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Small Things, Big Differences: Bruker Nano Atomic Force Microscopes

Welcome

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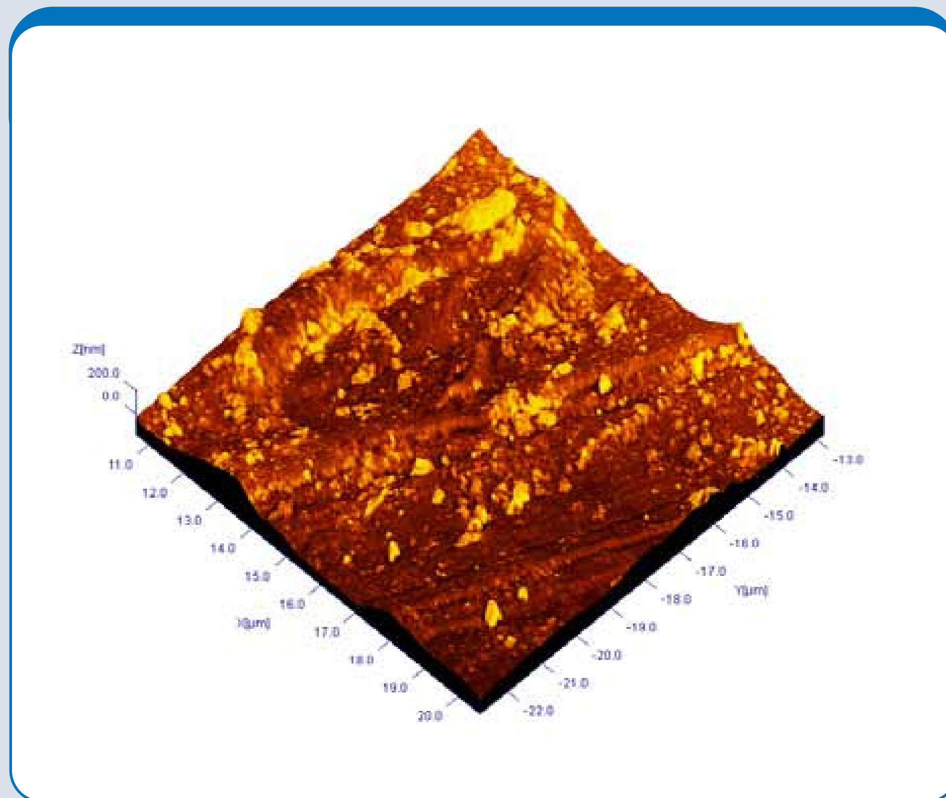


Today's Topics:

- The Bruker Difference
- Nanos in Action
- What's new

NANOS – the Simple Add-On for Optical Microscopy

Cantilever Detection: The Industry Norm

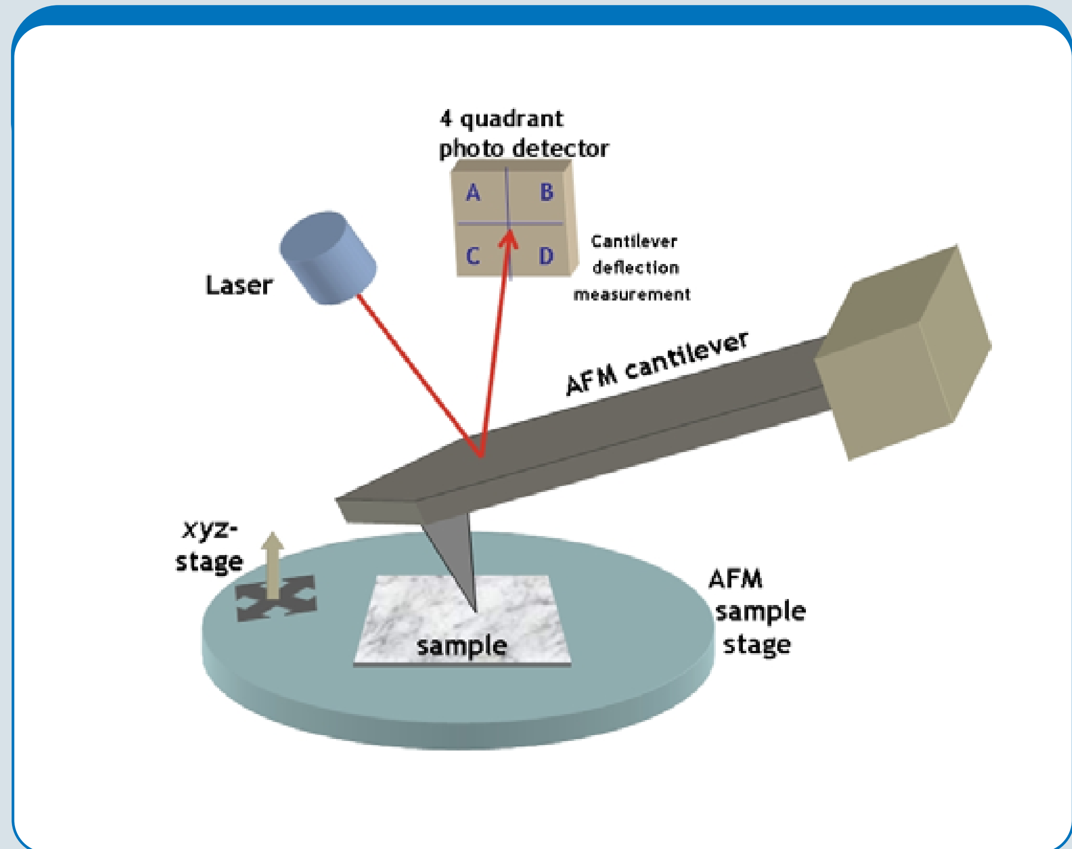
Laser Beam Bounce Detection is the industry norm

advantage:

Simple setup, cheap

disadvantage:

Alignment procedure, larger head design



The Bruker Difference

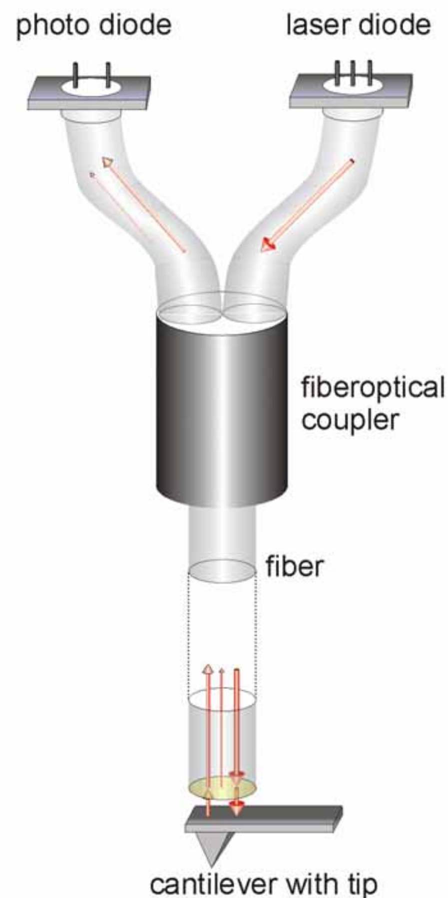
Interferometric Detection

advantage:

Compact design, accurate tip delfection infromation, No laser alignment – Easier to use

