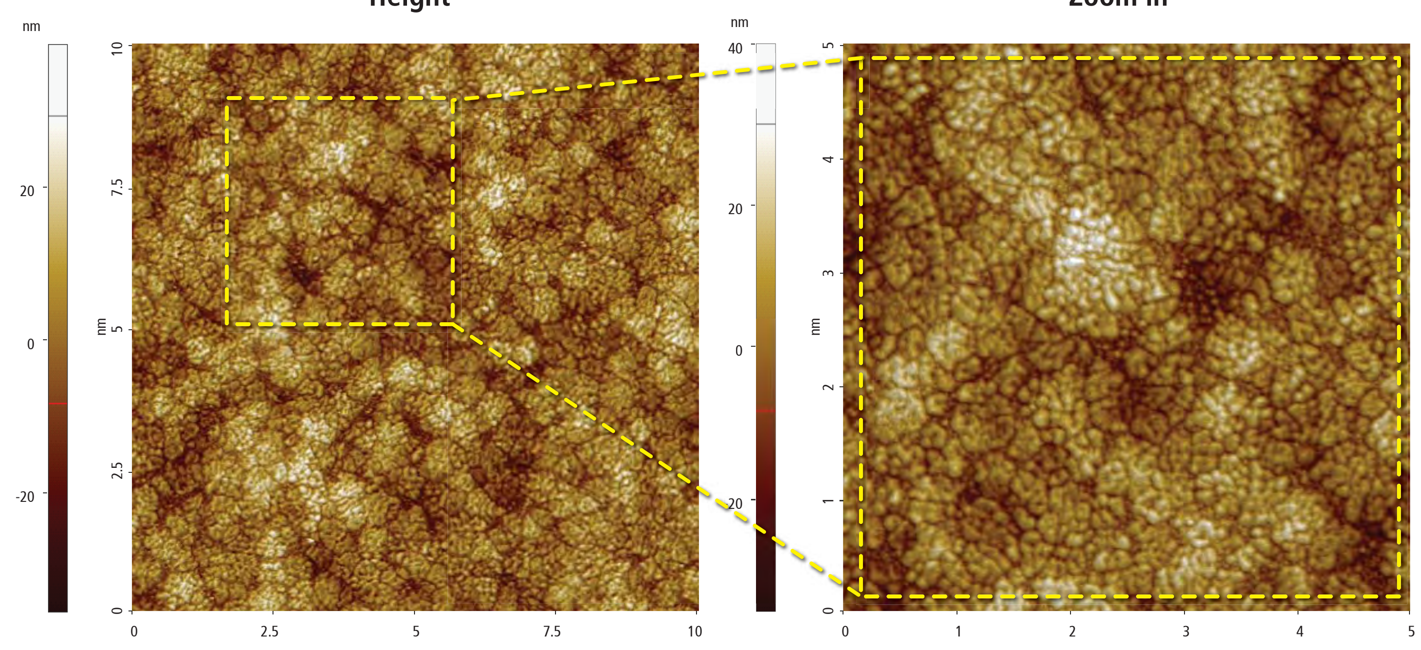


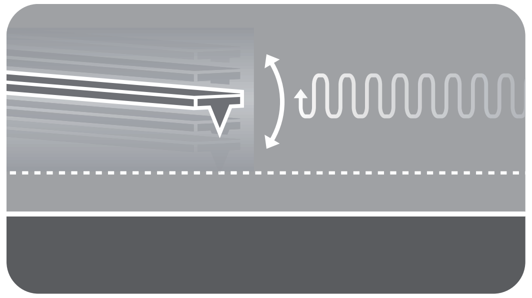
Peak to valley: 80 nm

Peak to valley: 76 nm

Sample courtesy: Dr. Subhajit Nandy, IIT-Chennai, India

System: Park NX10
Scan Mode: Non-contact
Cantilever: AC160TS (k=26 N/m, f=300 kHz)
Scan Size: 10 μm × 10 μm, 5 μm ×5 μm
Scan Rate: 0.8 Hz, 0.8 Hz
Pixel: 512 × 512, 512 × 512

STO ($SrTiO_3$), Annealed LAO ($LaAlO_3$)



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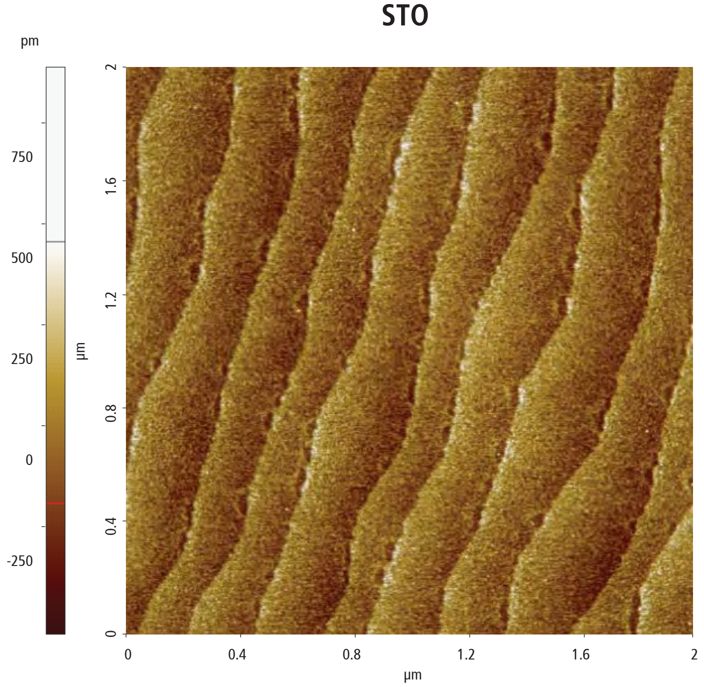
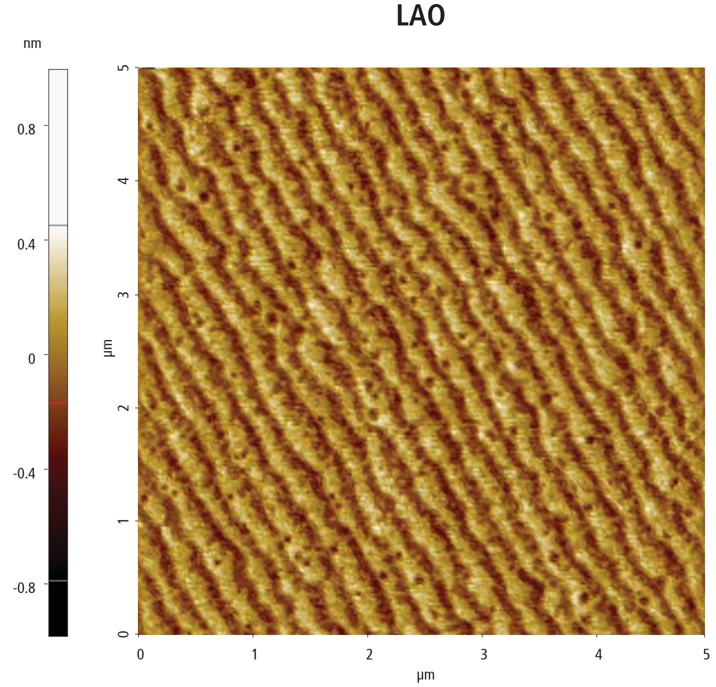
STO



Peak to valley: 1.1 nm

LAO

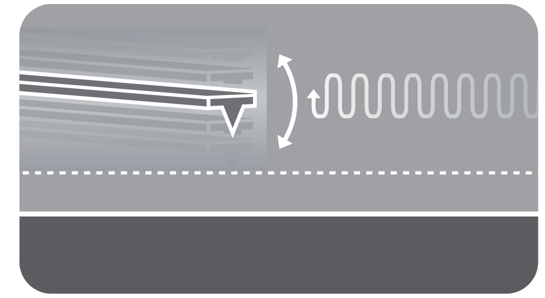


Peak to valley: 2 nm

Sample courtesy: Zhi Shiuh, NUSNNI, Singapore

System: Park NX10
Scan Mode: Non-contact
Cantilever: AC160TS (k=26 N/m, f=300 kHz)
Scan Size: 2 µm × 2 µm, 5 µm × 5 µm
Scan Rate: 0.8 Hz, 0.9 Hz
Pixel: 512 × 512, 256 × 256

$BiVO_4$ on treated YSZ substrate



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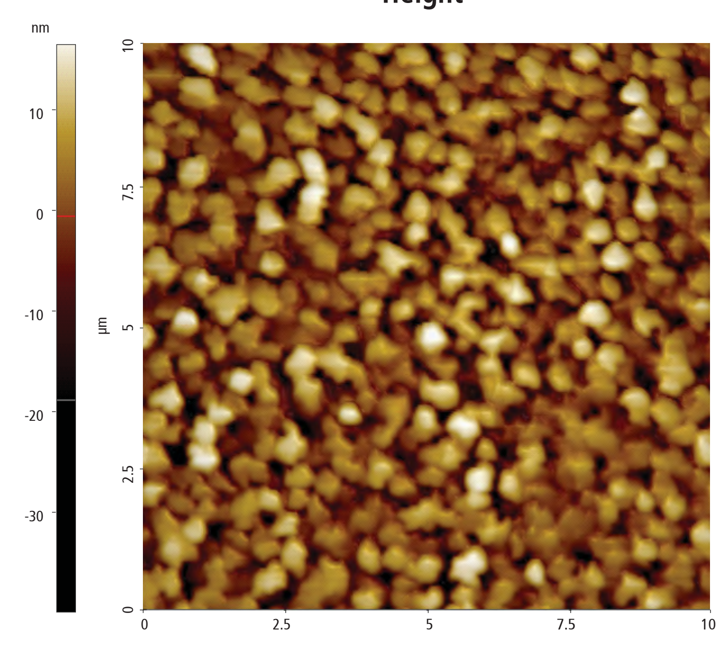
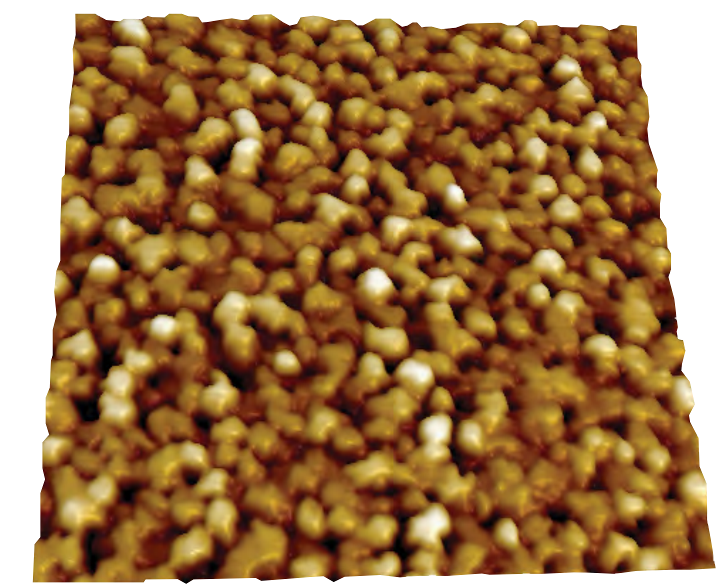
Height



Peak to valley: 55 nm

3D

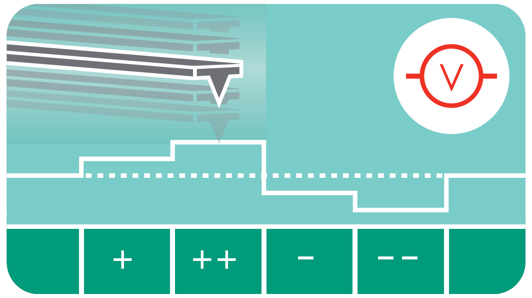


X:Y:Z scale = 1:1:15

Sample courtesy: Zhi Shiuh, NUSNNI, Singapore

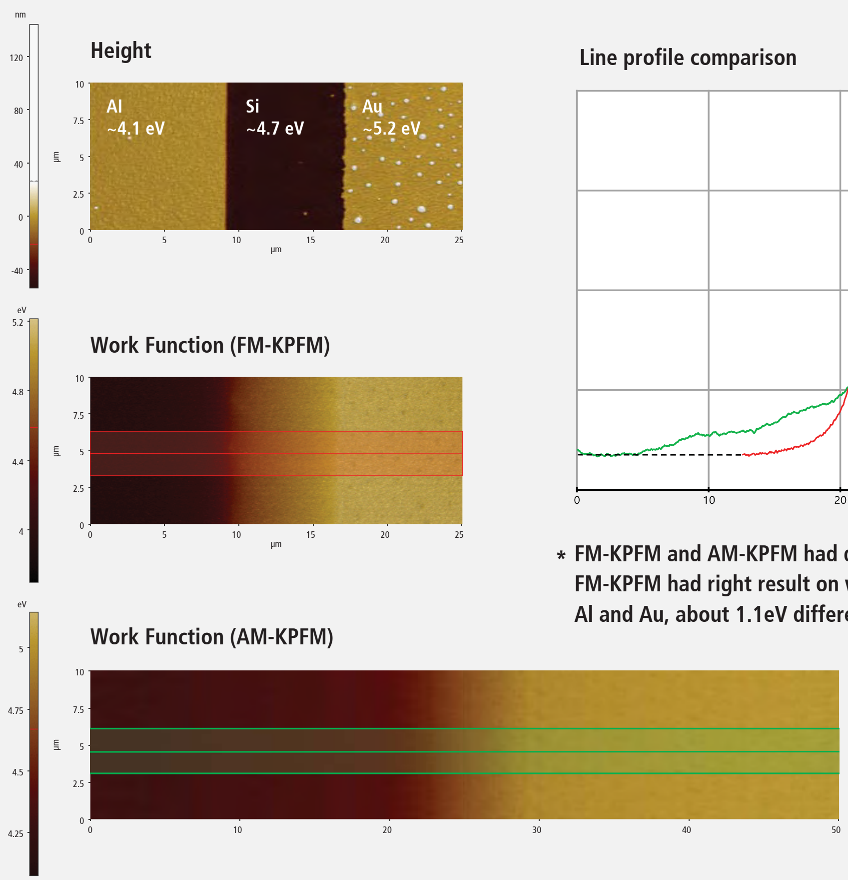
System: Park NX10
Scan Mode: Non-contact
Cantilever: AC160TS (k=26 N/m, f=300 kHz)
Scan Size: 10 µm × 10 µm
Scan Rate: 0.36 Hz
Pixel: 256 × 256

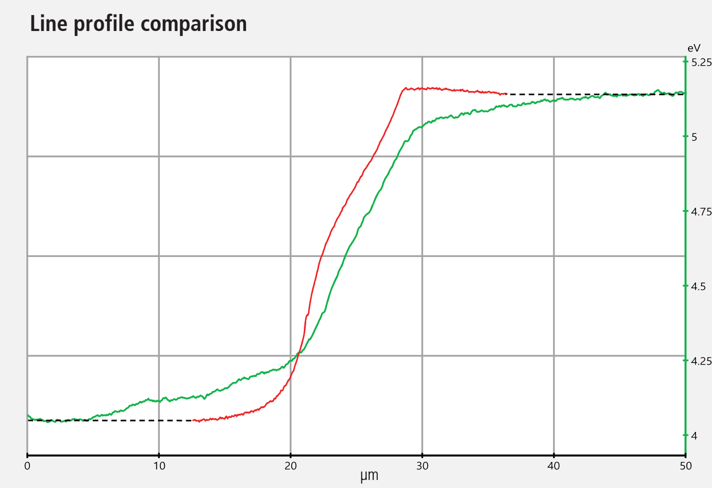
Al-Si-Au



Kelvin Probe Force Microscopy

In Kelvin Probe Force Microscopy (KPFM), the AFM operates in non-contact mode while a conductive cantilever, oscillated at its fundamental resonant frequency, laterally scans over the sample surface. The resulting electrostatic signal provides information related to surface potential and the capacitance gradient. The topographic data is taken by controlling the force between the tip and the sample.

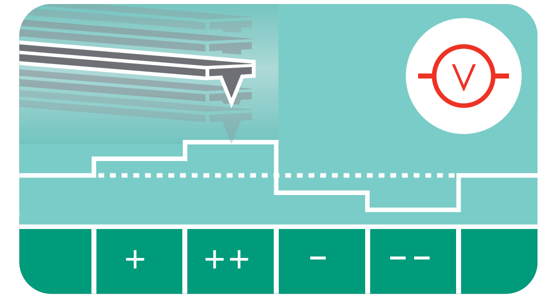




* FM-KPFM and AM-KPFM had different work function range. FM-KPFM had right result on work function difference between Al and Au, about 1.1eV differences.

System: Park NX10
Scan Mode: KPFM
Cantilever: NSC36Cr-Au A (k=1 N/m, f=90 kHz)
Scan Size: 25 µm × 10 µm, 50 µm x 10 µm
Scan Rate: 0.2 Hz, 0.2 Hz
Pixel: 512 × 256, 1024 x 256

HOPG



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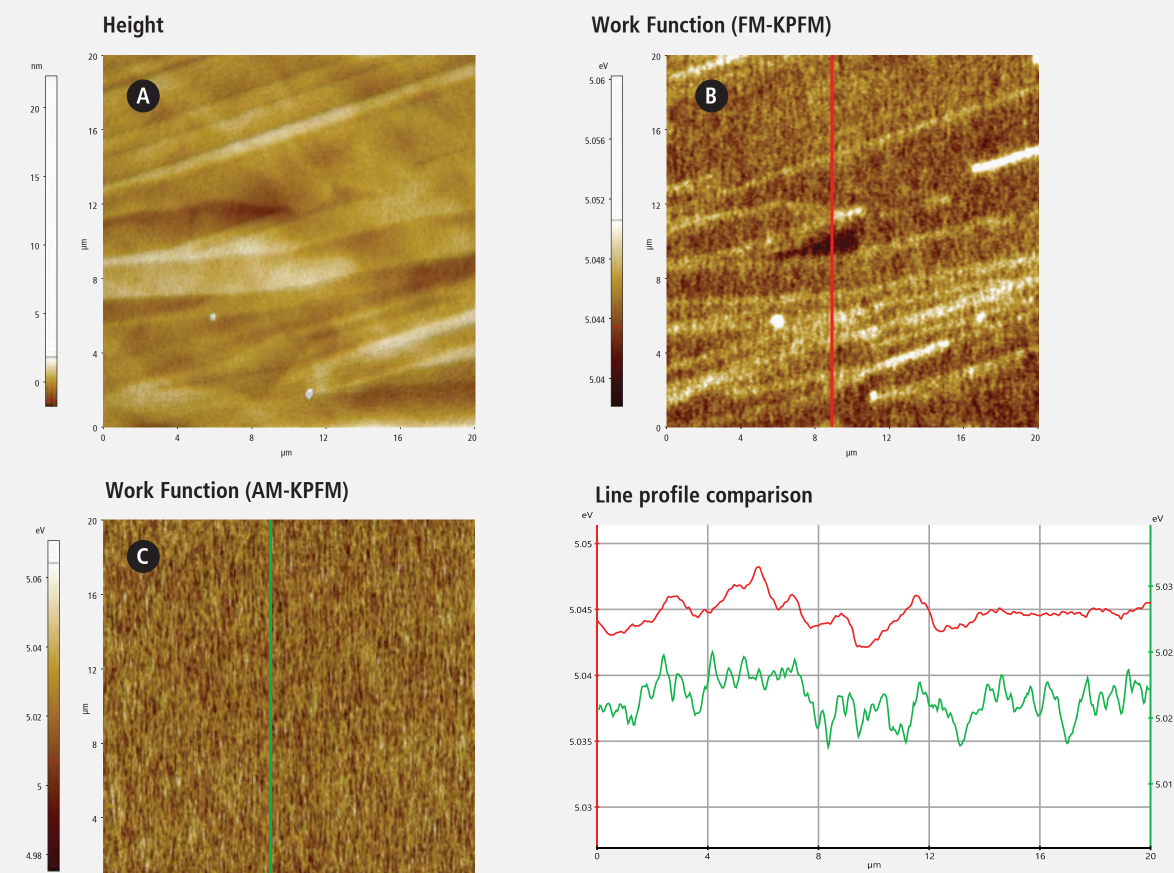
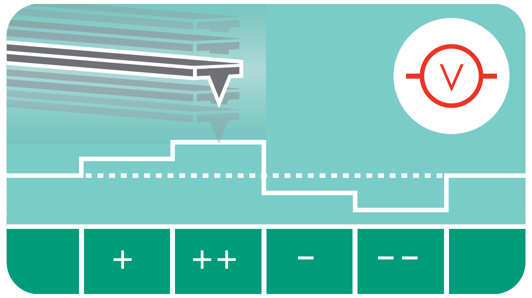


*FM-KPFM detected different work function depending on the layer.

