Contents

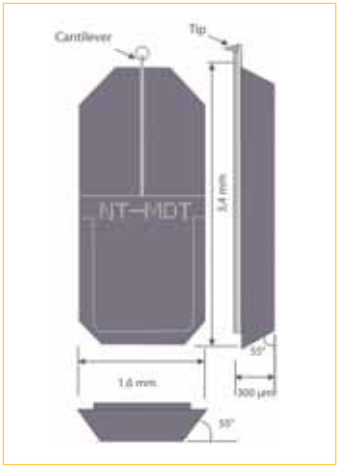
AFM "Golden" Silicon Probes

Au coating is chemically stable and suitable for air and liquid AFM measurements

General Information

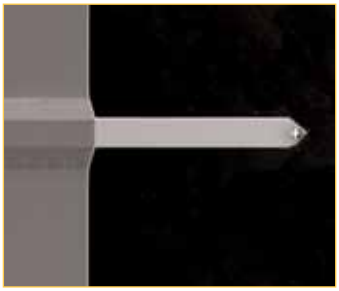
Substrate

- Material: Single Crystal Silicon, N-type, resistivity 0.01-0.025 Ohm-cm, Antimony doped.
- Standard chip size: 1.6x3.4x0.3 mm.
- Cross-section is trapezium-shape.
- High reflective chemically stable Au back side coating (reflectivity is 3 times better in comparison with uncoated probes).
- Compatible with the most of commercial AFM devices.
- The base silicon is highly doped to avoid electrostatic charges.



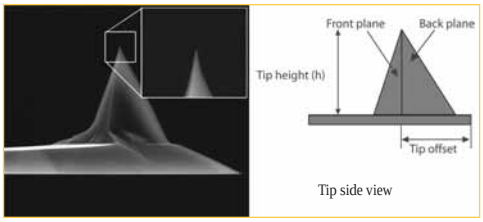
Cantilever

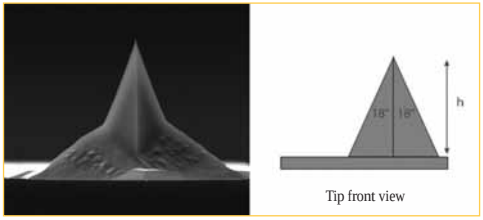
- Rectangular shape.
- Cross-section is trapezium-shape.
- Backside width is given in probes specifications.
- Available for contact, semicontact and noncontact modes.
- Tip is set on the controlled distance 5-20µm from the free cantilever end.



Tip

- Total tip shape is tetrahedral, the last 500nm from tip apex is cylindrical.
- Tip height: 14 – 16 µm.
- Typical curvature radius of uncoated tips 6 nm, guaranteed 10nm.
- Tip offset: 5 - 20 µm.
- Tip aspect ratio: 3:1 – 7:1.
- Front plane angle: 10°± 2°.
- Back plane angle: 30°± 2°.
- Side angle (half): 18°± 2°.
- Cone angle at the apex: 7° - 10°.





"Golden" Silicon Probes are available:

- with Au and Al reflective coating
- with PtIr, TiN, Au, diamond doped conductive coating
- with CoCr magnetic coating
- with no coatings (bare)
- tipless

Probes are packaged in GelPak® boxes. (GelPak® is a registered trade mark of Vichem Corporation)

Guaranteed product yield is better than 90%.

Probe series name

NSG01/TIN

Recommended measuring mode:
N - noncontact, semicontact
C - contact

Probe series

Tip coating

Semicontact/ noncontact probes

NSG01 series

Substrate specification

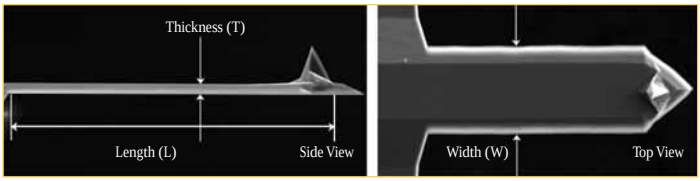
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au; magnetic CoCr
Available probes	bare, tipless, with Al reflective coating