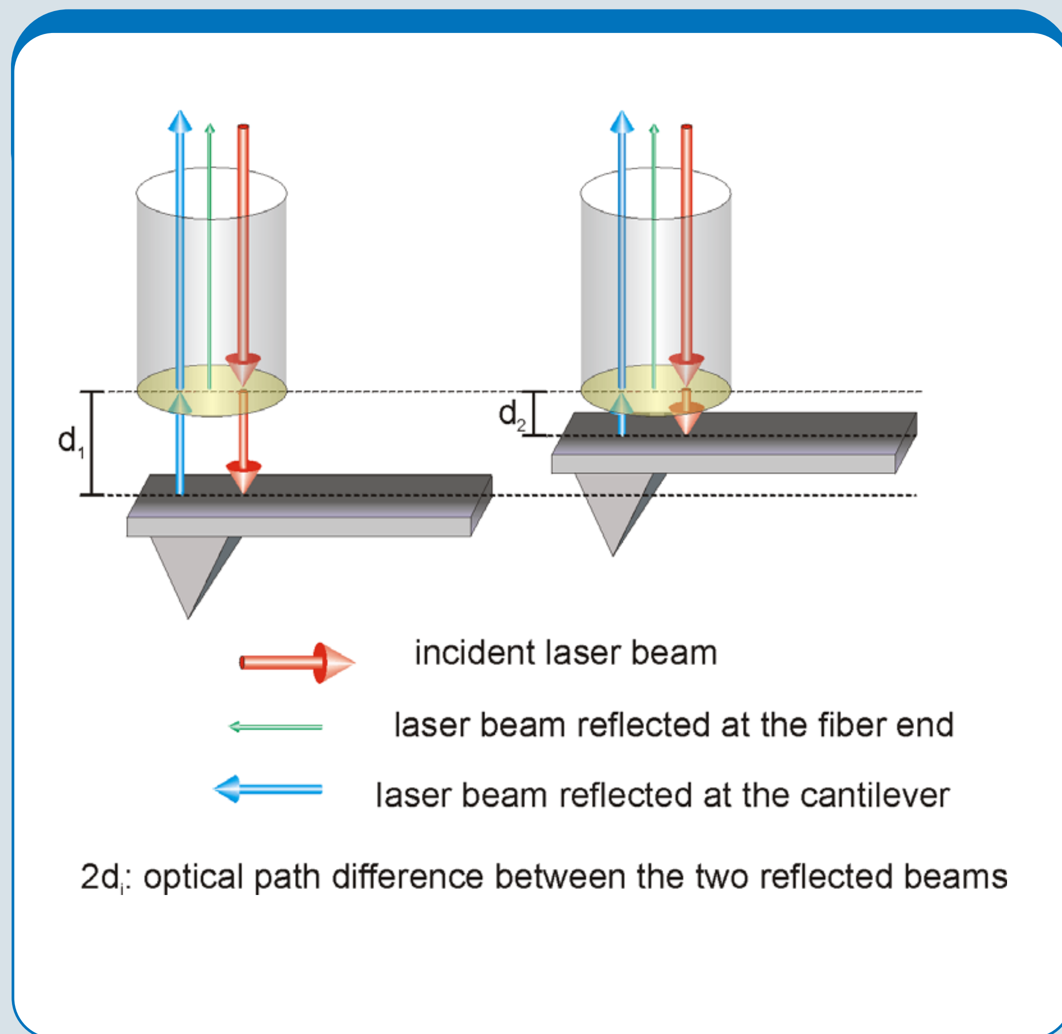
disadvantage:

Slightly more complex deflection detection system



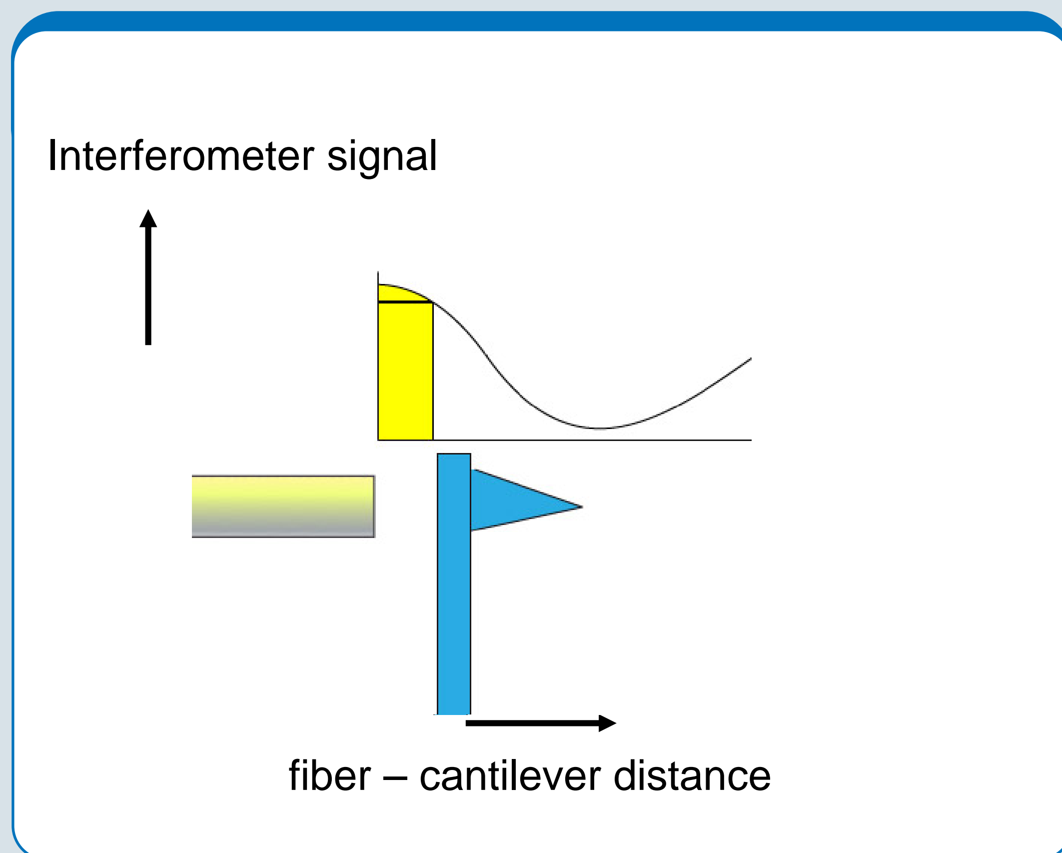
Interferometric Detection

Fiberoptic Interferometry for cantilever deflection detection



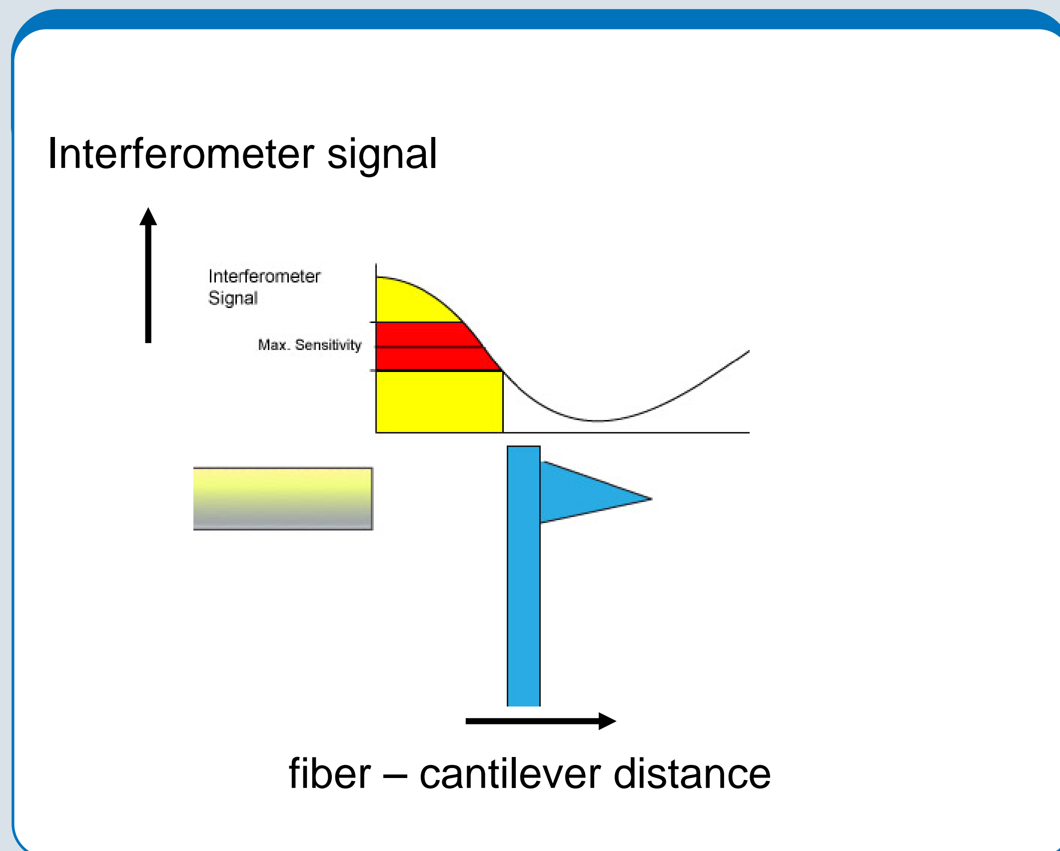
Interferometric Detection

Fiberoptic Interferometry for cantilever deflection detection



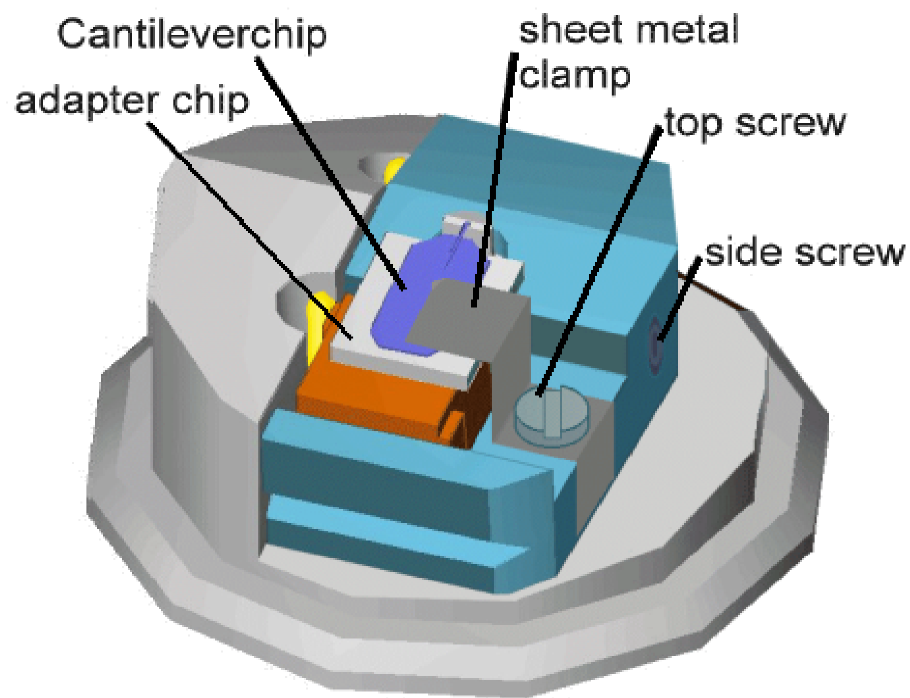
Interferometric Detection

Fiberoptic Interferometry for cantilever deflection detection



The Bruker Difference

The NANOS head design



NANOS Modes

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- **Contact Mode**
- **Oscillation Modes (Non-Contact, Intermittent Contact)**
- **Phase Contrast**
- Magnetic Force (MFM)
- Electrostatic Force (EFM)
- Friction Force Mode (FFM)
- Force Modulation (SFM)
- Spreading Resistance (SSR)
- Conductive AFM (C-AFM)
- Surface Potential, Kelvin Probe (SSPM)
- Scanning Capacitance (SCM)
- Scanning Tunneling (STM)
- Frequency Modulation and Self-Excitation, Q-Control
- Spectroscopy, Force vs Distance, I-V Curves
- Lithography/Surface Manipulation
- Liquid Compatible Version

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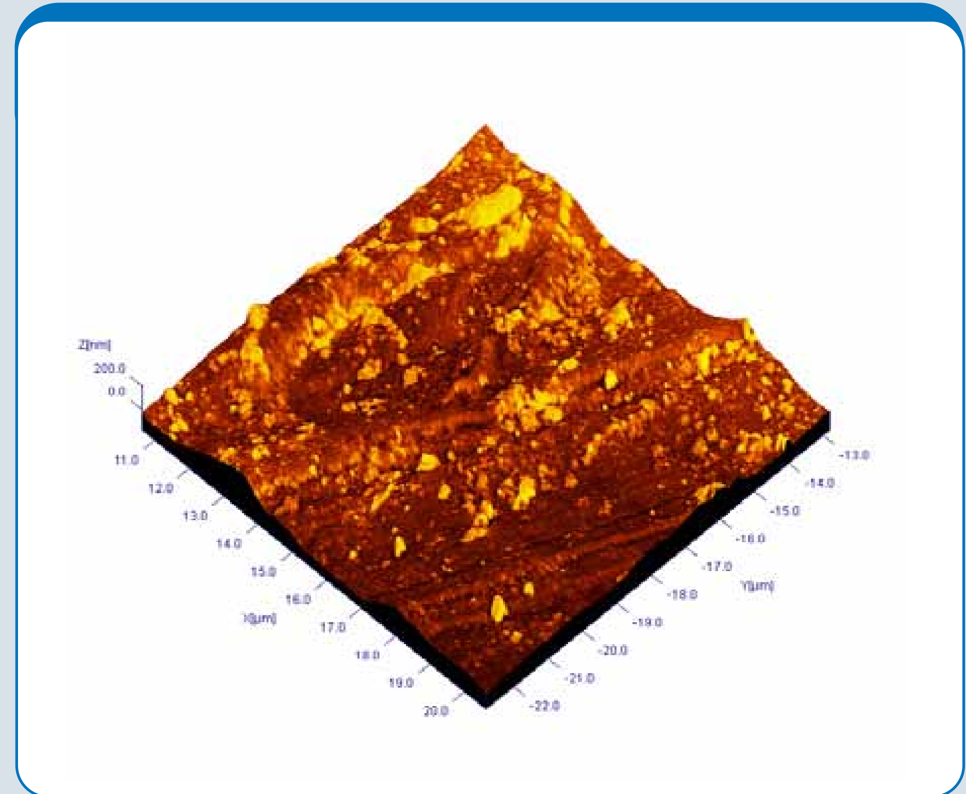
What is an AFM?

The Bruker Difference

NANOS in Action

What's new



NANOS – The Basis for Advanced AFM/SPM Instruments

- N8 ARGOS
- N8 NEOS
- N8 RADOS
- N8 TITANOS

N8 NEOS – The Workhorse in Surface Inspection

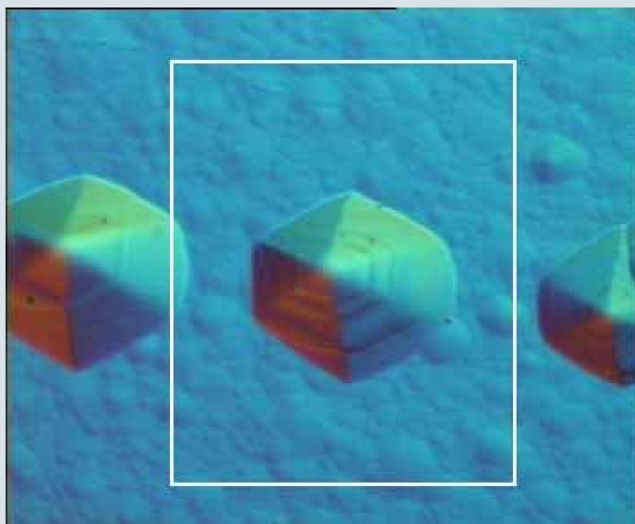
<u>Design Objective</u>

Objective based AFM that combines a research quality optical microscope with a research quality AFM

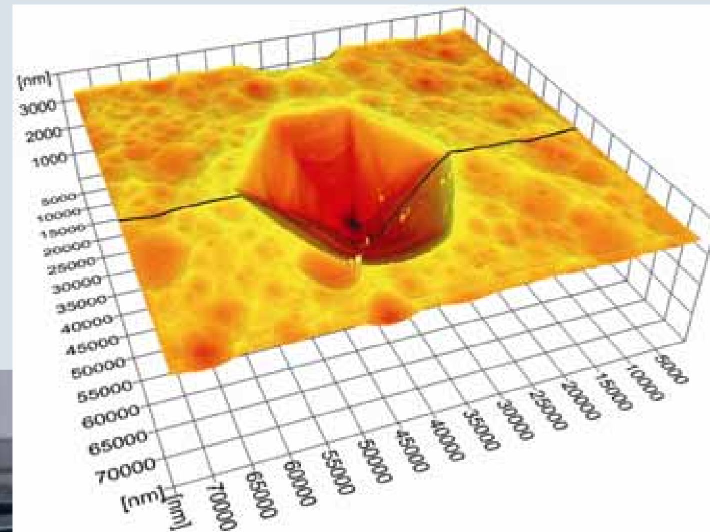
Maintaining all AFM functionality and angstrom level noise floor