- **A** Peak to valley: 26 nm
- **B** Peak to valley: 374 mV
- **C** Peak to valley: 130 mV

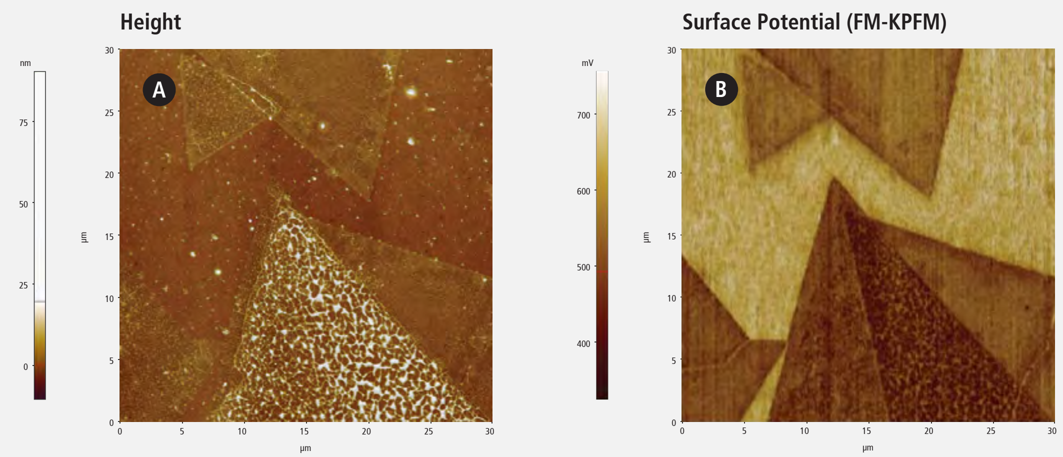
System: Park NX10
Scan Mode: KPFM
Cantilever: NSC36Cr-Au B (k=2N/m, f=130 kHz)
Scan Size: 20 µm × 20 µm
Scan Rate: 0.2 Hz
Pixel: 256 × 512

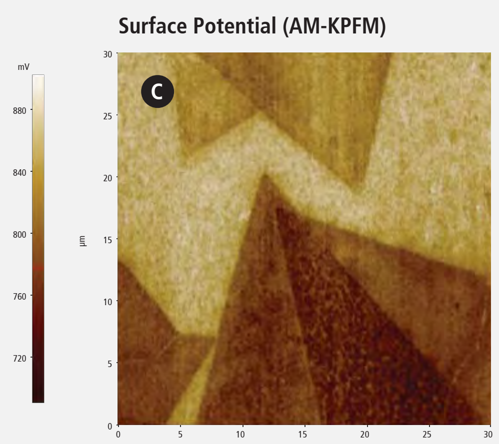
MoS_2



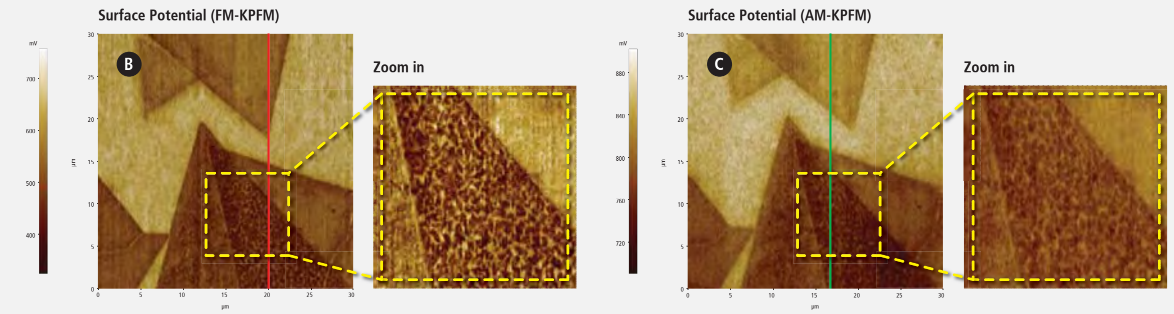
Kelvin Probe Force Microscopy

In Kelvin Probe Force Microscopy (KPFM), the AFM operates in non-contact mode while a conductive cantilever, oscillated at its fundamental resonant frequency, laterally scans over the sample surface. The resulting electrostatic signal provides information related to surface potential and the capacitance gradient. The topographic data is taken by controlling the force between the tip and the sample.

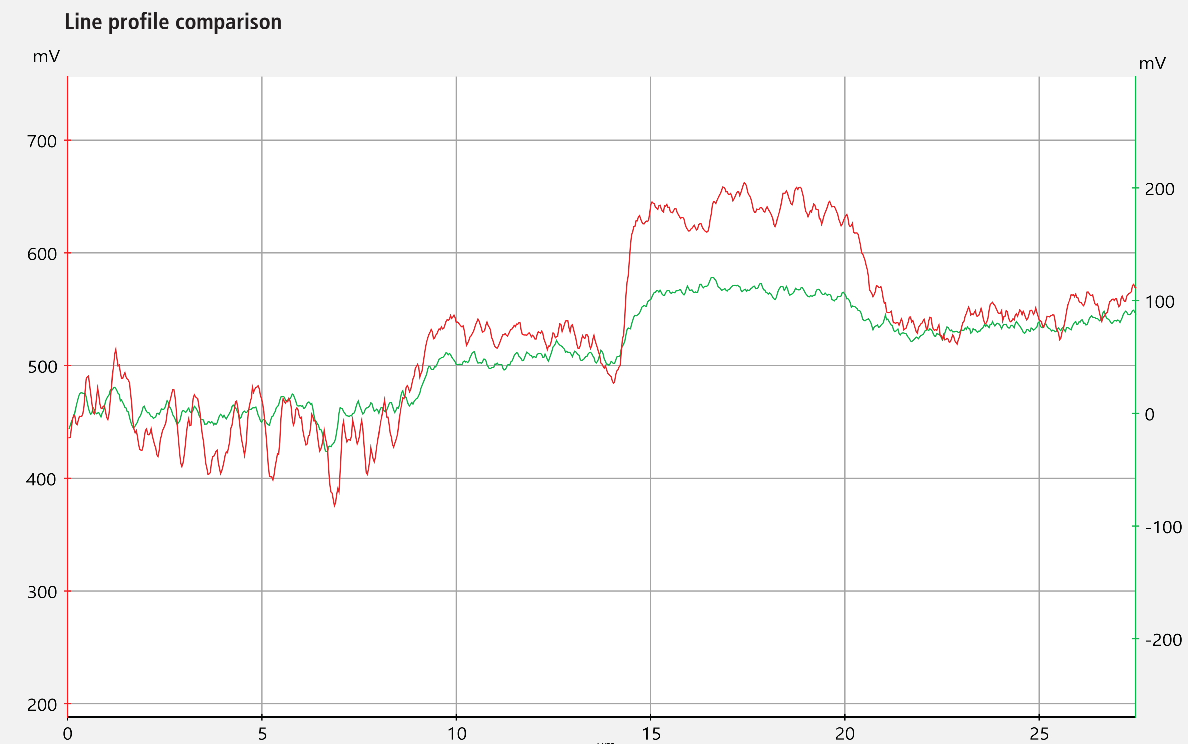




- (A) Peak to valley: 112 nm
- (B) Peak to valley: 493 mV
- (C) Peak to valley: 233 mV



* Comparison with same data color scale; 200 mV color scale

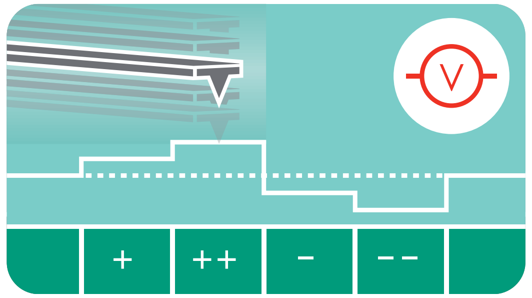


* FM-KPFM has better performance on both detailed features and absolute potential measurements.

System: Park NX10
Scan Mode: KPFM
Cantilever: NSC36Cr-Au A (k=1 N/m, f=90 kHz)
Scan Size: 30 µm × 30 µm
Scan Rate: 0.1 Hz
Pixel: 512 × 1024

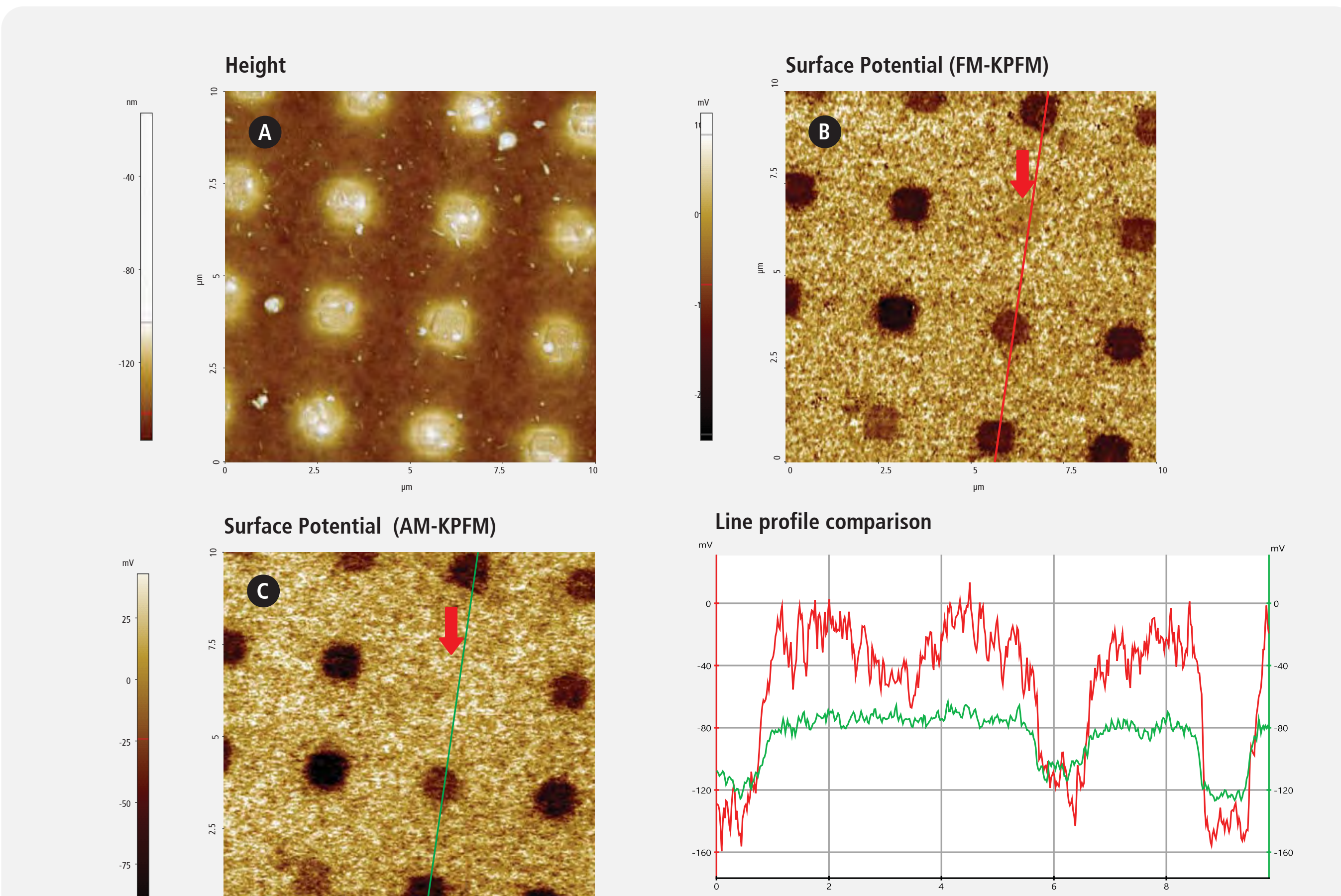
System: Park NX10
Scan Mode: KPFM
Cantilever: NSC36Cr-Au A (k=1 N/m, f=90 kHz)
Scan Size: 30 µm × 30 µm, 10 µm × 10 µm
Scan Rate: 0.1 Hz
Pixel: 512 × 1024

Polymer patterns on Si



Kelvin Probe Force Microscopy

In Kelvin Probe Force Microscopy (KPFM), the AFM operates in non-contact mode while a conductive cantilever, oscillated at its fundamental resonant frequency, laterally scans over the sample surface. The resulting electrostatic signal provides information related to surface potential and the capacitance gradient. The topographic data is taken by controlling the force between the tip and the sample.

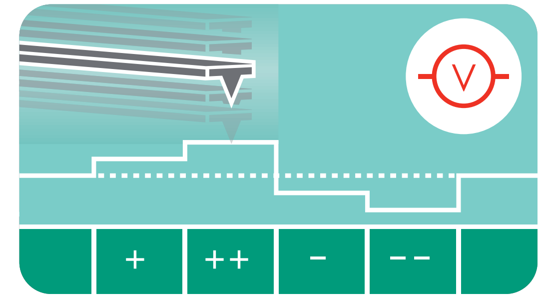


* FM-KPFM detected clear edge of the patterns and feature with weak potential while AM-KPFM didn't.

System: Park NX10
Scan Mode: KPFM
Cantilever: NSC36Cr-Au A (k=1 N/m, f=90 kHz)
Scan Size: 10 µm × 10 µm
Scan Rate: 0.2 Hz
Pixel: 512 × 256

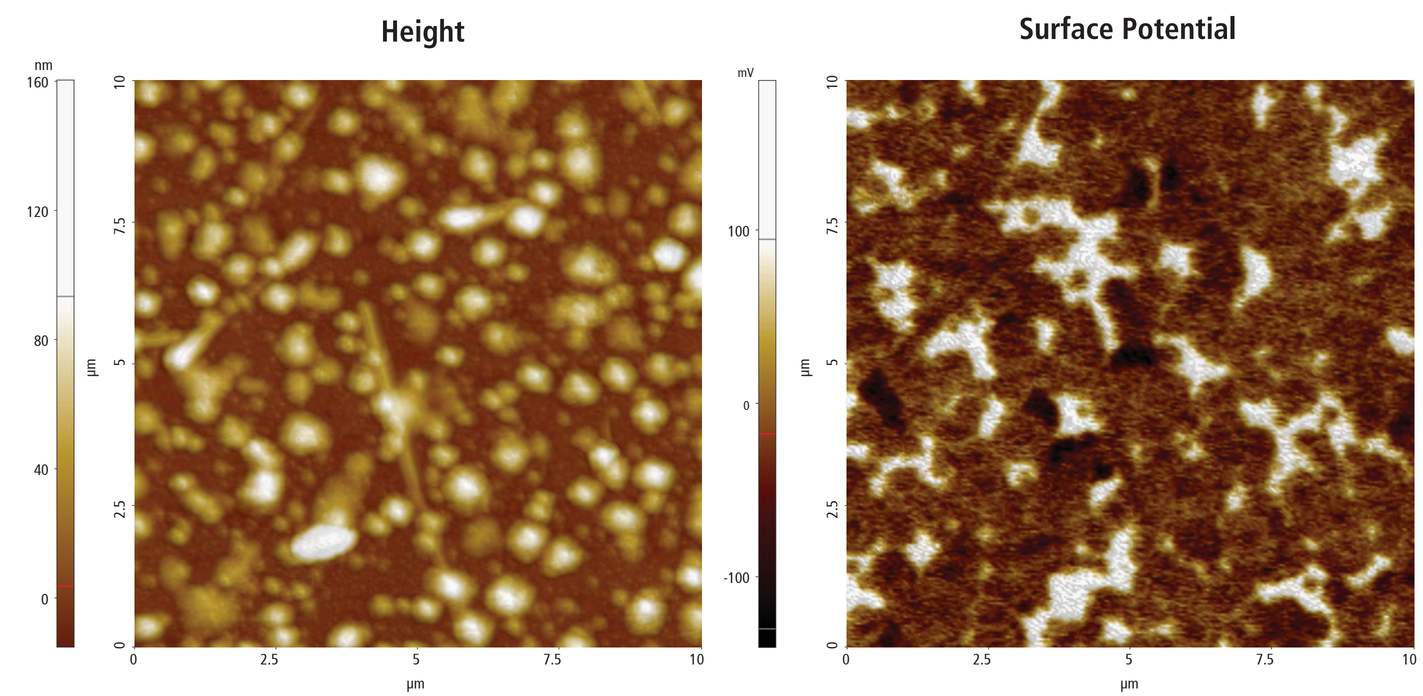
- A Peak to valley: 150 nm
- B Peak to valley: 374 mV
- C Peak to valley: 130 mV

HfO_2



Kelvin Probe Force Microscopy

In Kelvin Probe Force Microscopy (KPFM), the AFM operates in non-contact mode while a conductive cantilever, oscillated at its fundamental resonant frequency, laterally scans over the sample surface. The resulting electrostatic signal provides information related to surface potential and the capacitance gradient. The topographic data is taken by controlling the force between the tip and the sample.



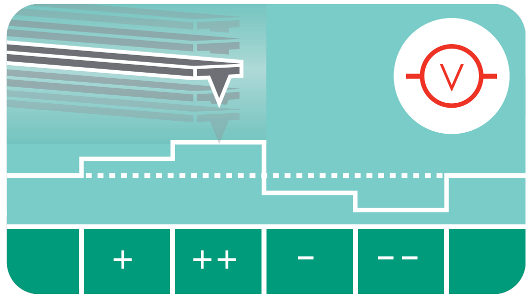
Peak to valley: 174 nm

Peak to valley: 331 mV

Sample courtesy: Zhi Shiuh, NUSNNI, Singapore

System: Park NX10
Scan Mode: AM-KPFM
Cantilever: ElectriMulti75 (k=3 N/m, f=75 kHz)
Scan Size: 10 µm × 10 µm
Scan Rate: 0.5 Hz
Pixel: 256 × 256

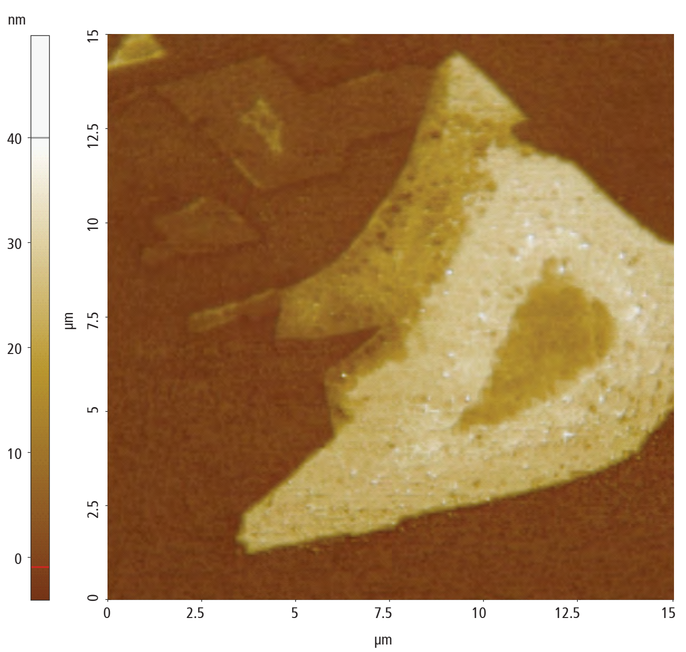
MoS_2



Kelvin Probe Force Microscopy

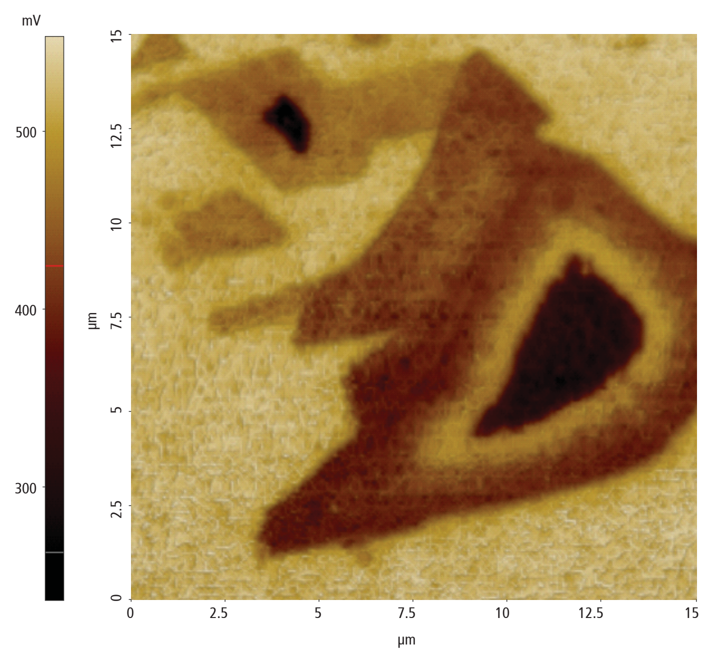
In Kelvin Probe Force Microscopy (KPFM), the AFM operates in non-contact mode while a conductive cantilever, oscillated at its fundamental resonant frequency, laterally scans over the sample surface. The resulting electrostatic signal provides information related to surface potential and the capacitance gradient. The topographic data is taken by controlling the force between the tip and the sample.

Height



Peak to valley: 54 nm

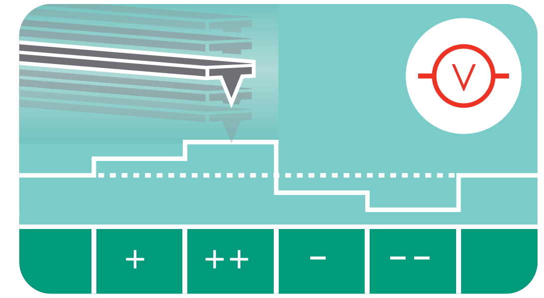
Surface Potential



Peak to valley: 353 mV

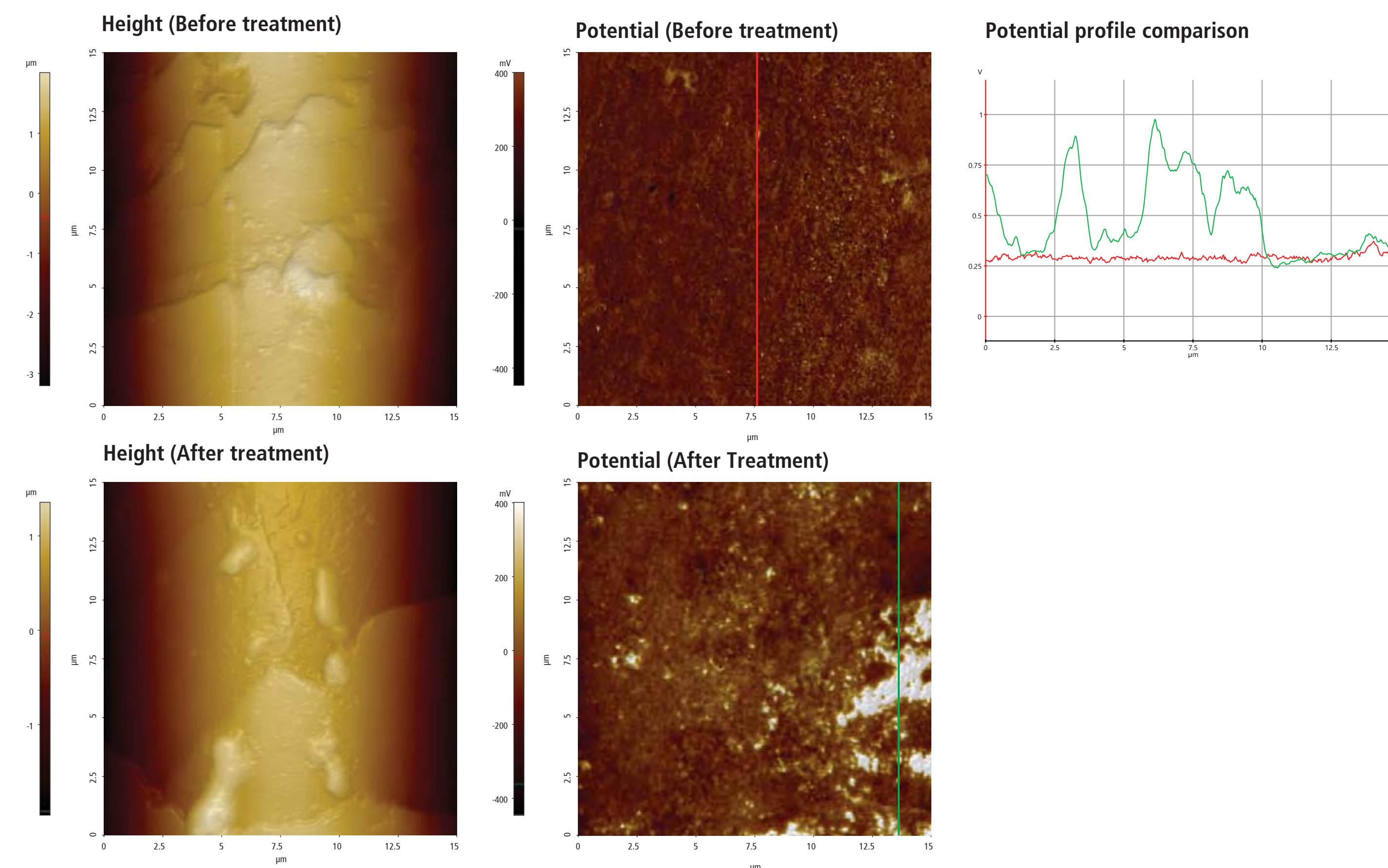
System: Park NX20
Scan Mode: AM-KPFM
Cantilever: NSC36Cr-Au C (k=0.6 N/m, f=65 kHz)
Scan Size: 15 µm × 15 µm
Scan Rate: 0.3 Hz
Pixel: 512 × 256

Hair



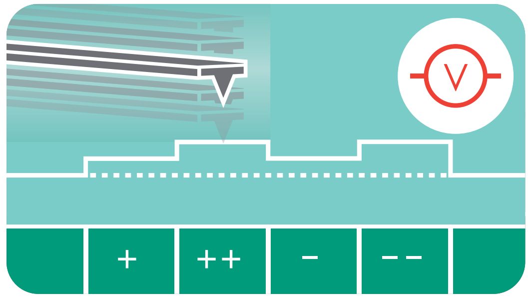
Kelvin Probe Force Microscopy

In Kelvin Probe Force Microscopy (KPFM), the AFM operates in non-contact mode while a conductive cantilever, oscillated at its fundamental resonant frequency, laterally scans over the sample surface. The resulting electrostatic signal provides information related to surface potential and the capacitance gradient. The topographic data is taken by controlling the force between the tip and the sample.



System: Park NX10
Scan Mode: AM-KPFM
Cantilever:NSC36Cr-Au C (k=0.6 N/m, f=65 kHz)
Scan Size: 15 µm × 15 µm
Scan Rate: 0.3 Hz
Pixel: 512 × 256

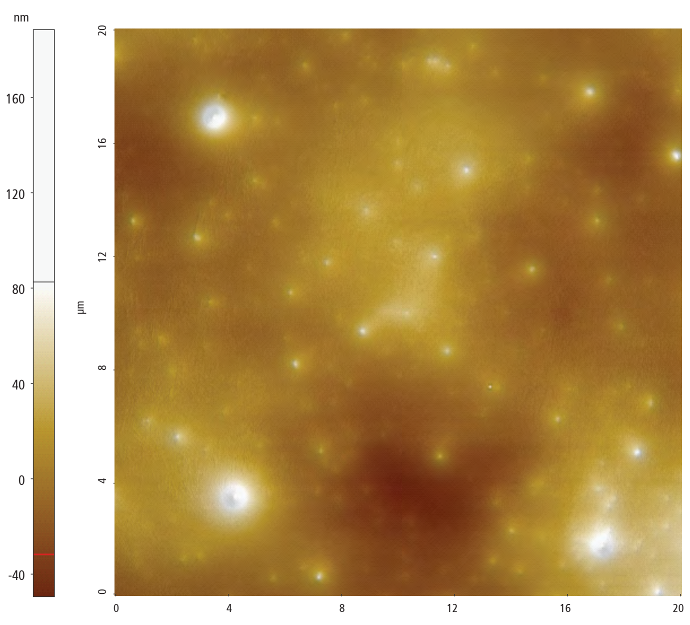
Phthalocyanine praseodymium



Electrostatic Force Microscopy

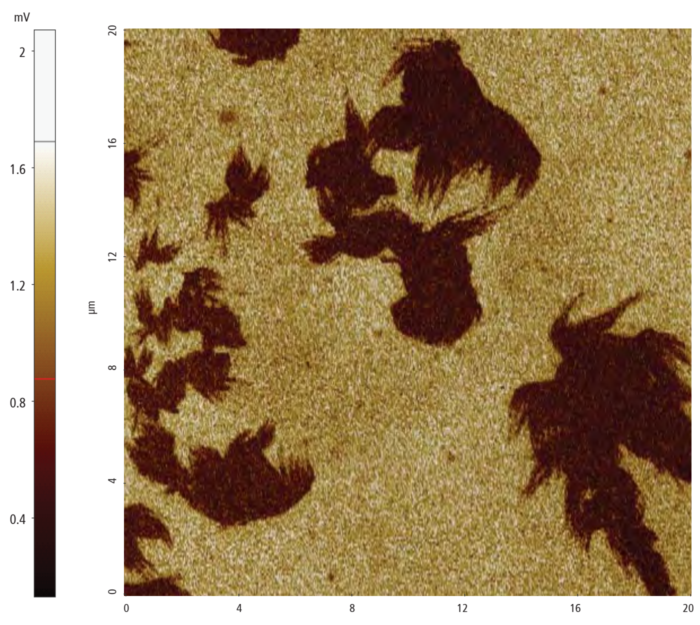
Electrostatic Force Microscopy (EFM) probes ferroelectric regions of a sample surface with a conductive cantilever. An EFM image is the result of two separate scans: one scan probes the topography, while in the other the cantilever is raised away from the surface to the region where long-range, electrostatic force begins to dominate. In this electrostatic domain, the attractive and repulsive deflections of the cantilever correspond to regions of positive and negative charge on a sample surface. EFM gives users an image that couples topography with the electrical properties of a nanoscale region.

Height



Peak to valley: 232 nm

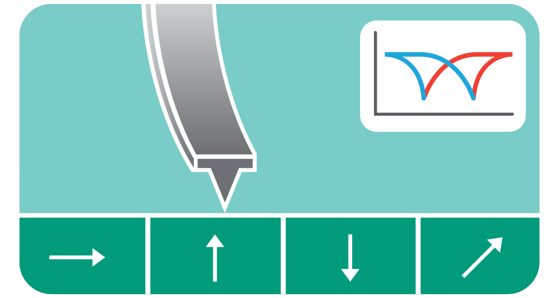
EFM Amplitude



Peak to valley: 2 mV

System: Park NX10
Scan Mode: EFM
Cantilever: PPP-EFM (k=2.8 N/m, f=75 kHz)
Scan Size: 20 µm × 20 µm
Scan Rate: 0.3 Hz
Pixel: 1024 × 256

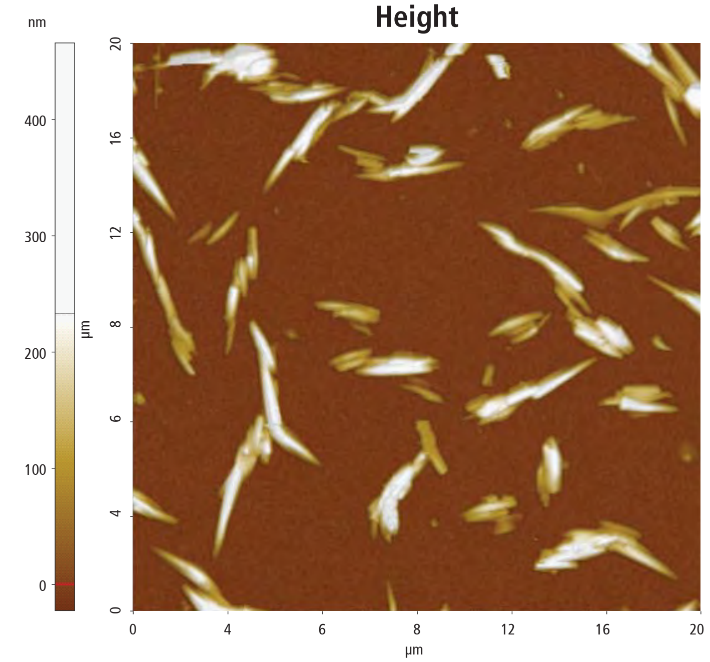
Annealed Phenanthrene



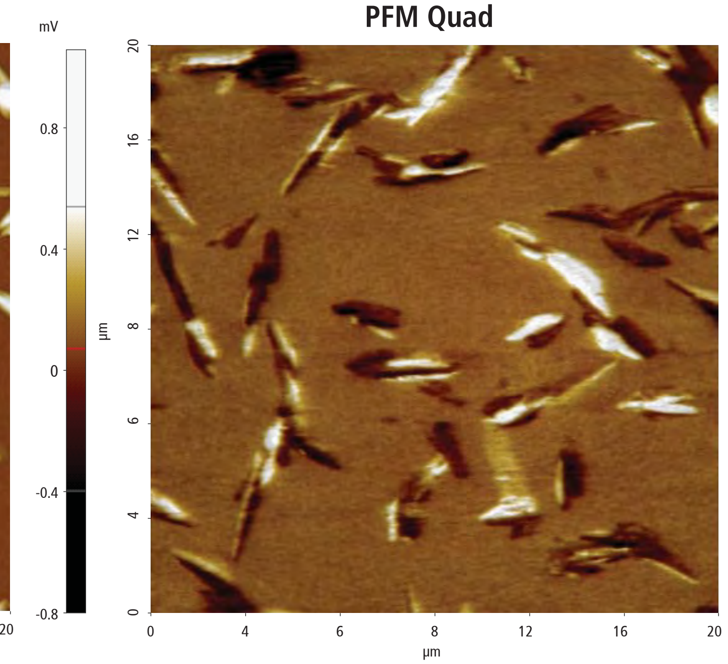
Piezoelectric Force Microscopy

PFM utilizes a lock-in amplifier to study the electrical properties and topography of a piezo sample surface in a single scan. Here, the cantilever is biased with an AC current different than the resonance of the cantilever. The oscillation component of the PSPD signal is extracted by the lock-in amplifier, resulting in the PFM signal.