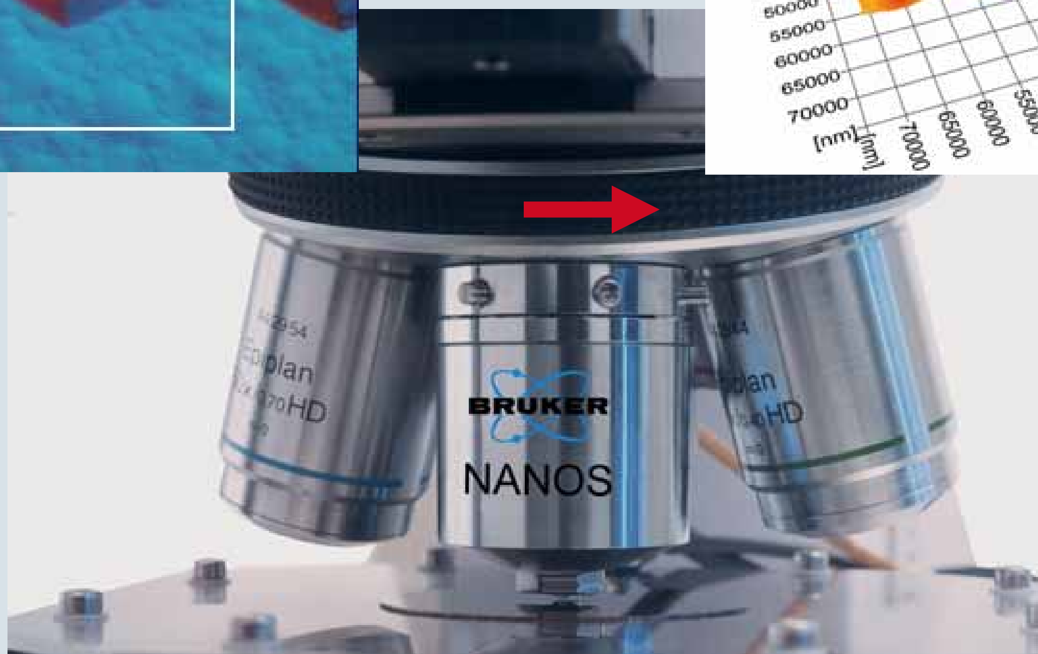
- excellent time-to-result performance
- rigid combination of optical microscopy and AFM/SPM
- simple switching between techniques
- flexible sample handling
- resolution below 1 nm

NANOS – The Unique AFM/SPM Most Compact AFM on the Market



DIC Image



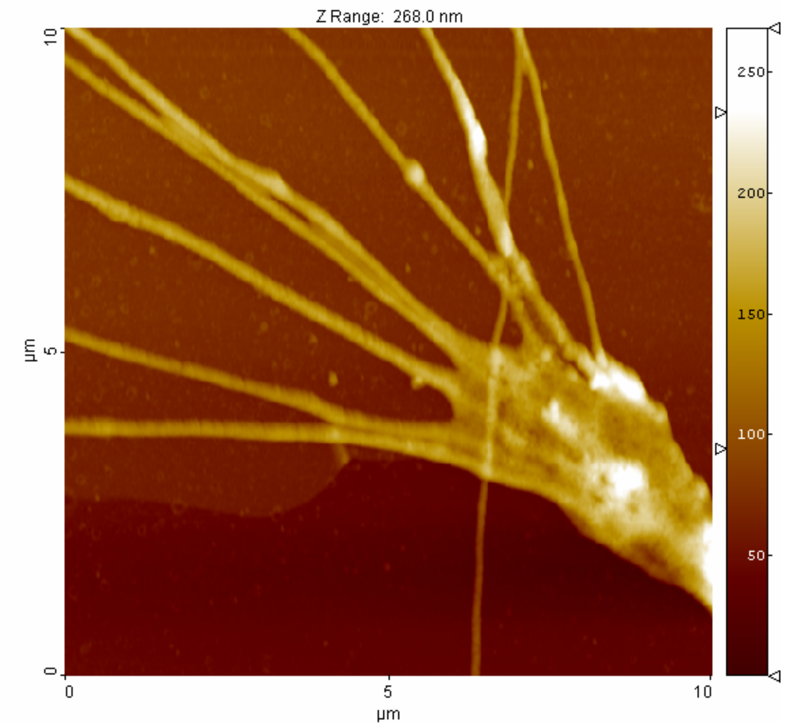


AFM Image

NANOS – The Unique AFM/SPM Most Compact AFM on the Market

Combination with optical microscope

Melanocyte Cell



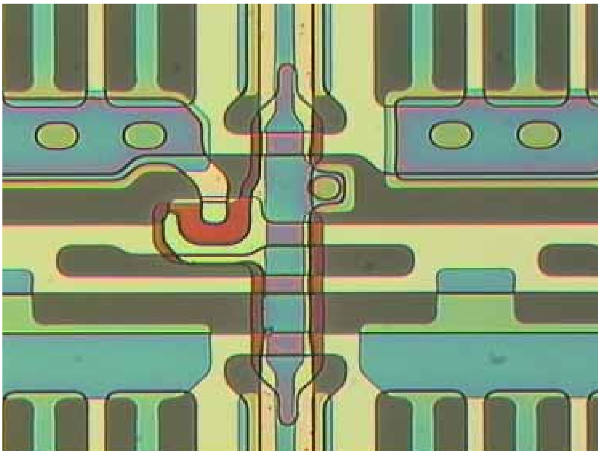
Optical Image
500x magnification

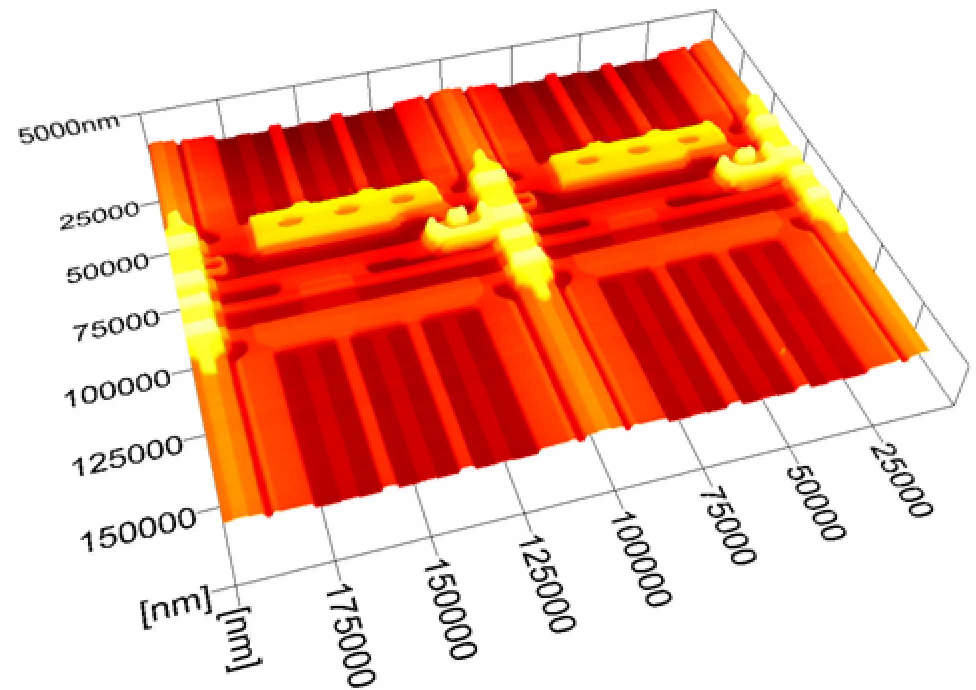
AFM Image
10 µm x 10 µm, Z-Range: 268 nm