Height

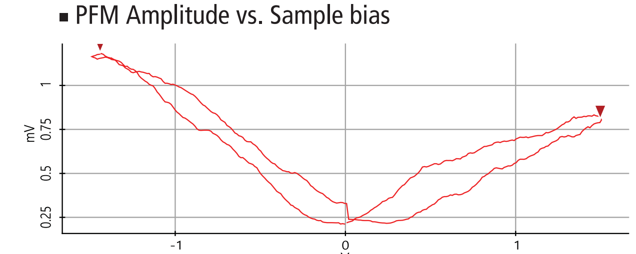


PFM Quad



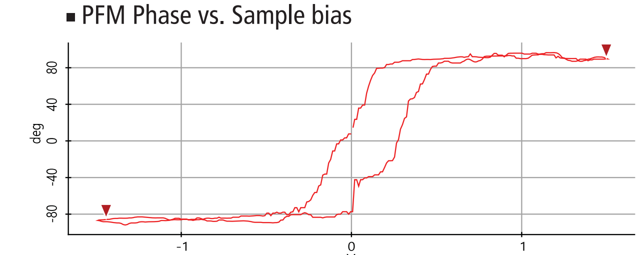
Piezo Response curve

- PFM Amplitude vs. Sample bias



Sample bias sweep: 0 V → +1.5 V → -1.5 V → 0 V

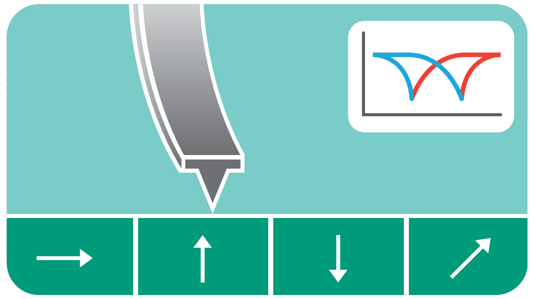
- PFM Phase vs. Sample bias



Sample bias sweep: 0 V → +1.5 V → -1.5 V → 0 V

System: Park NX10
Scan Mode: PFM with Pinpoint mode
Cantilever: PPP-EFM (k=2.8 N/m, f=75 kHz)
Scan Size: 20 µm × 20 µm
Scan Rate: 0.3 Hz
Pixel: 512 × 256

BFO ($BiFeO_3$)



Piezoelectric Force Microscopy

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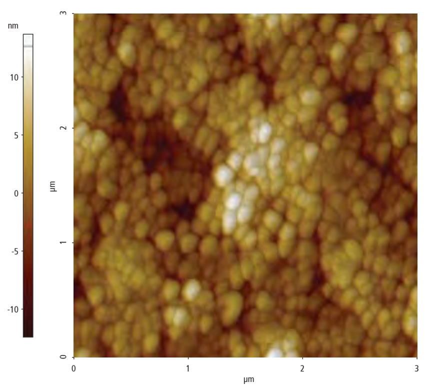
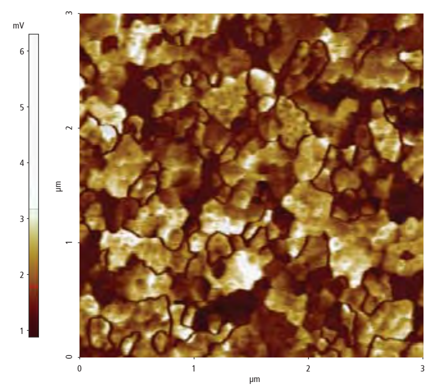
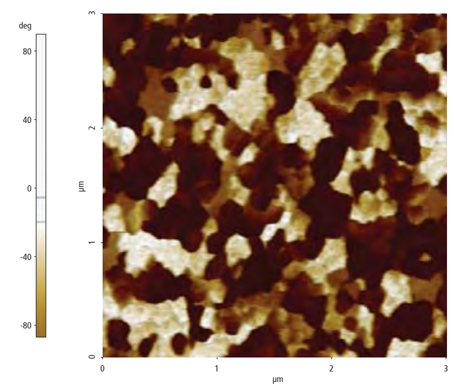
Height



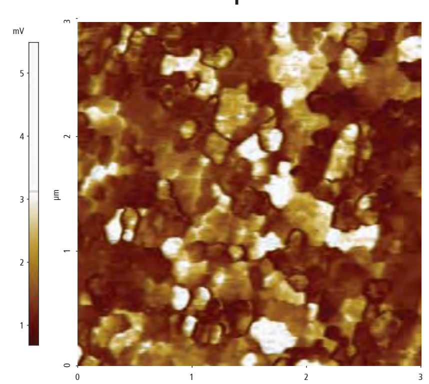
Vertical PFM Amplitude



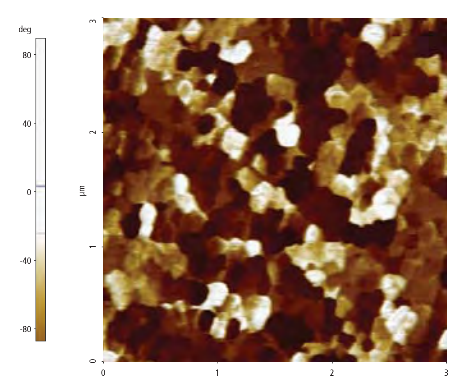
Vertical PFM Phase



Lateral PFM Amplitude



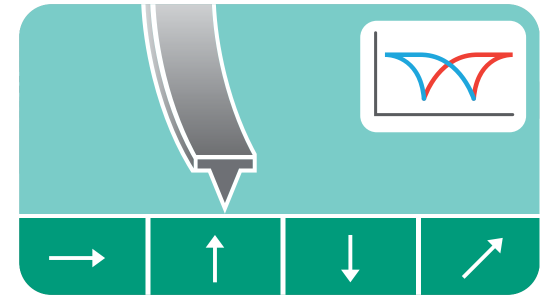
Lateral PFM Phase



Sample courtesy: Dr. Subhajit Nandy, IIT-Chennai, India

System: Park NX10
Scan Mode: PFM
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 3 µm × 3 µm
Scan Rate: 0.5 Hz
Pixel: 512 × 512

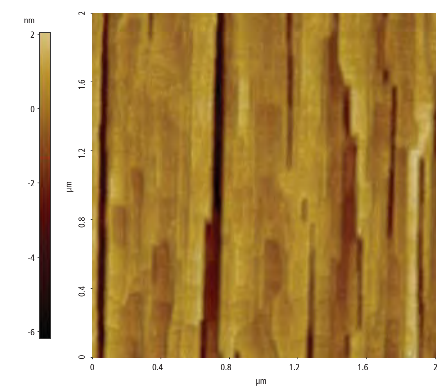
BFO ($BiFeO_3$)



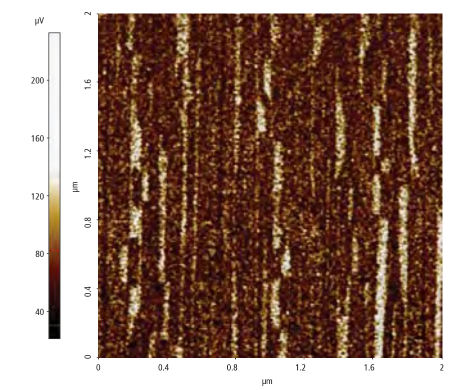
Piezoelectric Force Microscopy

PFM utilizes a lock-in amplifier to study the electrical properties and topography of a piezo sample surface in a single scan. Here, the cantilever is biased with an AC current different than the resonance of the cantilever. The oscillation component of the PSPD signal is extracted by the lock-in amplifier, resulting in the PFM signal.

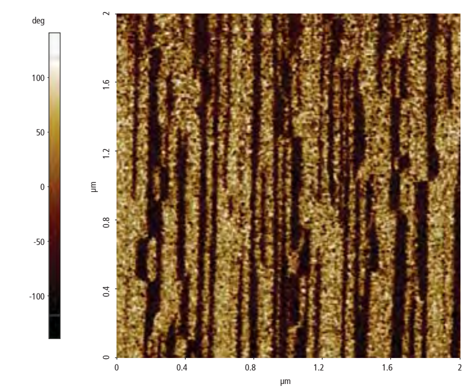
Height



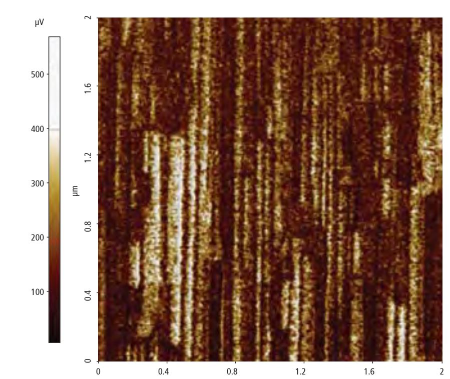
Vertical PFM Amplitude



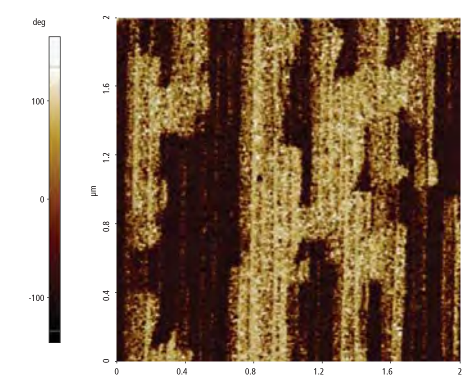
Vertical PFM Phase



Lateral PFM Amplitude

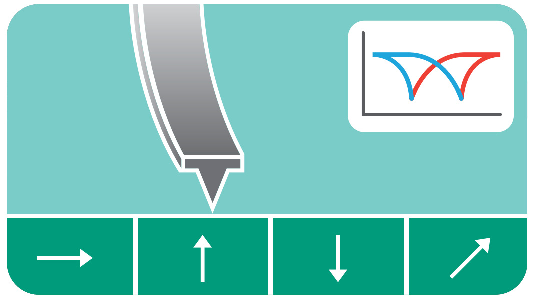


Lateral PFM Phase



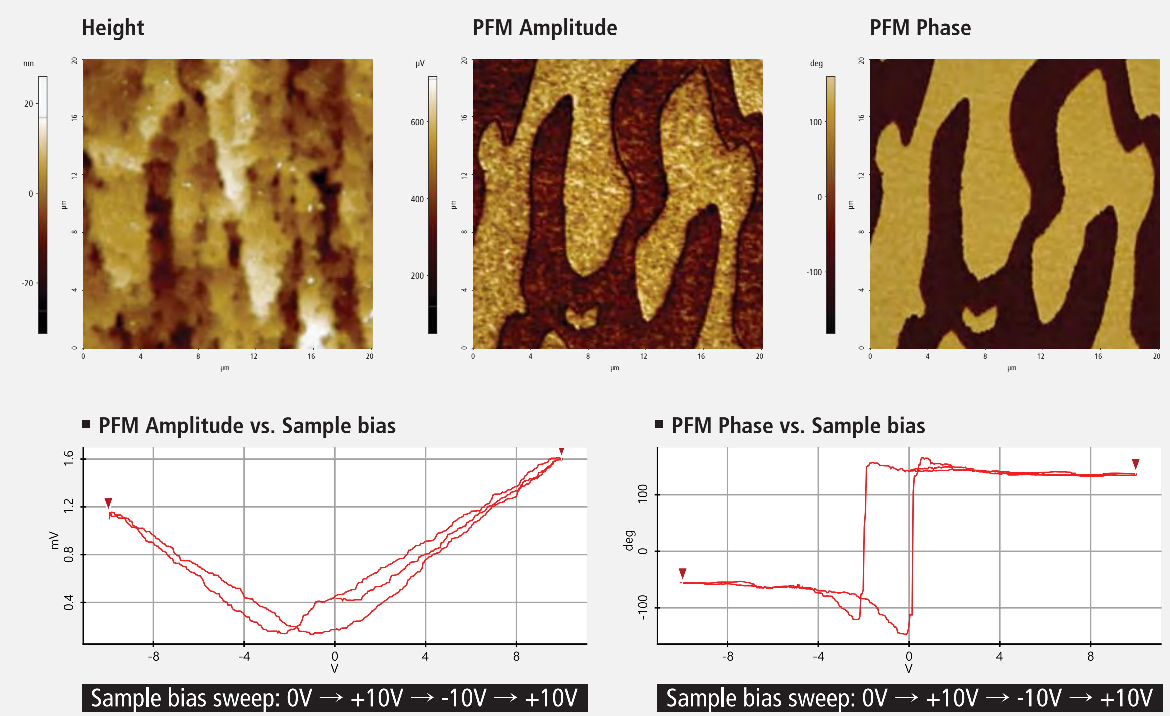
System: Park NX10
Scan Mode: PFM
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 2 µm × 2 µm
Scan Rate: 0.2 Hz
Pixel: 256 × 256

DLaTGS Pyroelectric detectors



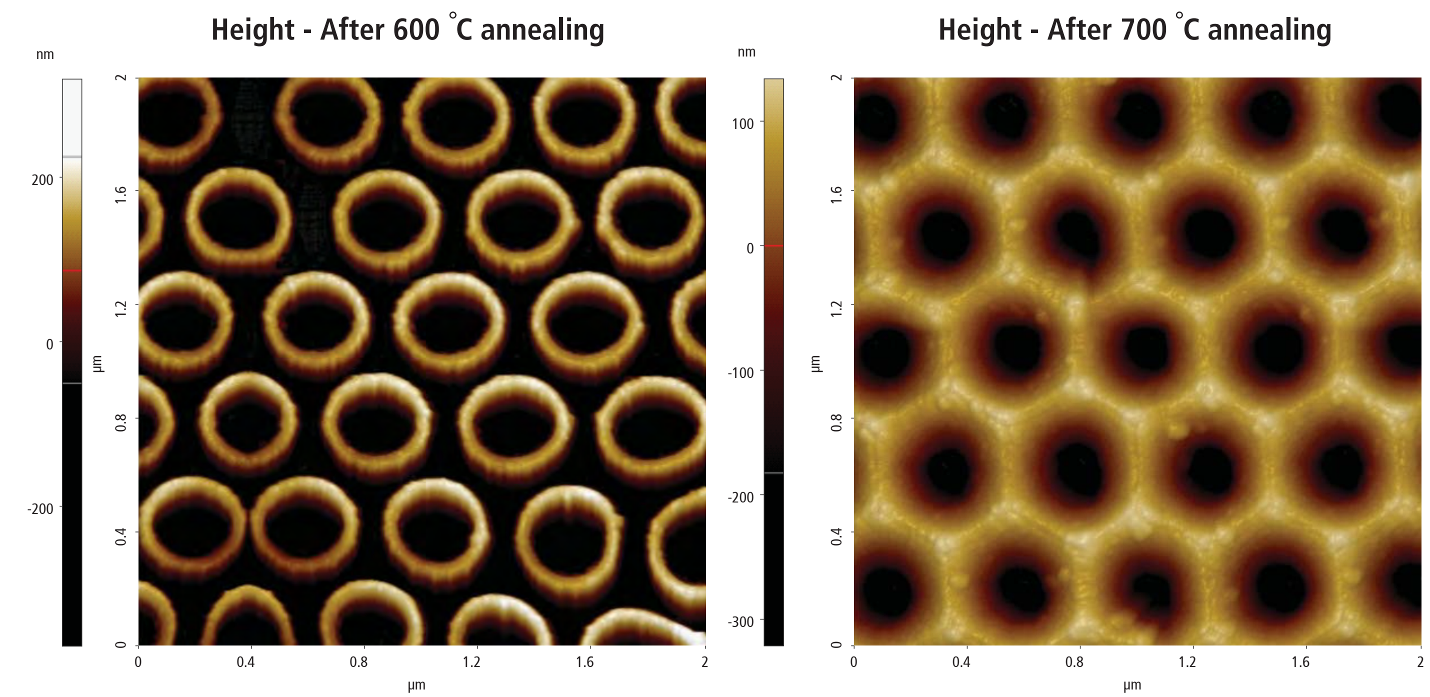
Piezoelectric Force Microscopy

PFM utilizes a lock-in amplifier to study the electrical properties and topography of a piezo sample surface in a single scan. Here, the cantilever is biased with an AC current different than the resonance of the cantilever. The oscillation component of the PSPD signal is extracted by the lock-in amplifier, resulting in the PFM signal.

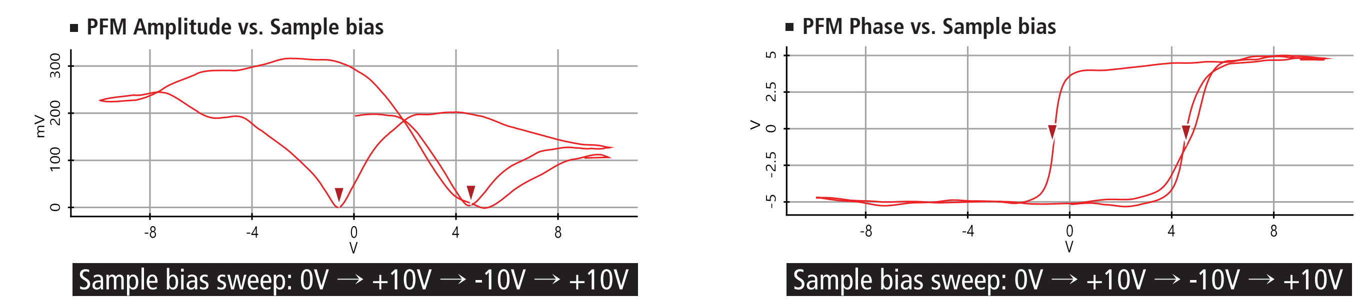


System: Park NX10
Scan Mode: PFM
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 20 µm × 20 µm
Scan Rate: 0.2 Hz
Pixel: 256 × 256

PZT nanotubes on Nb-STO

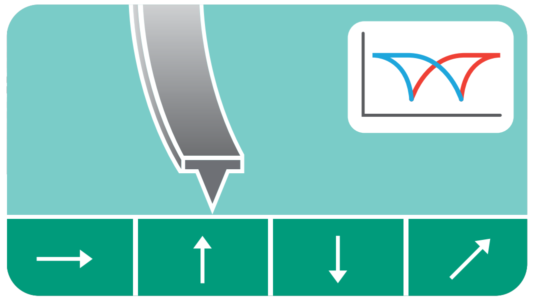


Piezo Response curve



System: Park NX20
Scan Mode: NCM, Piezo response curve
Cantilever: NCHR, ContscPt
Scan Size: 2 µm × 2 µm, 2 µm × 2 µm
Scan Rate: 0.3 Hz, 0.3 Hz
Pixel: 512 × 512, 512 × 512

PZT thin film



Piezoelectric Force Microscopy

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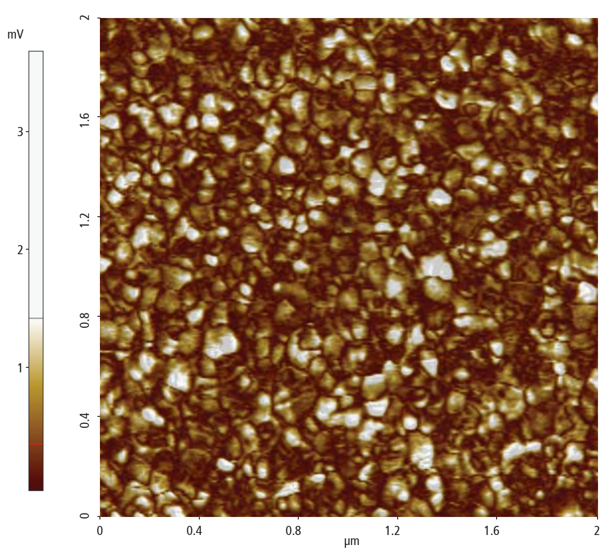
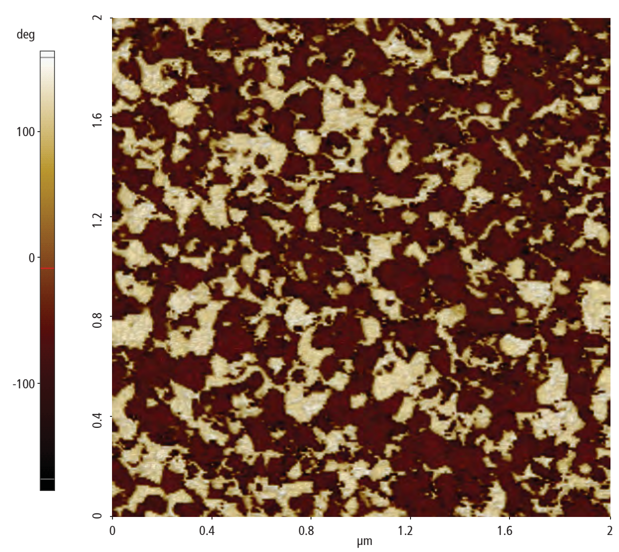
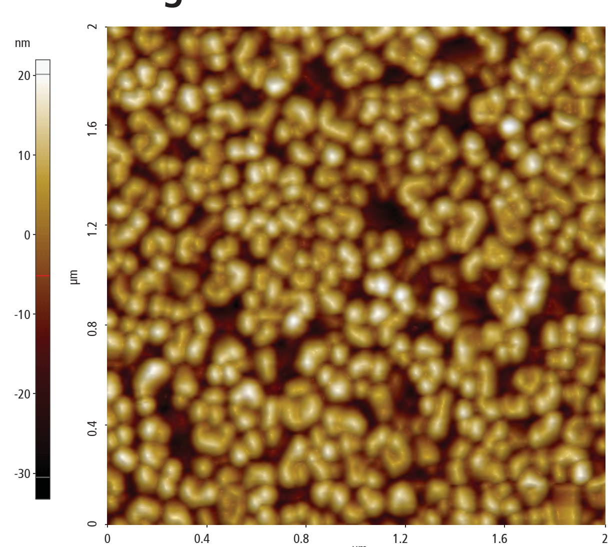
PFM Amplitude



PFM Phase



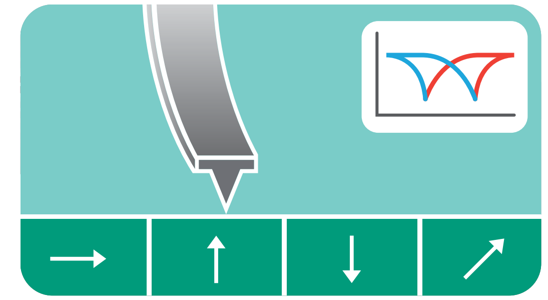
Height



Peak to valley: 57nm

System: Park NX10
Scan Mode: PFM
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 2 μm × 2 μm
Scan Rate: 0.5 Hz
Pixel: 512 × 512

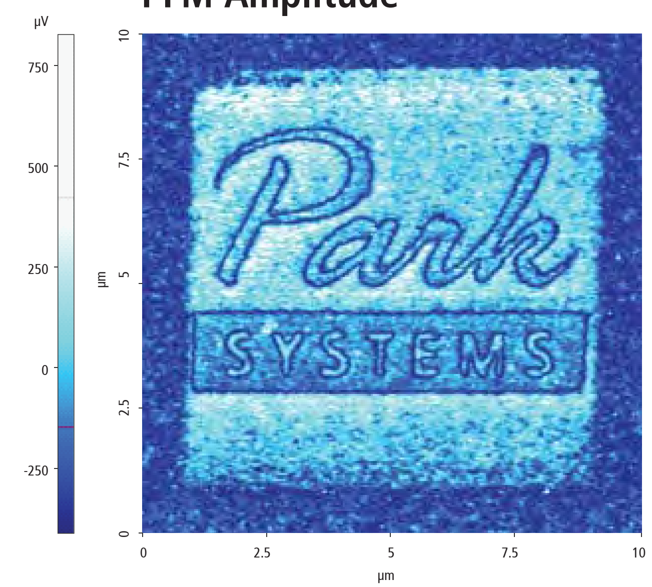
Domain switching on PZT



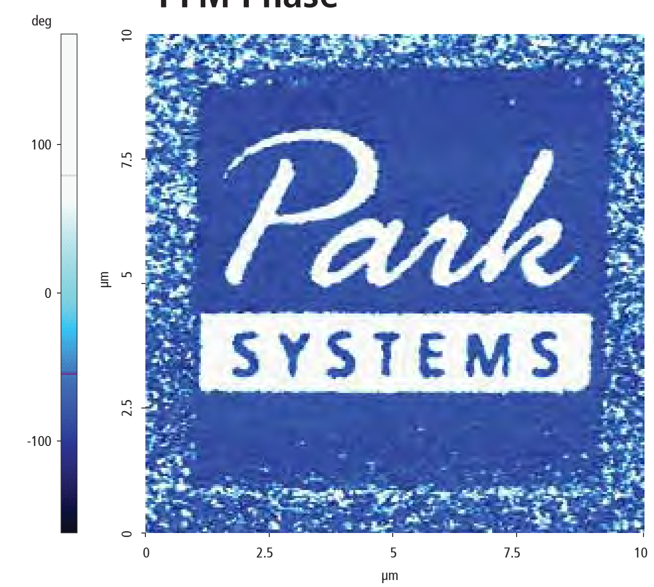
Piezoelectric Force Microscopy

PFM utilizes a lock-in amplifier to study the electrical properties and topography of a piezo sample surface in a single scan. Here, the cantilever is biased with an AC current different than the resonance of the cantilever. The oscillation component of the PSPD signal is extracted by the lock-in amplifier, resulting in the PFM signal.

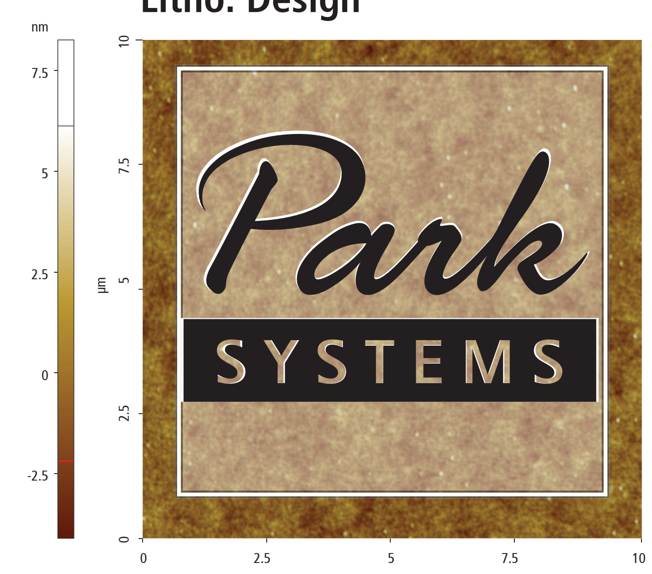
PFM Amplitude



PFM Phase

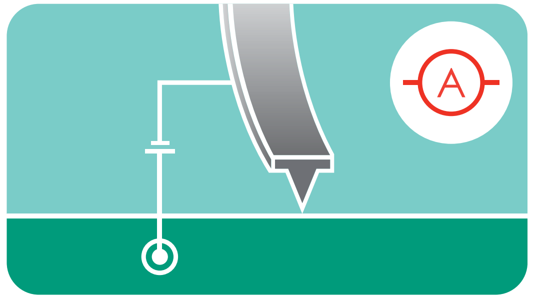


Litho. Design



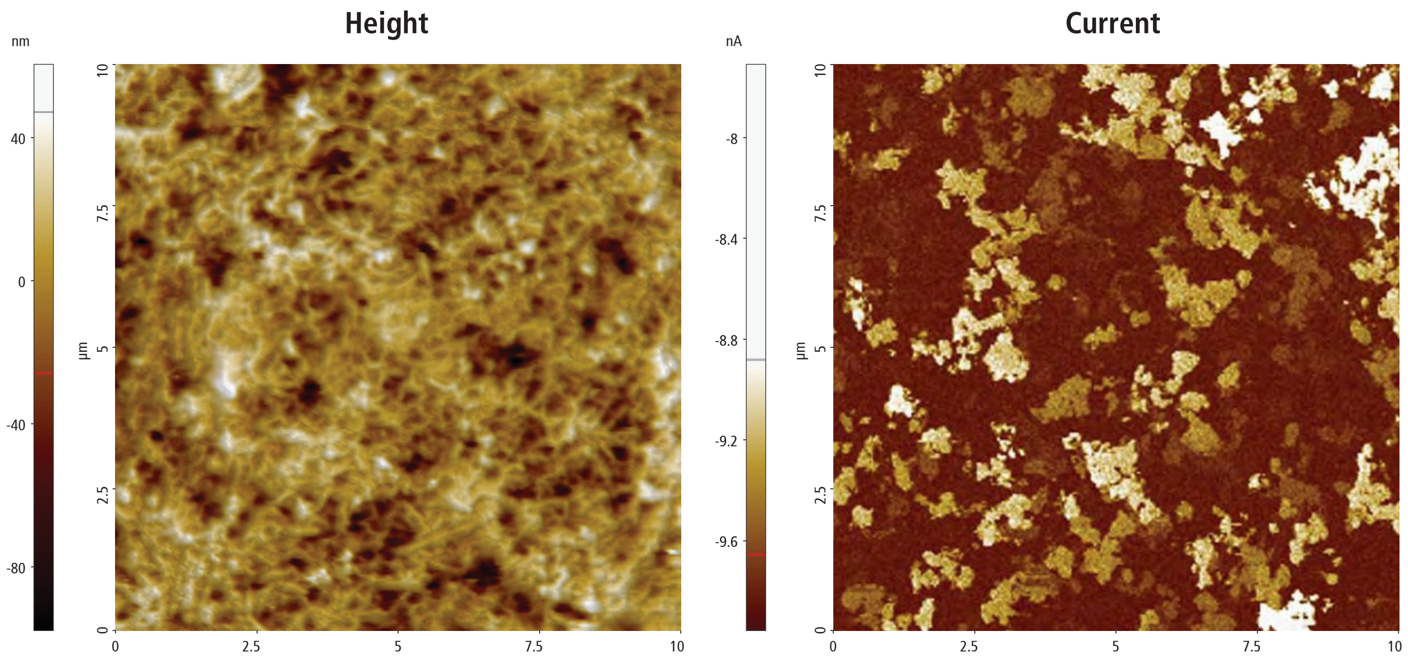
System: Park NX10
Scan Mode: Lithography, PFM
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 10 μm × 10 μm
Scan Rate: 0.5 Hz
Pixel: 512×512
Litho. mode: Tip bias mode
Litho. Tip bias: Black +10 V, White -10 V

Floppy



Conductive AFM

The conductivity of the sample can be measured by performing a contact AFM scan with a conducting, biased tip. Regions of high conductivity on the sample surface allow current to pass through easily, while regions of low conductivity will have a higher resistance. C-AFM yields both the topography and the electrical properties of a sample surface.

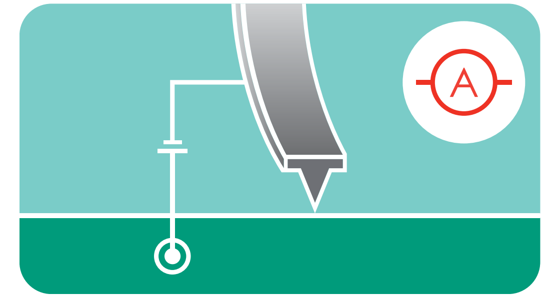


Peak to valley: 162 nm

Sample courtesy: Zhi Shiuh, NUSNNI, Singapore

System: System: Park NX10
Scan Mode: Conductive AFM
Cantilever: CDT-NCHR (k=80 N/m, f=300 kHz)
Scan Size: 10 µm × 10 µm
Scan Rate: 1 Hz
Pixel: 256 × 256
Sample Bias: +10 mV

ITO glass



Conductive AFM

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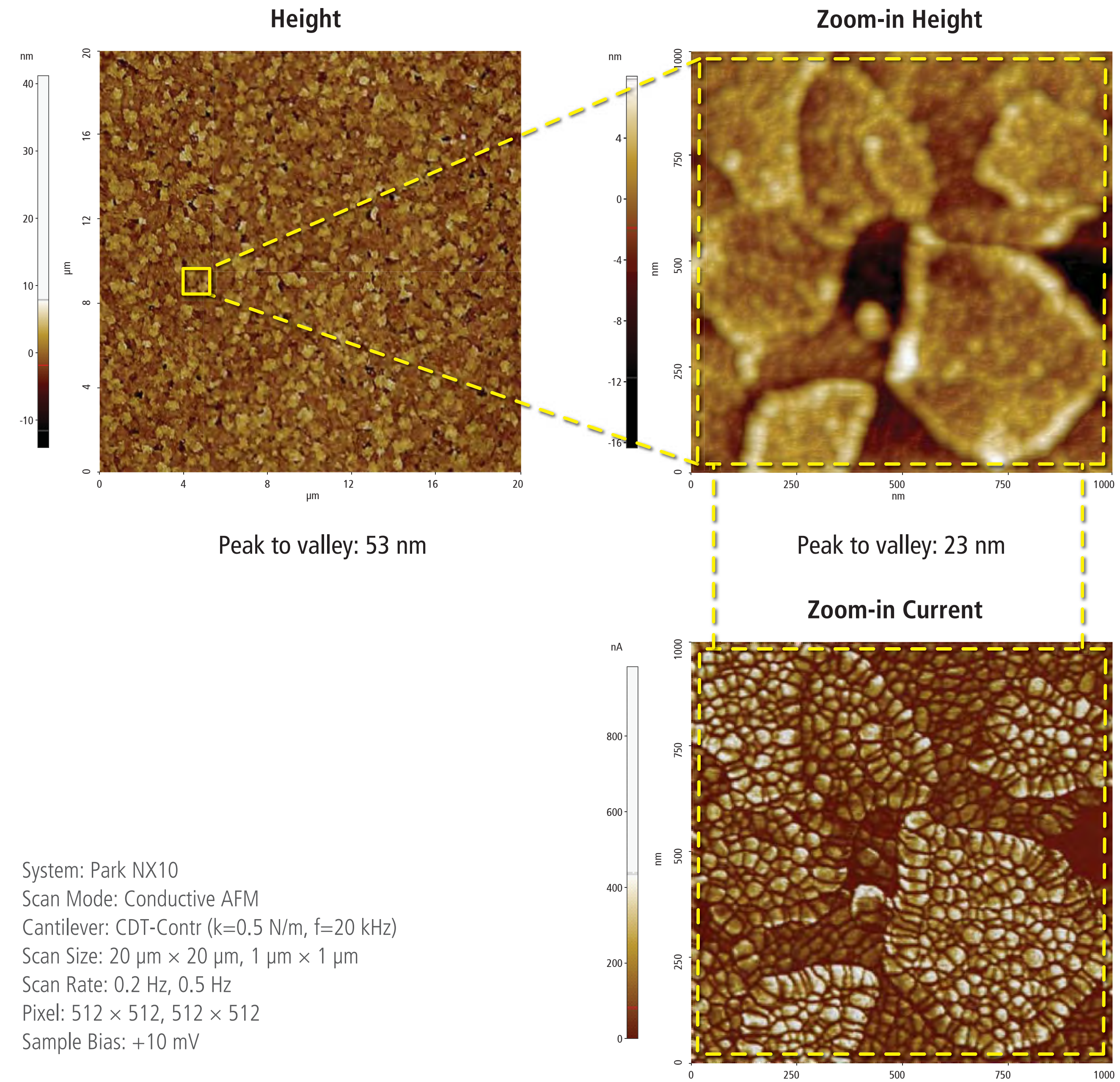
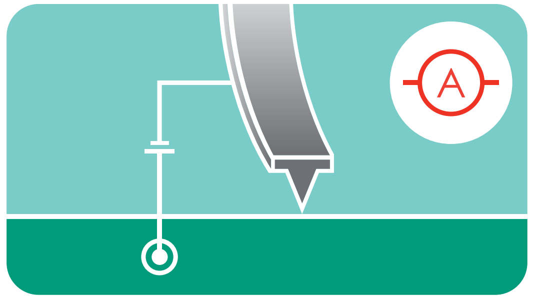


Peak to valley: 53 nm

Peak to valley: 23 nm

System: Park NX10
Scan Mode: Conductive AFM
Cantilever: CDT-Contr (k=0.5 N/m, f=20 kHz)
Scan Size: 20 µm × 20 µm, 1 µm × 1 µm
Scan Rate: 0.2 Hz, 0.5 Hz
Pixel: 512 × 512, 512 × 512
Sample Bias: +10 mV

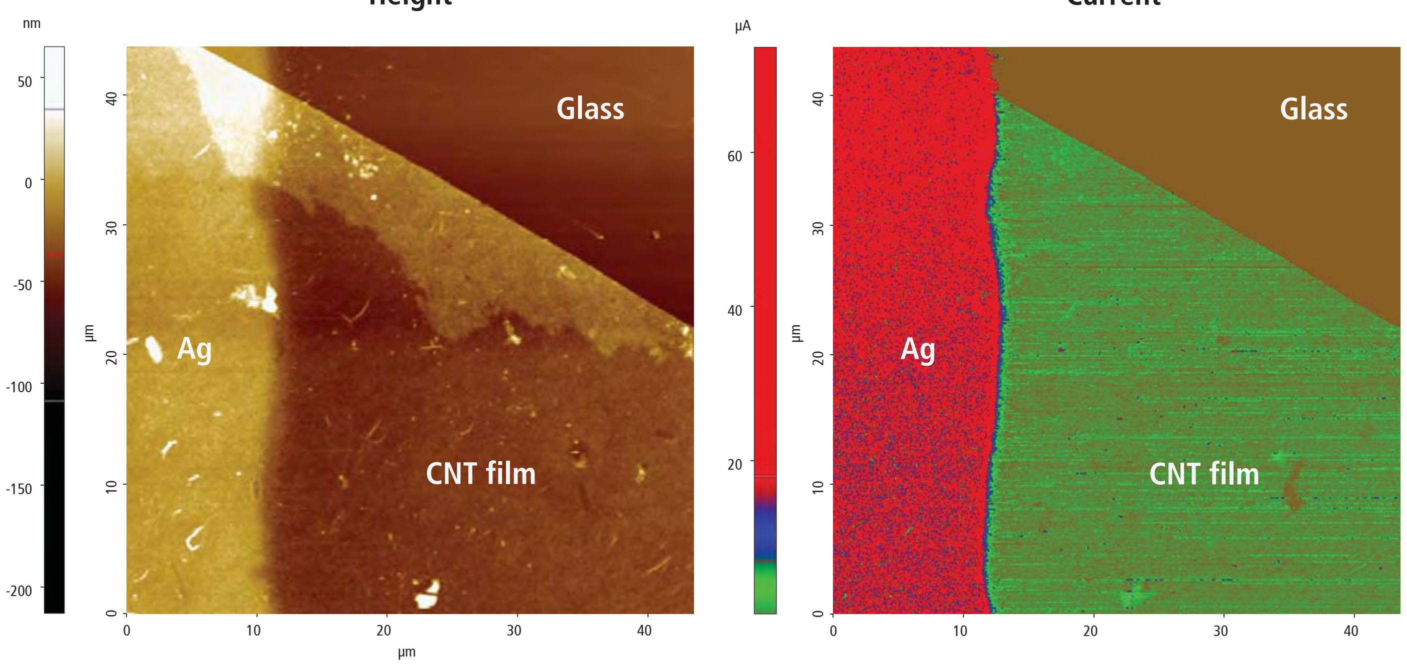
CNT Film



Conductive AFM

The conductivity of the sample can be measured by performing a contact AFM scan with a conducting, biased tip. Regions of high conductivity on the sample surface allow current to pass through easily, while regions of low conductivity will have a higher resistance. C-AFM yields both the topography and the electrical properties of a sample surface.