NANOS – The Unique AFM/SPM Most Compact AFM on the Market

Combination with optical microscope

TFT Display





Optical Image:
DIC contrast, 500x magnification

AFM Image:
200 µm x 175 µm, Z-Range: 4980 nm

NANOS – The Basis for Advanced AFM/SPM Instruments

N8 ARGOS

N8 NEOS

N8 RADOS

N8 TITANOS

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N8 RADOS – The Industrial AFM/SPM

<u>Design Objective</u>

Inspection AFM that combines a research quality optical microscope with a research quality AFM

Employing a translation stage to shuttle the sample between the Optical Microscope and the AFM

- surface roughness <0.2nm
- location: near production line, rough environment
- high optical resolution to detect defects in Darkfield and DIC contrast
- height of scratches and defects <2nm
- automatic measurements

N8 RADOS – The Industrial AFM/SPM

- motorized stages
- in X-Y or X-Θ version

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- separated AFM/SPM on rigid stand
- up to 100 µm scan range
- resolution < 0.1 nm
- auto measurements

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- highest quality optics with BF/DF, DIC, etc.
- separated AFM/SPM on rigid stand
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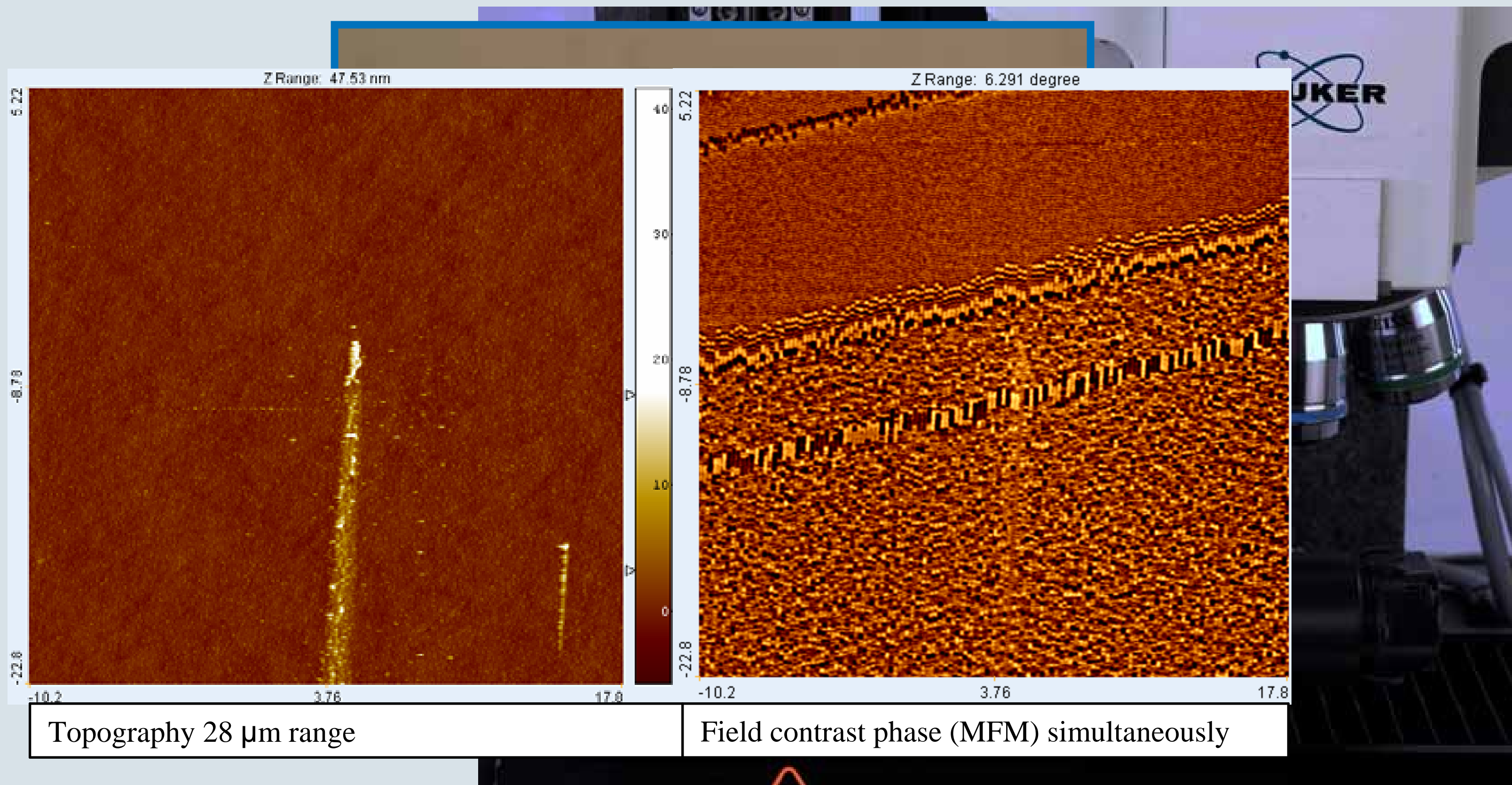
- resolution < 0.1 nm
- auto measurements
- scriber tool