Height | Current



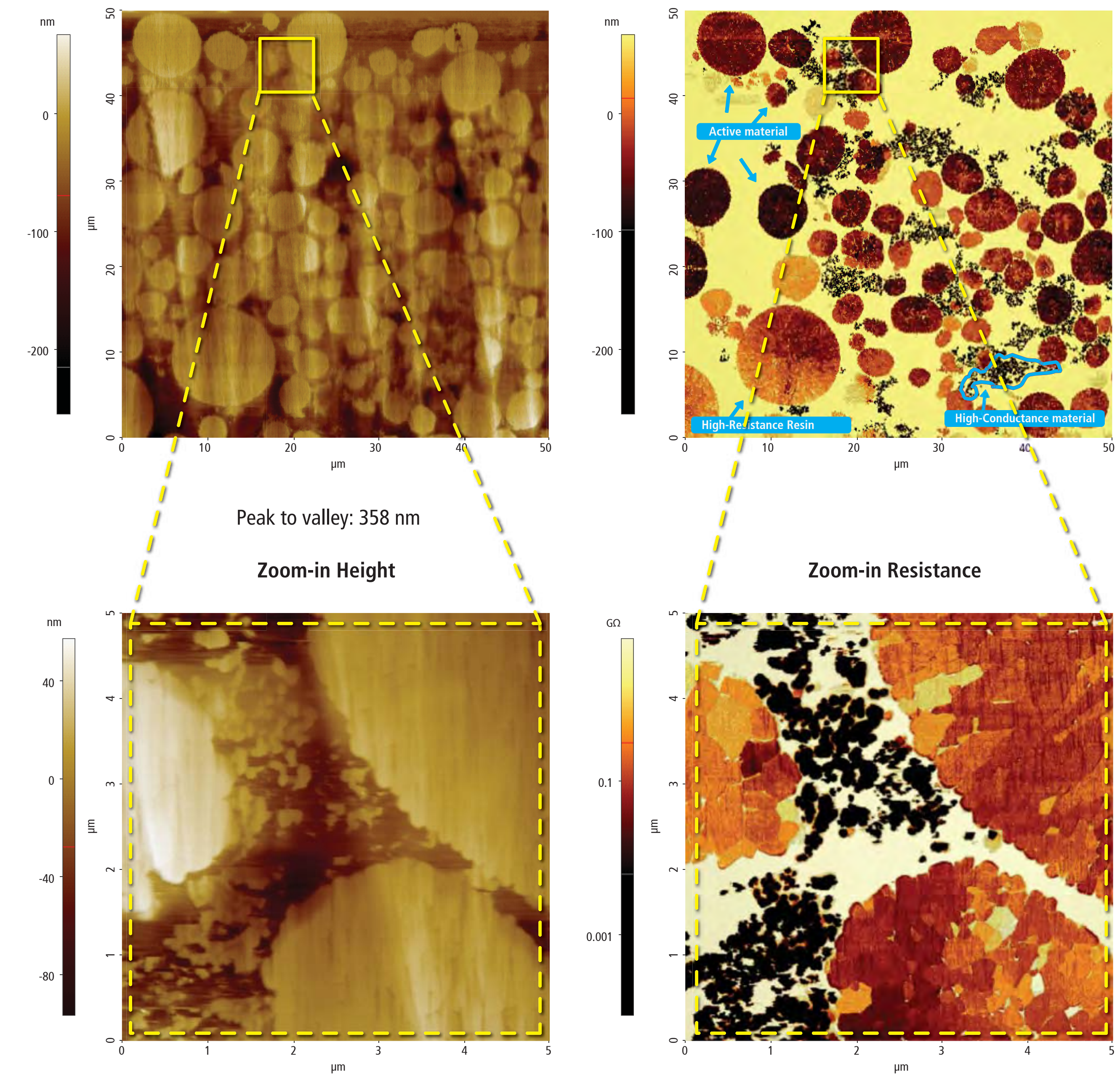
Peak to valley: 300 nm

Region	Mean(μA)
Ag	23.18
CNT Film	0.98
Glass	0.00

System: Park NX10
Scan Mode: Conductive AFM
Cantilever: CDT-Contr (k=0.5 N/m, f=20 kHz)
Scan Size: 45 μm × 45 μm
Scan Rate: 0.5 Hz
Pixel: 512 × 512
Sample Bias: +0.3 V

Li ion battery electrode

Height | SSRM Resistance



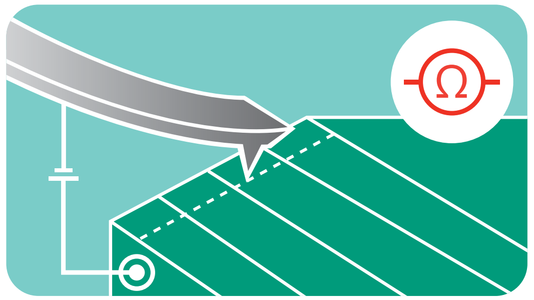
Peak to valley: 358 nm

Zoom-in Height | Zoom-in Resistance

Peak to valley: 158 nm | Peak to valley: 7.9 GΩ

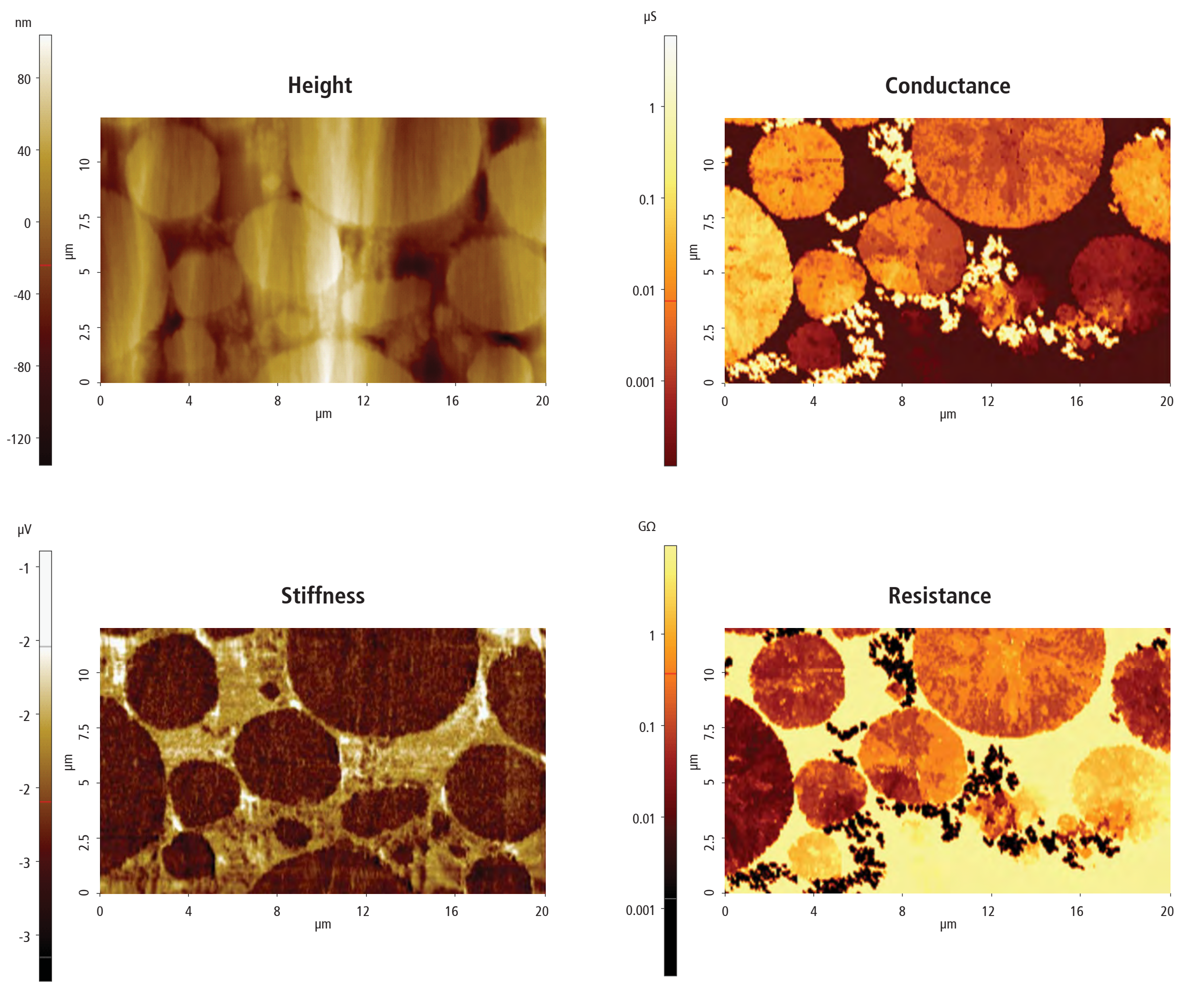
System: Park NX-Hivac
Scan Mode: SSRM
Cantilever: CDT-NCHR (k=80 N/m, f=400 kHz)
Scan Size: 50 μm × 50 μm, 5 μm × 5 μm
Scan Rate: 1 Hz
Pixel: 4096 × 2048, 512 × 512
Sample Bias: +3 V

Li ion battery electrode



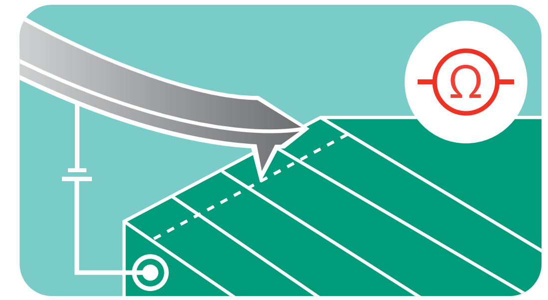
Scanning Spreading Resistance Microscopy

Our SSRM mode precisely measures the local resistance over a sample surface by using a conductive AFM tip to scan a small region while applying DC bias.



System: Park NX-Hivac
Scan Mode: SSRM with Pinpoint mode
Cantilever: CDT-NCHR (k=80 N/m, f=400 kHz)
Scan Size: 20 μm × 12 μm
Scan Rate: 0.22 Hz
Pixel: 256 × 150
Sample Bias: +3 V

SiC MOSFET



Scanning Spreading Resistance Microscopy

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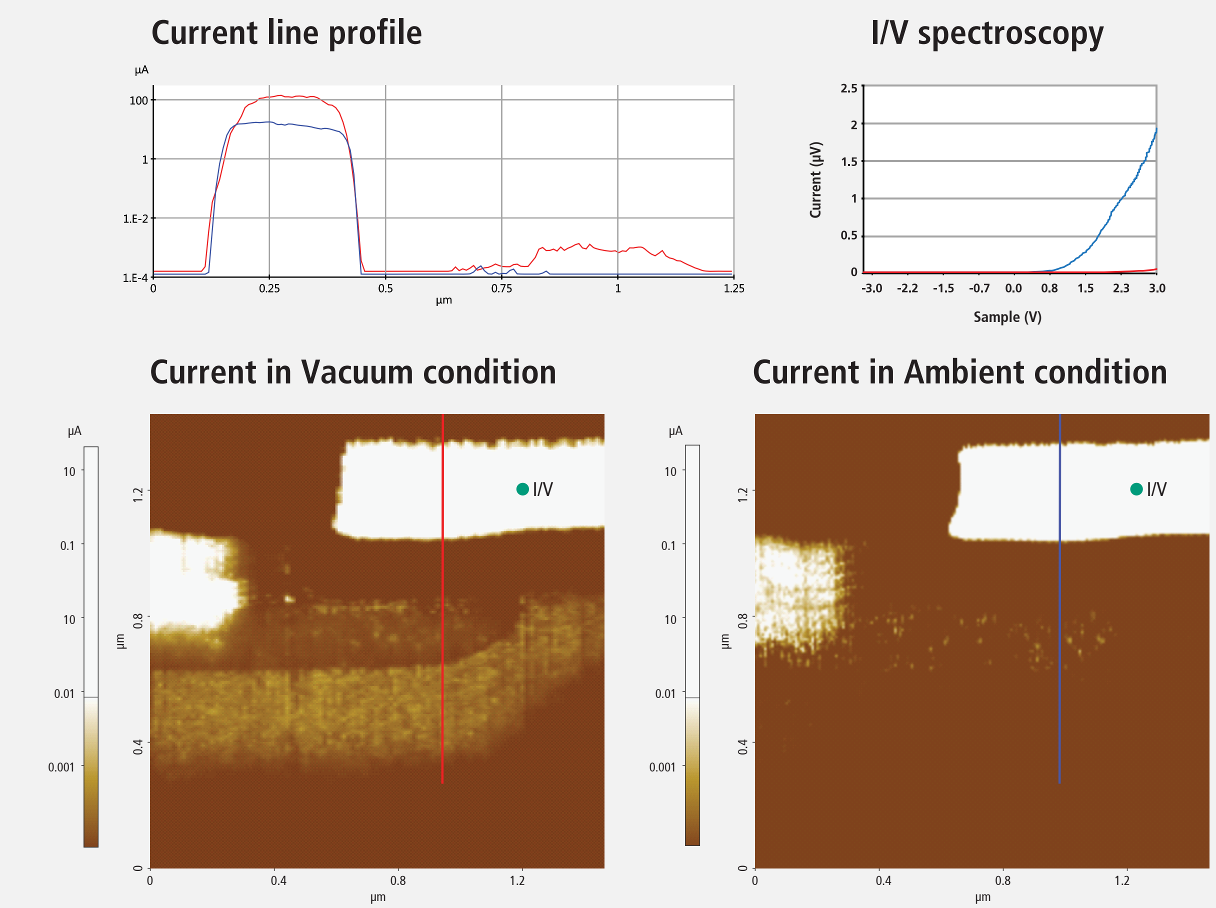
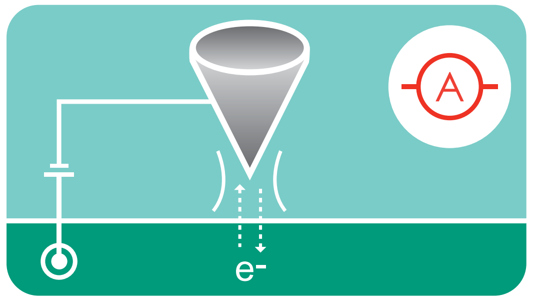


* Current in vacuum condition showed stronger than ambient by better tip-sample contact.

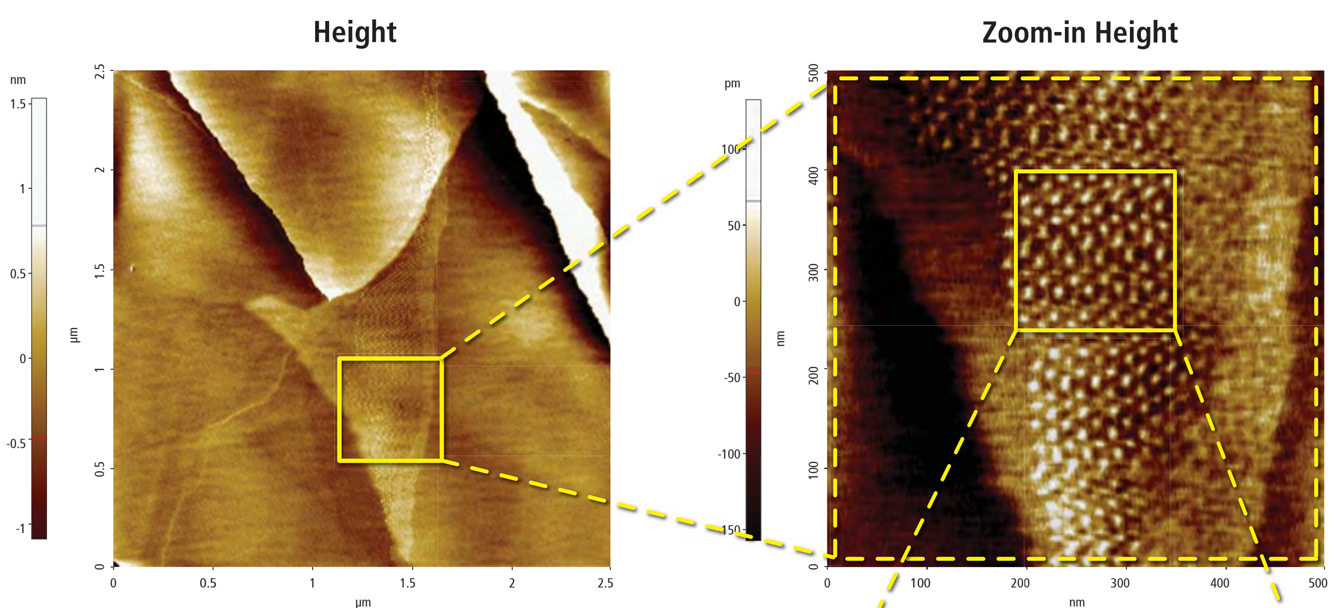
System: Park NX-Hivac
Scan Mode: SSRM
Cantilever: Full diamond (k=27 N/m)
Scan Size: 2 μm × 2 μm
Scan Rate: 0.5 Hz
Pixel: 256 ×512
Sample Bias: +2.5 V

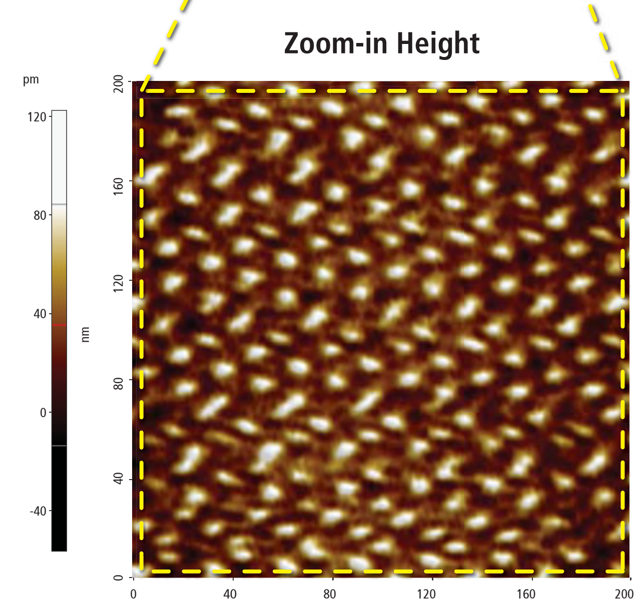
HOPG Moire



Scanning Tunneling Microscopy

STM measures the tunneling current between tip and sample, giving highly accurate sub-nanometer scale images you can use to gain insights into sample properties.



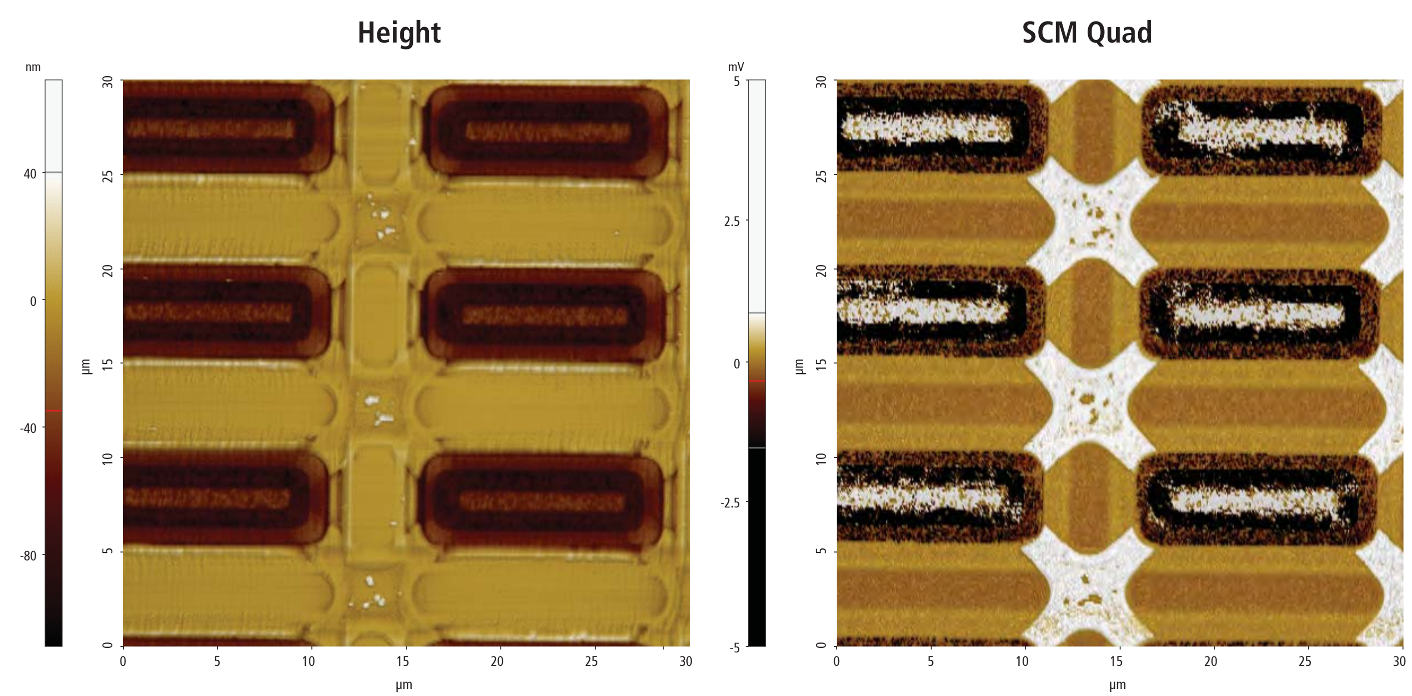


System: Park NX10
Scan Mode: STM
Cantilever: Pt wire
Scan Size: 2.5 µm × 2.5 µm, 0.5 µm × 0.5 µm, 0.2 µm × 0.2 µm
Scan Rate: 0.3 Hz, 1 Hz, 2 Hz
Pixel: 512 × 256, 512 × 256, 256 × 128

SiC Device

Scanning Capacitance Microscopy

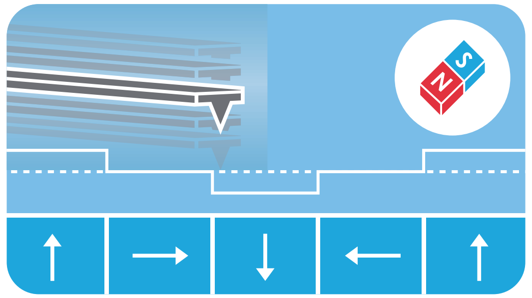
Scanning Capacitance Microscopy (SCM) is used to characterize a sample surface by recording local changes in capacitance between the surface and a metal probe. The tip-sample capacitance can be probed by modulating carriers with a bias containing AC and DC components. An amplifier is used to measure the capacitance sensor output with a high signal-to-noise ratio. The magnitude of the SCM output (dC/dV) signal is a function of carrier density or dopant concentration.



Peak to valley: 172 nm

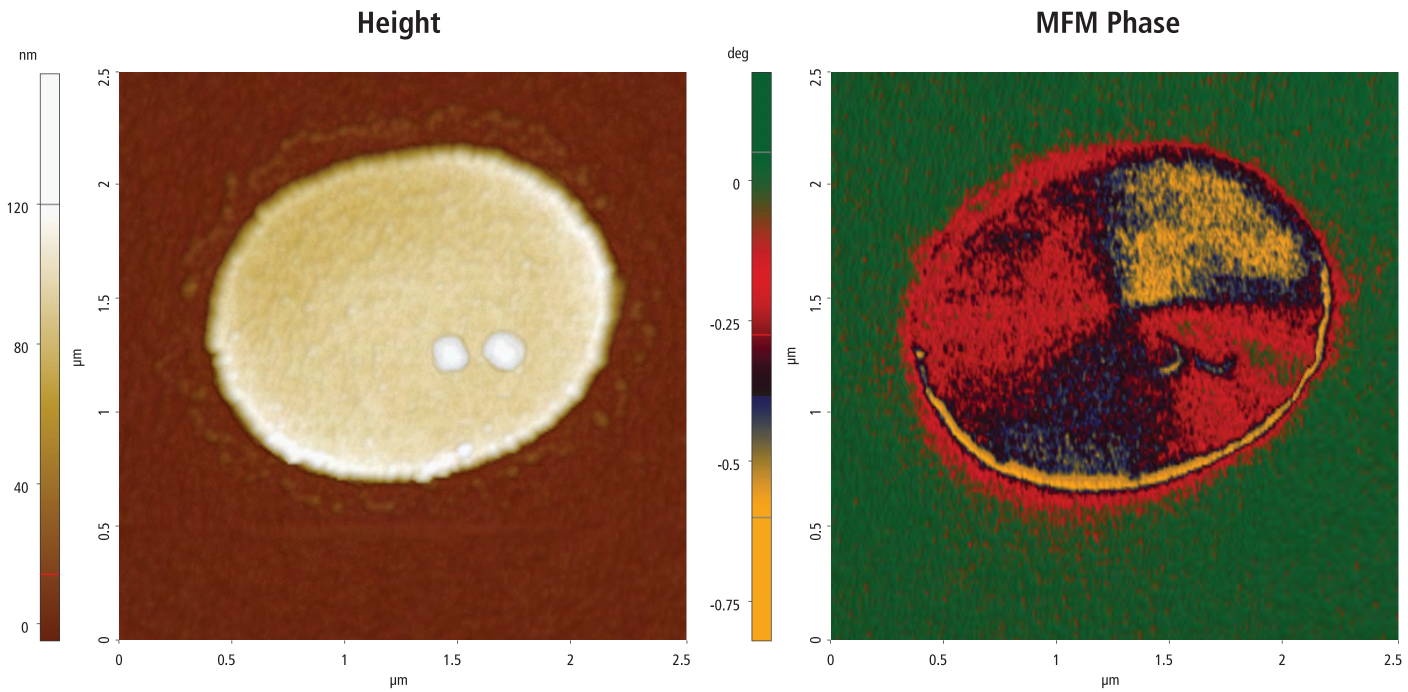
System: Park NX20
Scan Mode: SCM
Cantilever: ContscPt (k=0.2 N/m, f=25 kHz)
Scan Size: 30 µm × 30 µm
Scan Rate: 0.2 Hz
Pixel: 512 × 256

Magnetic Vortex Core



Magnetic Force Microscopy

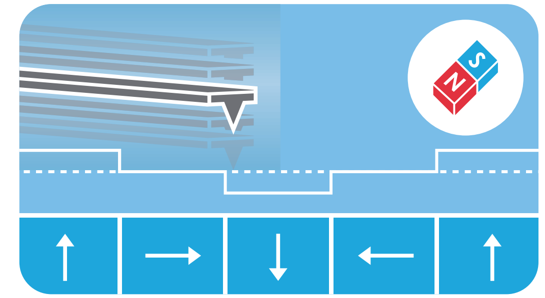
As much as EFM couples a topography scan with a separate scan for electrical properties, Magnetic Force Microscopy (MFM) combines a topography scan with a separate scan for magnetic properties. MFM features a contact AFM scan to obtain the topography, and a scan farther from the surface to probe long-range magnetic force. In this magnetic force domain, deflections of the magnetized cantilever correspond



Peak to valley: 161 nm

System: Park NX10
Scan Mode: MFM
Cantilever: PPP-MFMR (k=2.8 N/m, f=75 kHz)
Scan Size: 2.5 µm × 2.5 µm
Scan Rate: 0.3 Hz
Pixel: 512 × 256
Lift Height: 35 nm

Co/Cr/Pt



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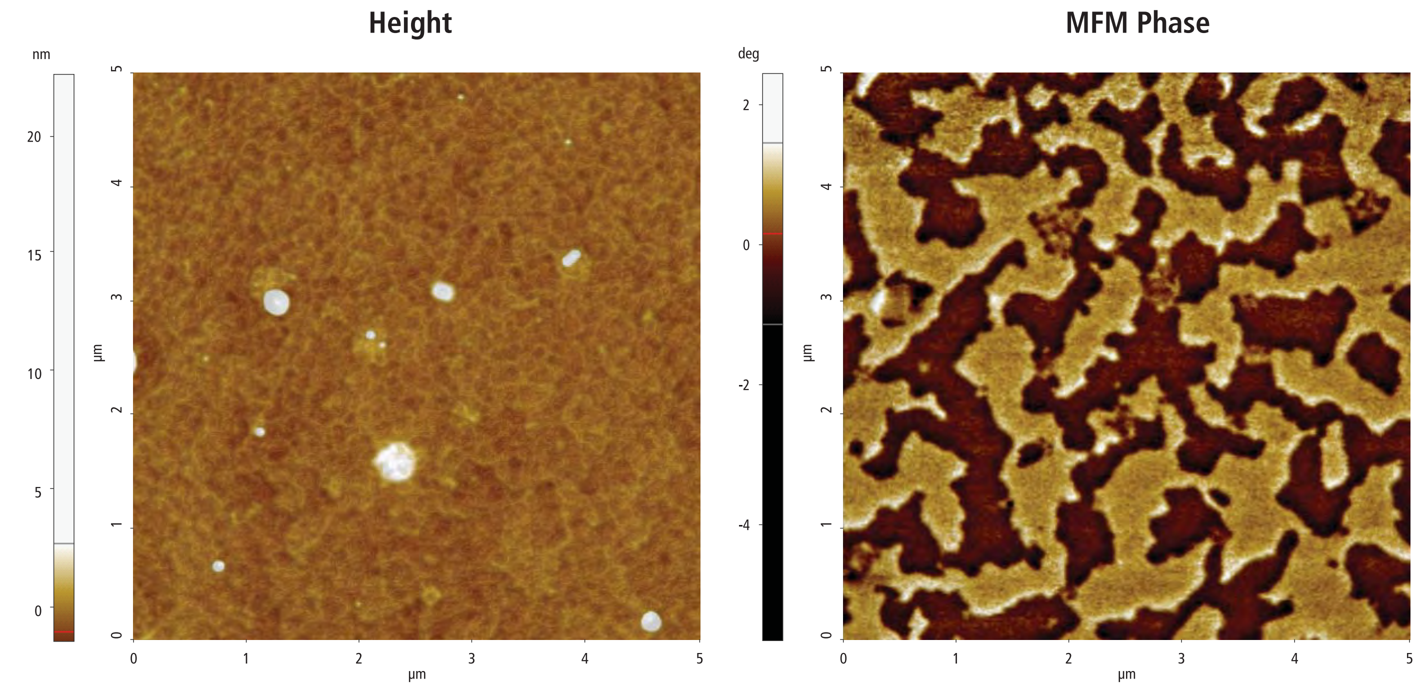
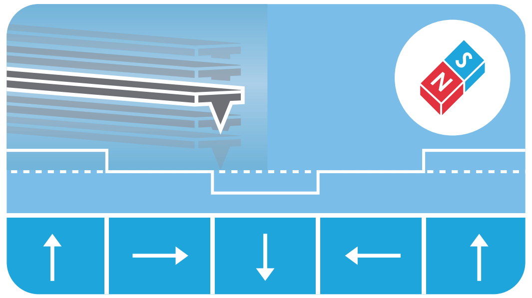


Peak to valley: 1 nm

System: Park NX10
Scan Mode: MFM
Cantilever: PPP-MFMR (k=2.8 N/m, f=75 kHz)
Scan Size: 5 µm × 5 µm
Scan Rate: 1 Hz
Pixel: 512 × 512
Lift height: 40 nm

Phthalocyanine praseodymium



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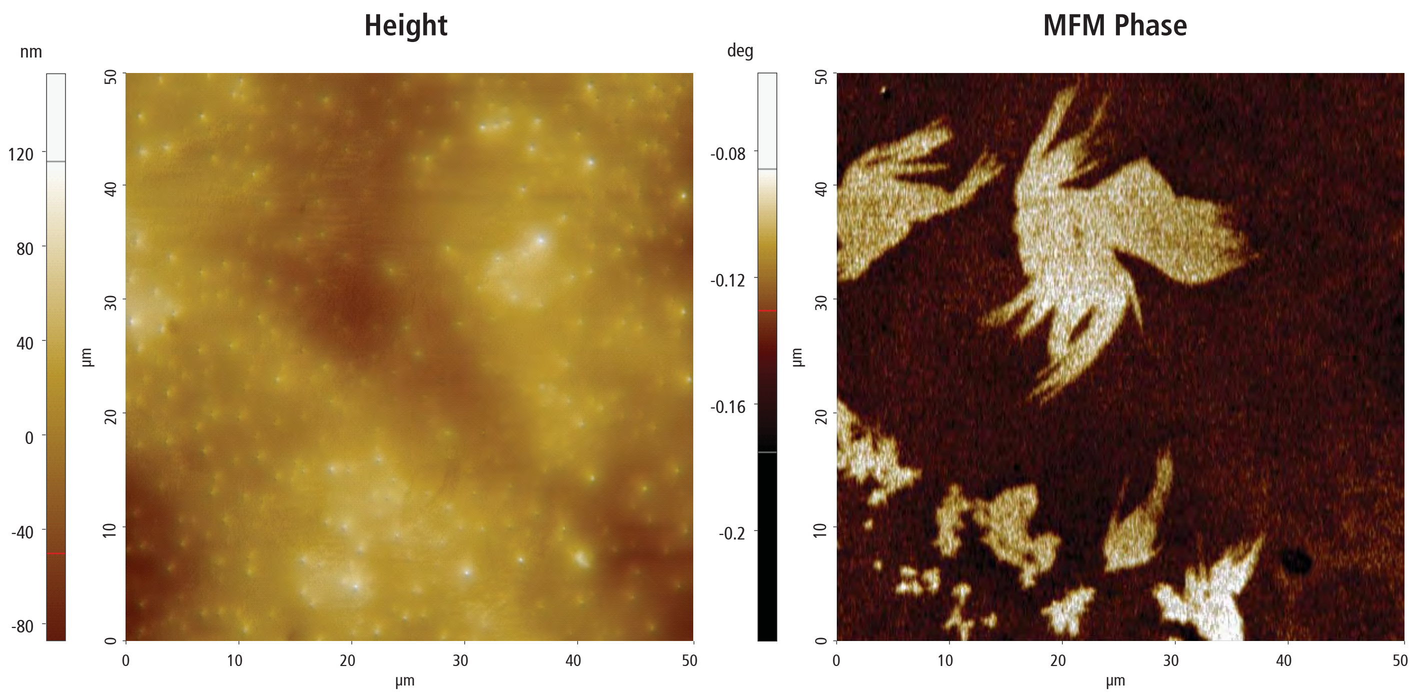
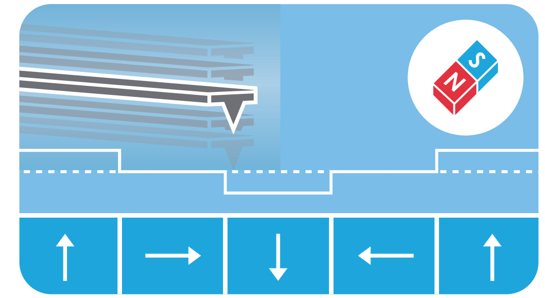


Peak to valley: 231 nm

System: Park XE7
Scan Mode: MFM
Cantilever: PPP-MFMR (k=2.8 N/m, f=75 kHz)
Scan Size: 50 µm × 50 µm
Scan Rate: 0.3 Hz
Pixel: 512 × 512
Lift height: 100 nm

NiFe



Magnetic Force Microscopy

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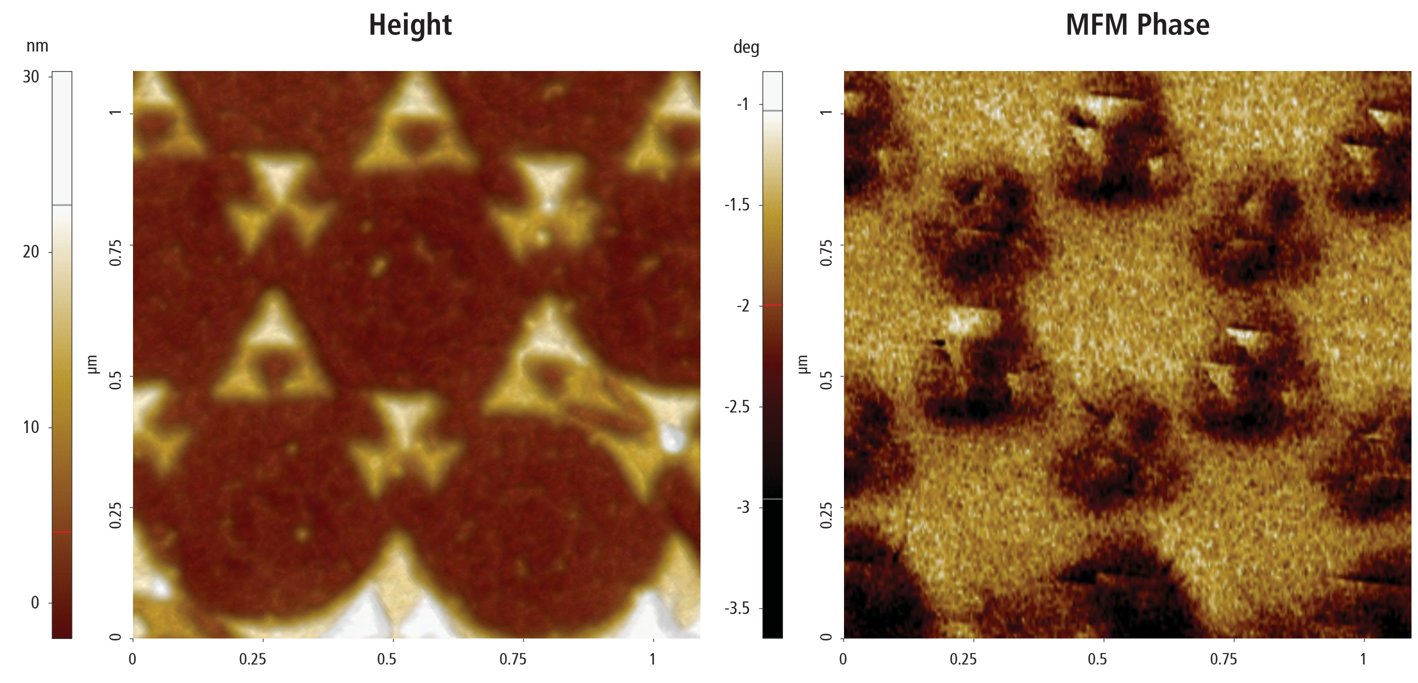


Peak to valley: 231 nm

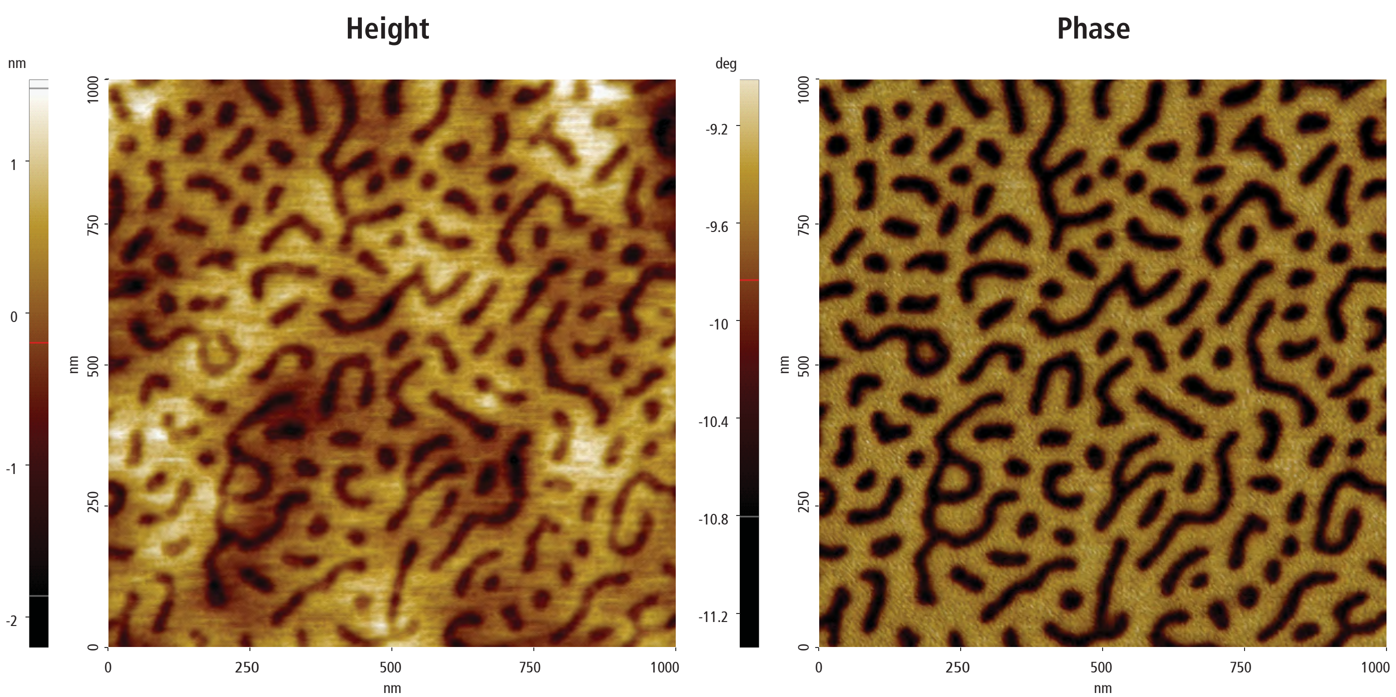
Sample courtesy: Gong Xiao, NUS-ECE, Singapore

System: NX10
Scan Mode: MFM
Cantilever: PPP-MFMR (k=2.8 N/m, f=75 kHz)
Scan Size: 1.2 µm × 1.2 µm
Scan Rate: 0.5 Hz
Pixel: 256 × 256
Lift height: 20 nm

Polymer on Si

Tapping Mode

In this alternative technique to non-contact mode, the cantilever again oscillates just above the surface, but at a much higher amplitude of oscillation. The bigger oscillation makes the deflection signal large enough for the control circuit, and hence an easier control for topography feedback. It produces modest AFM results but blunts the tip's sharpness at a higher rate, ultimately speeding up the loss of its imaging resolution.