N8 RADOS – The Industrial AFM/SPM



Topography 28 µm range

Field contrast phase (MFM) simultaneously

NANOS – The Basis for Advanced AFM/SPM Instruments

N8 ARGOS

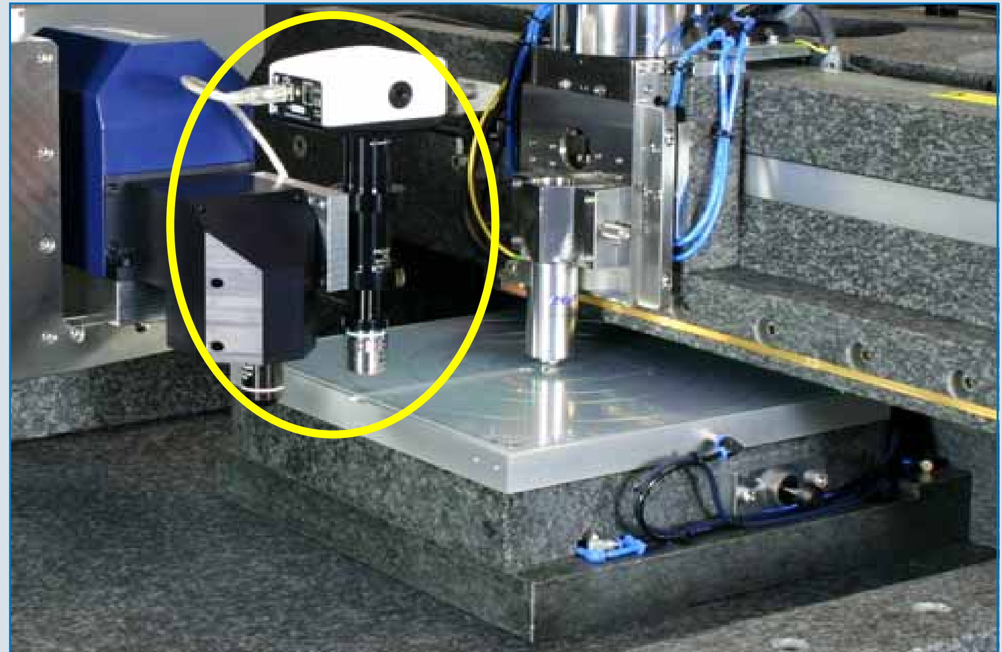
N8 NEOS

N8 RADOS

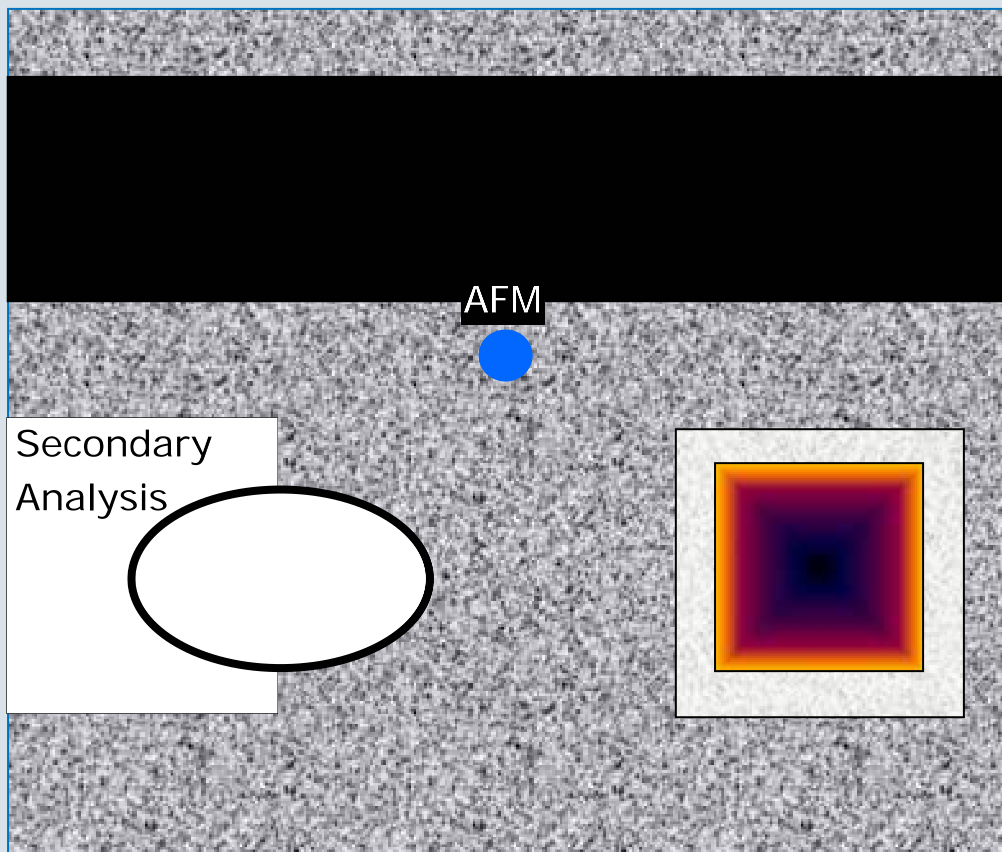
N8 TITANOS

N8 TITANOS – The Large Sample AFM/SPM Tool

- High efficiency for large sample AFM/SPM inspection: no sample transfer needed
- Measures samples of up to 300 mm size with quasi-atomic resolution
- Combined with automated wafer-inspection microscope or confocal microscope
- High position accuracy of $\pm$100 nm
- Near Zero X-Y stage drift, air-bearing stages
- Macro programmable and fully automated measurements
- Extremely rigid by using a solid granite body
- Highly flexible design



N8 TITANOS – The Large Sample AFM/SPM Tool



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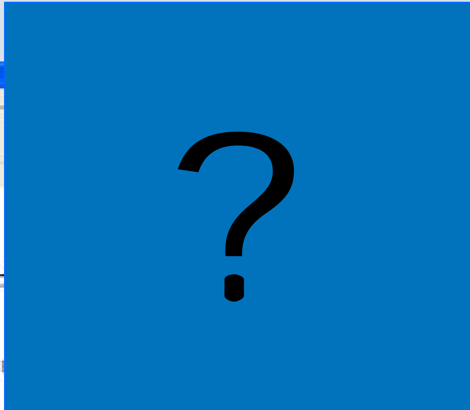
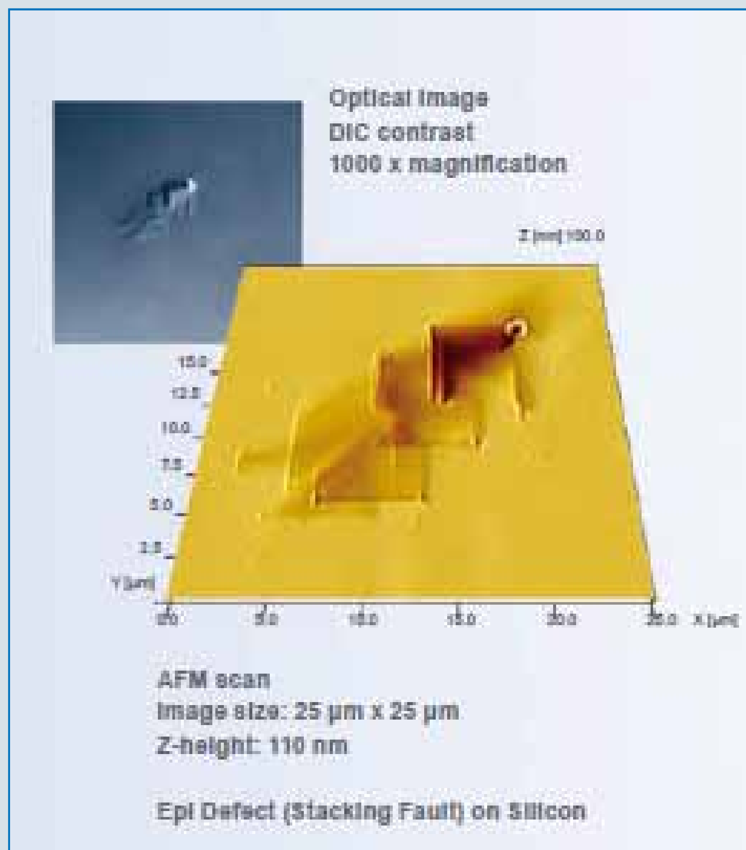


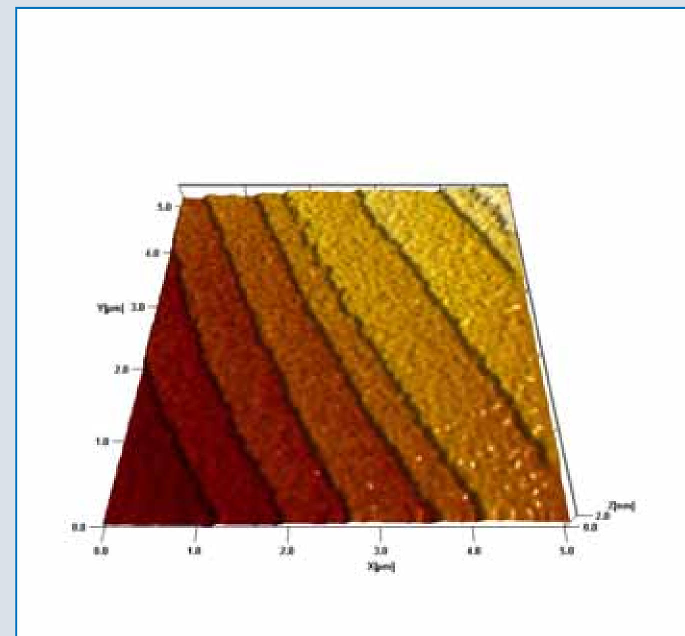
N8 TITANOS – The Large Sample AFM/SPM Tool

AFM

Secondary Analysis

N8 TITANOS – The Large Sample AFM/SPM Tool





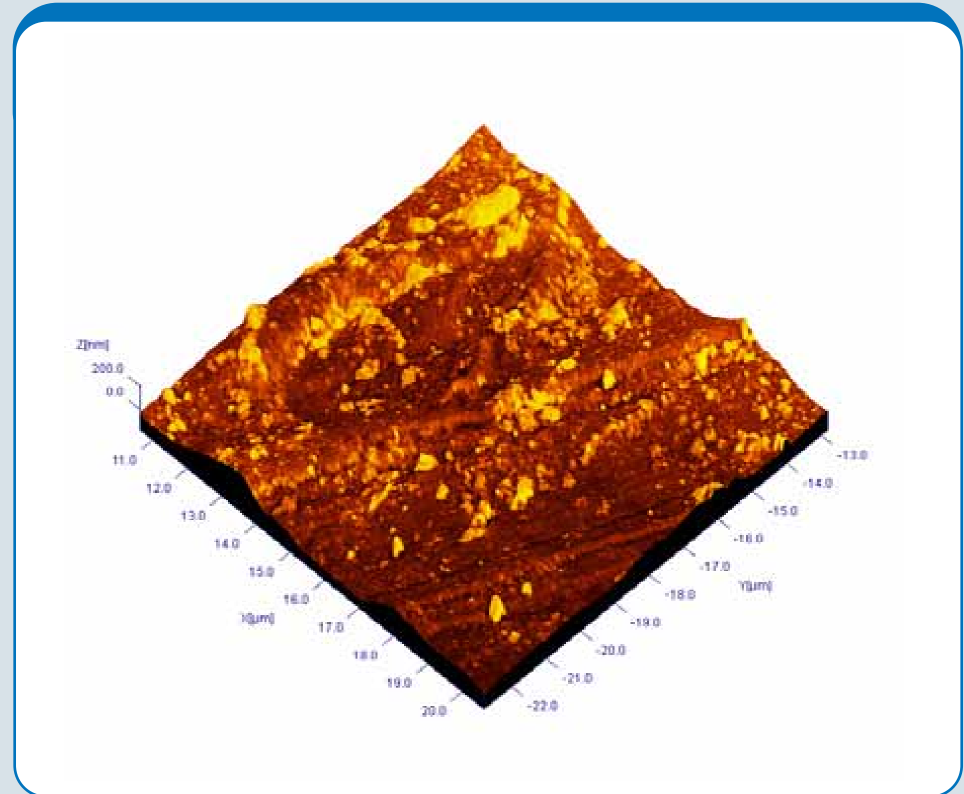
mono-atomic steps on Si 111

What is an AFM?

The Bruker Difference

NANOS in Action

What's New



SENTERRA with AFM N8 NEOS

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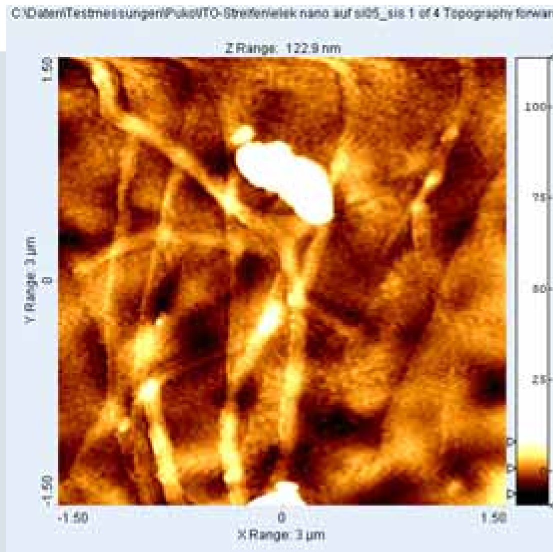
Bruker Nano's AFM objective

- including scanner and cantilever
- mounted on the nosepiece as any optical objective
- Senterra mounted on a granite stand