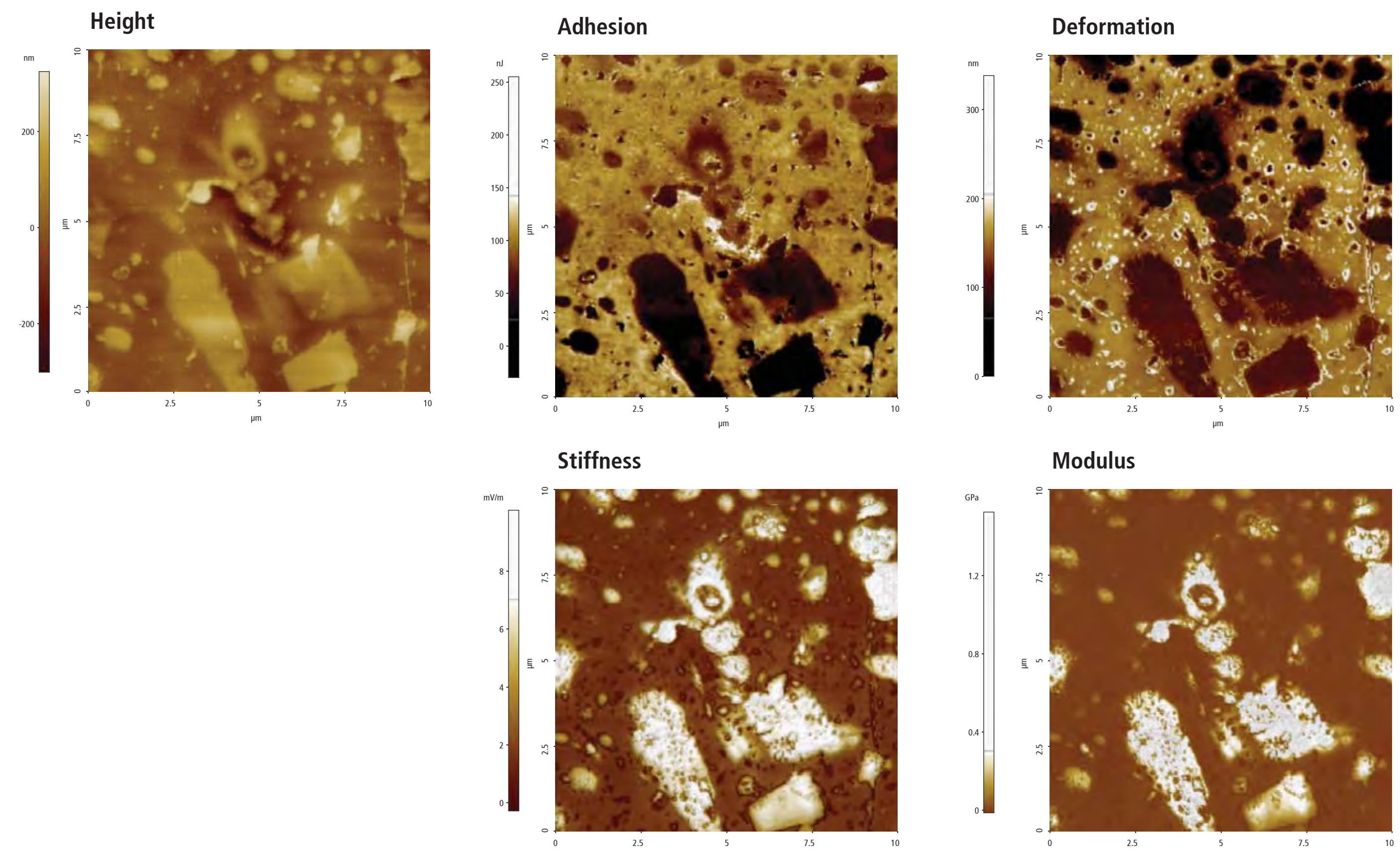
Peak to valley: 274 nm

System: Park NX10
Scan Mode: Tapping
Cantilever: AC160TS (k=26 N/m, f=300 kHz)
Scan Size: 1 μm × 1μm
Scan Rate: 0.5 Hz
Pixel: 512 × 256

Blended Polymer

PinPoint™ Nanomechanical Mode

PinPoint™ Nanomechanical Mode obtains the best of resolution and accuracy for nanomechanical characterization. Stiffness, elastic modulus, adhesion force are acquired simultaneously in real-time. While the XY scanner stops, defined control of contact force and contact time between the tip and the sample. Due to controllable data acquisition time, PinPoint™ Nanomechanical Mode allows optimized nanomechanical measurement with high signal-to-noise ratio over various sample surfaces.



Sample courtesy: Dr. Anil Bhowrnick, IIT-Kharagpur, India

System: Park NX10
Scan Mode: PinPoint nanomechanical mode
Cantilever: FMR (k=2.8 N/m, f=75 kHz)
Scan Size: 10 μm × 10 μm
Scan Rate: 0.11 Hz
Pixel: 256 × 256

Crystal Facetts

PinPoint™ Nanomechanical Mode

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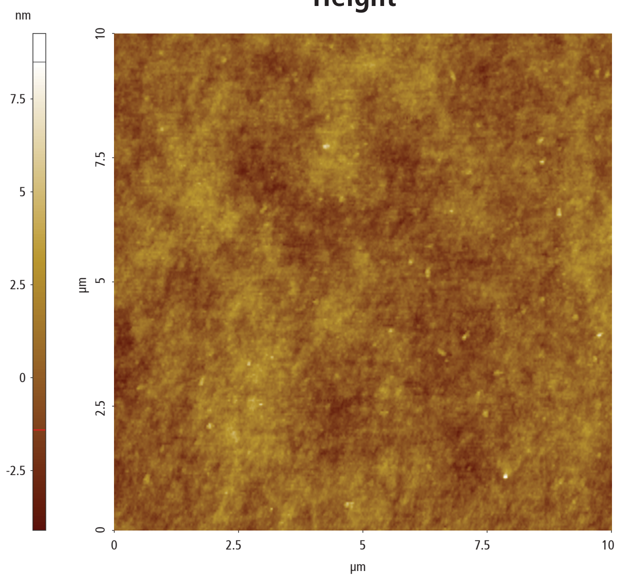
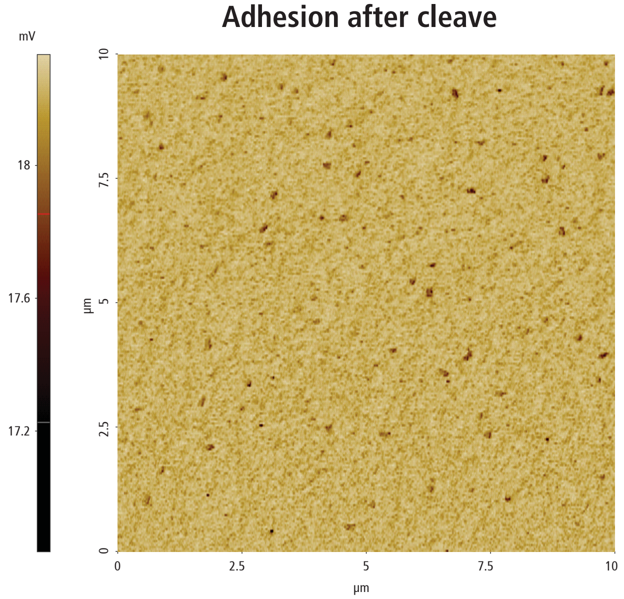
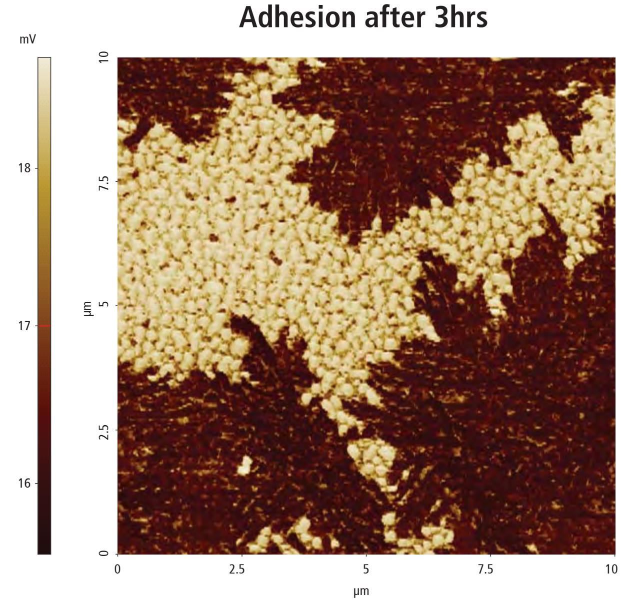
Height



Adhesion after cleave



Adhesion after 3hrs

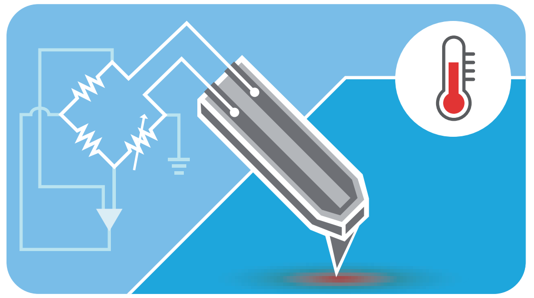


Peak to valley: 14 nm

*** Adhesion property of the sample was changed after exposure to ambient for 3hrs**

System: Park NX10
Scan Mode: Pinpoint nanomechanical mode
Cantilever: NSC36 C (k=0.6 N/m, f=65 kHz)
Scan Size: 10 μm × 10 μm
Scan Rate: 0.21 Hz
Pixel: 256 × 256

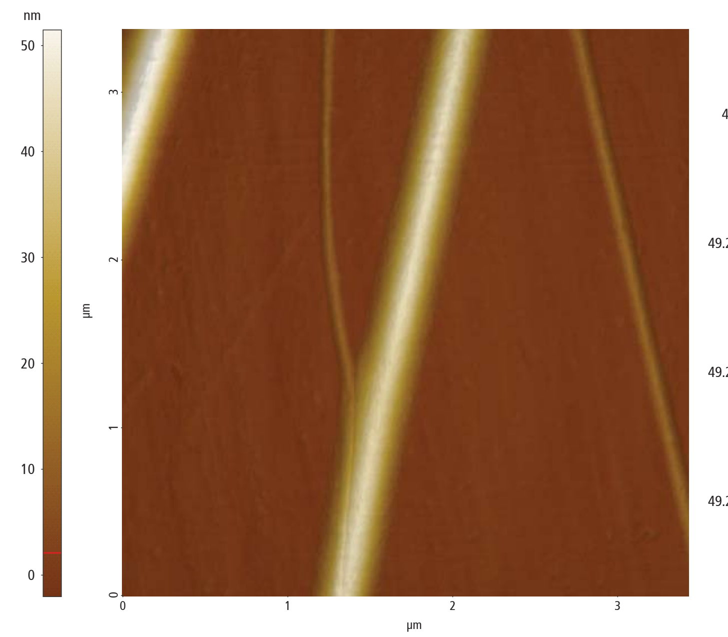
Si nanowire on glass



Scanning Thermal Microscopy

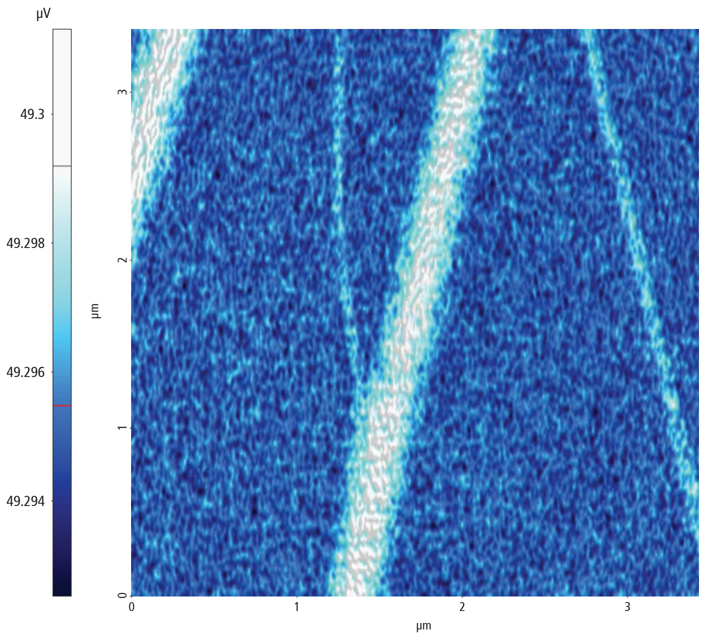
In order to measure the thermal properties of a sample surface, a contact AFM scan is performed using a cantilever with temperature-dependent resistivity. Any changes in the tip resistance during the scan are recorded and correlated into a thermal image of the sample surface.

Height



Peak to valley: 55 nm

Thermal conductivity



Peak to valley: 353 mV

System: Park XE7
Scan Mode: SThM
Cantilever: Thermal probe (k=0.25 N/m)
Scan Size: 3.5 μm× 3.5 μm
Scan Rate: 1 Hz
Pixel: 512 × 256

ATOMIC FORCE MICROSCOPY

Park Systems

Dedicated to producing the most accurate and easiest to use AFMs

General AFMs

Park Systems provides a range of popular AFMs for general research and industrial applications. Designed to be extremely versatile while still providing the accuracy and functionality necessary to do high quality work, our line of general AFMs offer researchers and engineers alike the ability to get extremely accurate results quickly and easily.

Applications:

- Biological Science
- Materials Science
- Failure Analysis
- Semiconductor Analysis
- Hard Disk Media Analysis

Park NX10

The world's most accurate easy-to-use research AFM

Park NX20

Power, versatility, ease of use, brilliantly combined for large sample AFM

Park XE15

Capable, adaptable, and affordable -the best value large sample AFM

Park XE7

True research-grade AFM for the practical budget

Park NX-Hivac

The most advanced high vacuum AFM for failure analysis and sensitive materials research

Bio and Chemistry

Allowing users to take highly accurate measurements and complete their work more quickly, these tools can improve efficiency in the workplace and reduce errors, leading to more profitable, more consistent development and productive processes.

Park NX10 SICM

Cutting-edge nanoscale imaging in aqueous environments

Park NX-Bio

Three compelling nanoscale microscopies in one innovative platform

Park NX12

The most versatile AFM platform for your nanoscale microscopy needs

Industrial AFMs

Park Systems is dedicated not just to advancing research, but industry as well. That's why our designers have worked to build a line of the most effective AFMs for FA engineers and industrial applications. Allowing users to take highly accurate measurements and complete their work more quickly, these tools can improve efficiency in the workplace and reduce errors, leading to a more profitable, more consistent development and production process.

Applications:

- Failure Analysis
- Semiconductor Analysis
- Hard Disk Media Analysis

Park NX-HDM

The most innovative AFM for automated defect review and surface roughness measurement

Park NX-PTR

Fully automated AFM for accurate inline metrology of hard disk head sliders

Park NX-Wafer

Low noise, high throughput atomic force profiler with automatic defect review

Park NX-3DM

Innovation and efficiency for 3D metrology

The most accurate and easiest to use Atomic Force Microscope

Park NX10

Better data

Park NX10 produces data you can trust, replicate, and publish at the highest nano resolution. It features the world's only true non-contact AFM that prolongs tip life while preserving your sample, and flexure based independent XY and Z scanner for unparalleled accuracy and resolution.

Better productivity

Powered by our revolutionary operating software **Park SmartScan™**, Park NX10 is capable of quicker, easier setup and more optimal data collection than ever before. Park SmartScan's **auto mode** allows novices to quickly collect high quality nanoscale images with just **single click** of a mouse while its manual mode provides all of the functionality necessary for veterans to **customize** their workflow as needed.

Better research

With more time and better data, you can focus on doing more innovative research. And the Park NX10's wide range of measurement modes and customizable design means it can be easily tailored to the most unique projects.

Park SYSTEMS

Park NX12

The most versatile atomic force microscope for analytical chemistry

- *Built on proven Park AFM performance*
- *Equipped with inverted optical microscope*

Proven Performance

The Park NX12 is based on the Park NX10, one of the most trusted and widely used AFMs for research. Users can rest assured that they are taking measurements with a cutting-edge tool.

Built for Versatility

Multi-user labs need a versatile microscope to meet a wide range of needs. The Park NX12 was built from the ground up to be a flexible modular platform to allow shared facilities to invest in a single AFM to perform any task.

Competitive Pricing

Early career researchers need to do great work with cost-effective tools. Despite its outstanding pedigree, the Park NX12 is priced affordably—ideal for those on a constrained budget.