SENTERRA with AFM

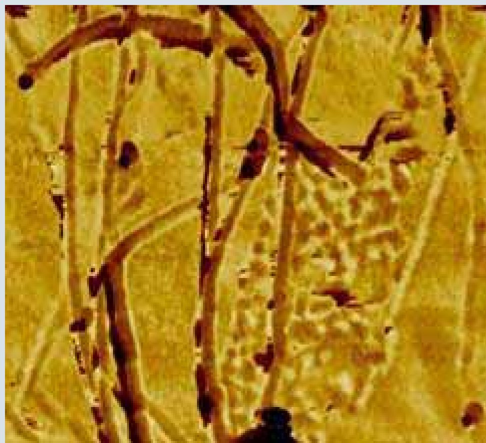


topography

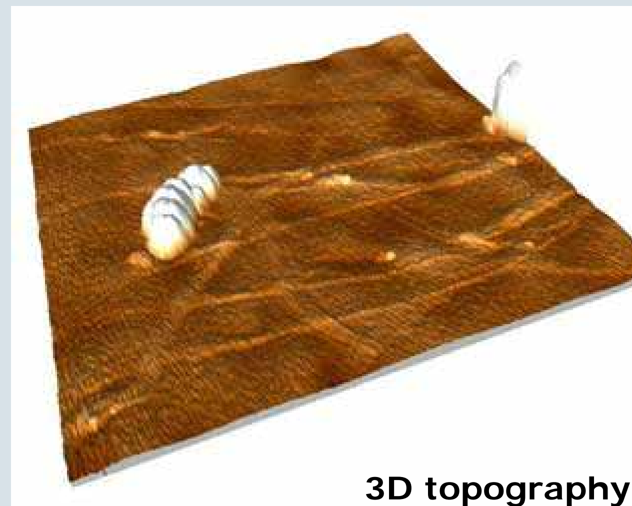
amplitude

Nanotubes on silicon

- Field of view: 3 x 3 µm
- Diameter of nanotubes about 100 nm



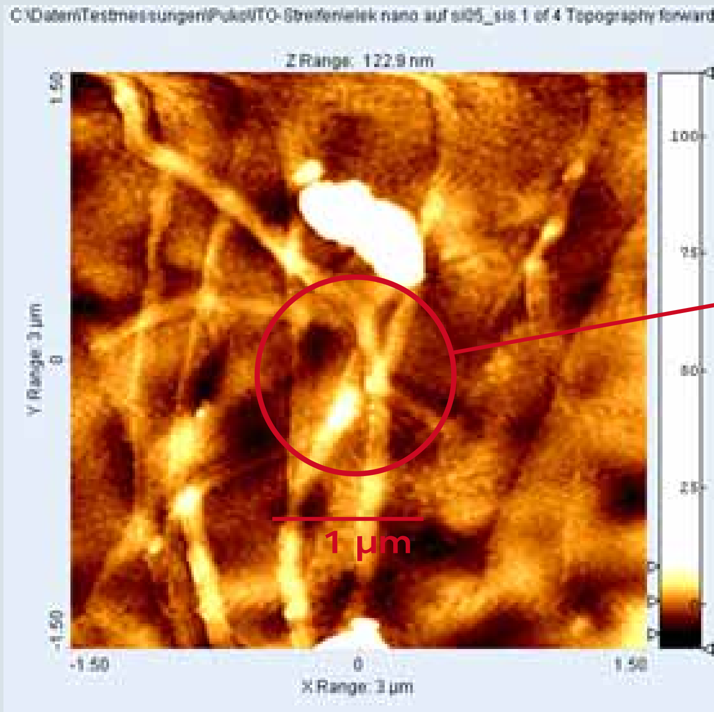
phase

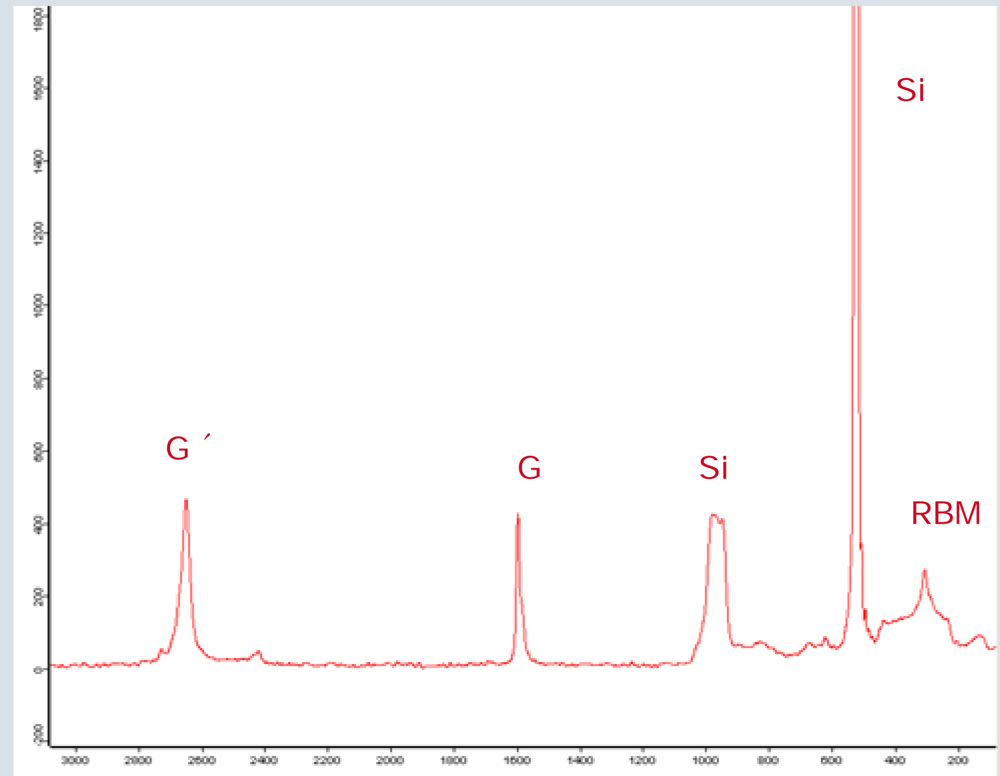


3D topography

SENTERRA with AFM

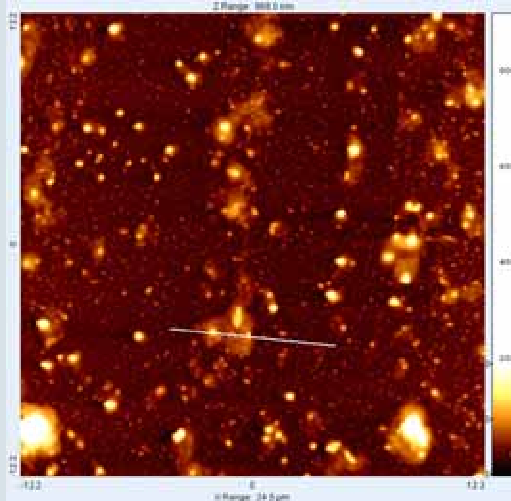
- **Nanotubes on silicon**
- Field of view: 3 x 3 µm
- Diameter of nanotubes about 100 nm

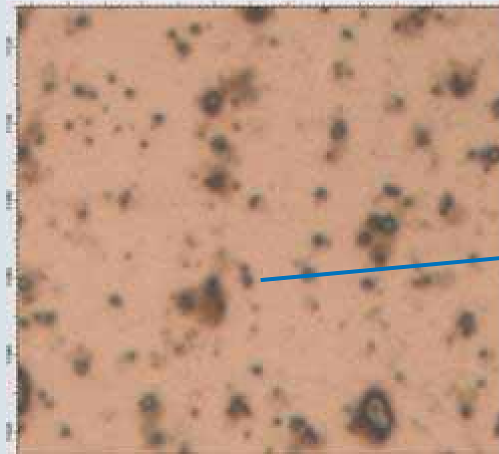




SENTERRA with AFM

AFM topography

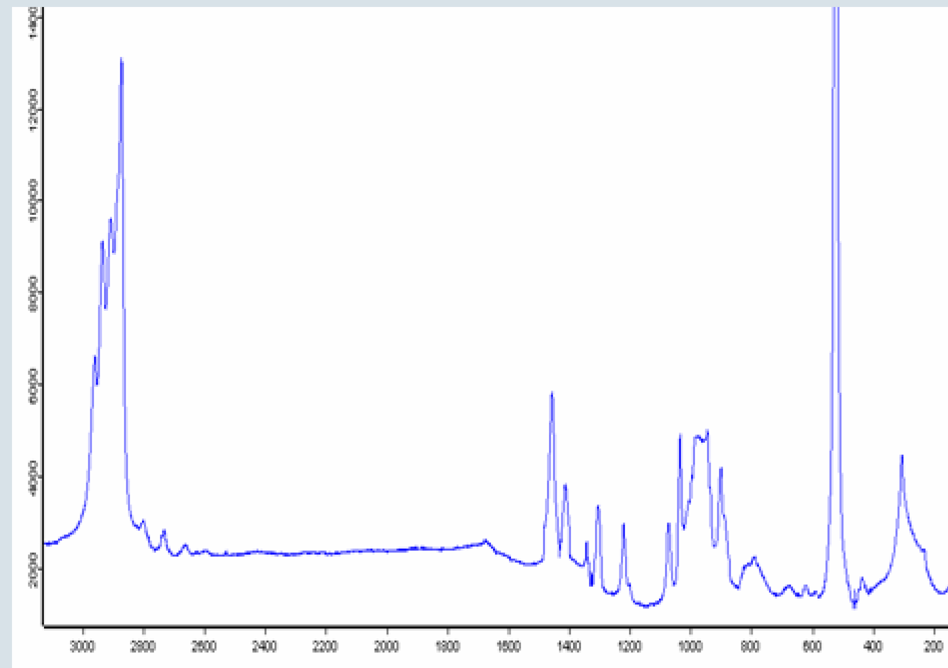




100x obj.

Siloxane on silicon

Field of view: 20 x 20 µm



NANOS

BRUKER

We have created an easy-to-use, customizable high-resolution metrology solution that couples research quality microscopy with state-of-the-art scanning probe technology.

Whether you need a basic research system or a 300-millimeter highly automated system, Bruker has an AFM that will meet your needs.

Bruker Nano AFMs

	NANOS	N8 NEOS	N8 ARGOS	N8 RADOS	N8 TITANOS
upgrade AFM	X				
routine lab instrument	X	X			
routine lab instrument, automated				X	
localized objects, defect inspection	X	X		X	X
sample sizes up to 50 mm	X	X	X	X	
sample sizes up to 100 mm		X	X	X	
sample sizes up to 150 mm		X		X	X
sample sizes up to 300 mm					X
application in liquids	X	X	X		

Bruker Nano AFMs

	NANOS	N8 NEOS	N8 ARGOS	N8 RADOS	N8 TITANOS
req. resolution ~ 1 nm	X	X	X	X	X
req. resolution ~ 0.1 nm		X	X	X	X
req. resolution > 0.05 nm			X	X	X
quasi atomic resolution			X		
semiconductor industry				X	X
Industry, R&D, QA		X		X	
basic research		X	X		
automated systems				X	X
teaching instrument		X	X		

Any Questions?

Please type any questions you may have in the Q&A panel and then click Submit.

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Thank you for attending!

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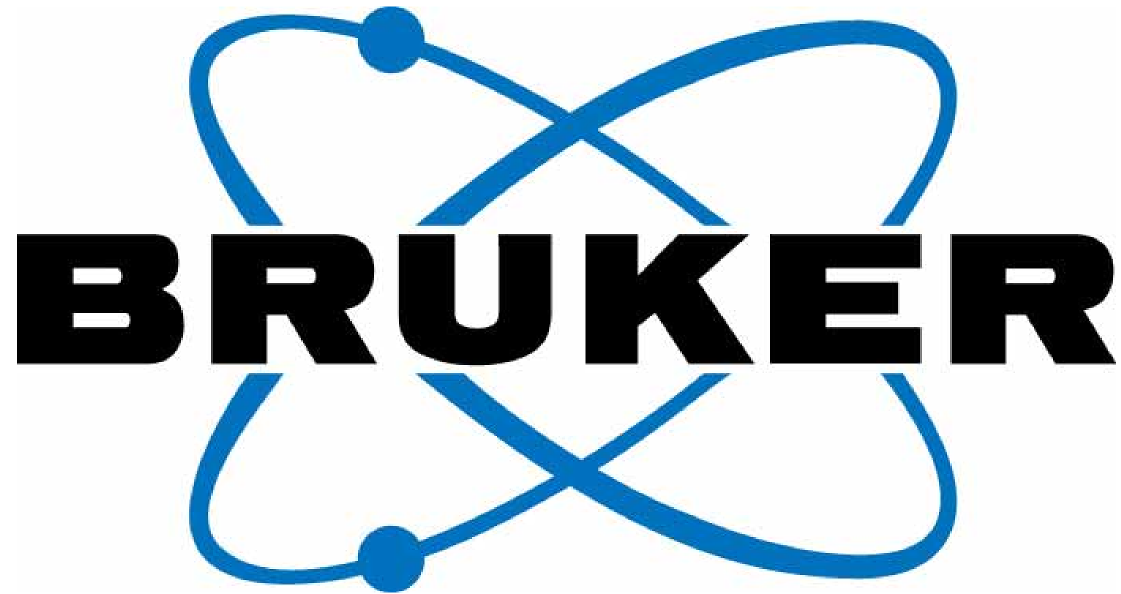
Please take a moment to complete the brief survey on your screen. Your feedback is very important to us.



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