Code for ordering

NSG01/15	15 separated chips
NSG01/50	50 separated chips
NSG01W	Minimum 410 chips

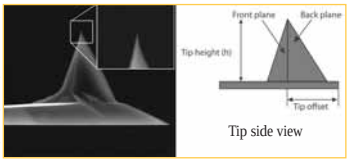
Cantilever specification

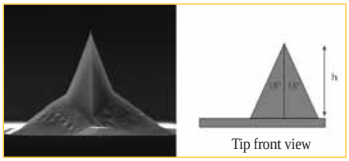
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
125	30	2.0	87	150	230	1.45	5.1	15.1



Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°





NSG03 series

Substrate specification

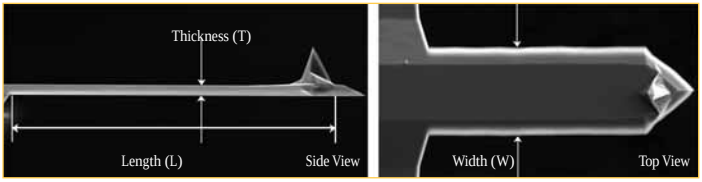
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au
Available probes	bare, tipless, with Al reflective coating

Code for ordering

NSG03/15	15 separated chips
NSG03/50	50 separated chips
NSG03W	Minimum 410 chips

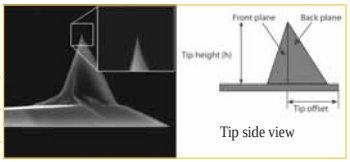
Cantilever specification

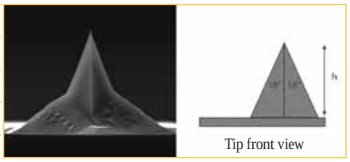
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
135	30	1.5	47	90	150	0.35	1.74	6.1



Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°





NSG10 series

Substrate specification

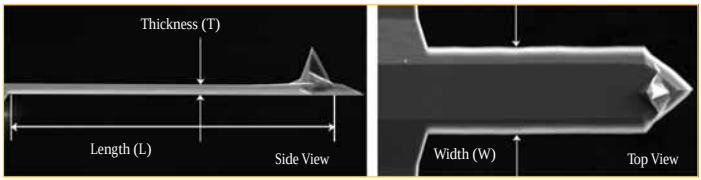
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au
Available probes	bare, tipless, with Al reflective coating

Code for ordering

NSG10/15	15 separated chips
NSG10/50	50 separated chips
NSG10W	Minimum 410 chips

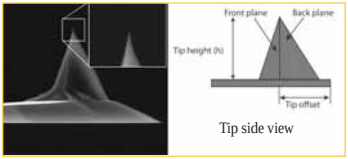
Cantilever specification

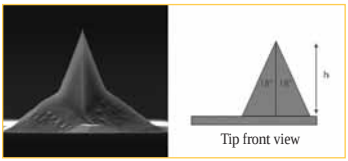
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
95	30	2.0	140	240	390	3.1	11.8	37.6



Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°





NSG30 series

Substrate specification

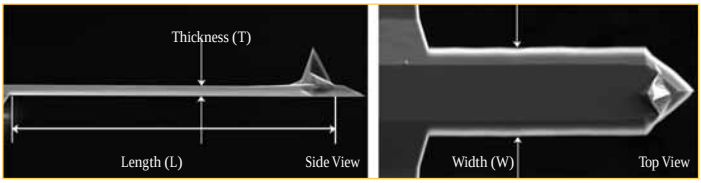
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au
Available probes	bare, tipless, with Al reflective coating

Code for ordering

NSG30/15	15 separated chips
NSG30/50	50 separated chips
NSG30W	Minimum 410 chips

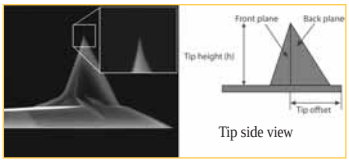
Cantilever specification

Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
125	40	4.0	240	320	440	22	40	100

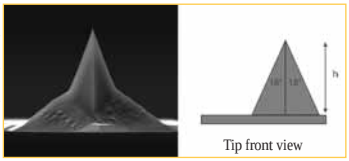


Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°



Tip side view



Tip front view

Force Modulation probes

FMG01 series

Substrate specification

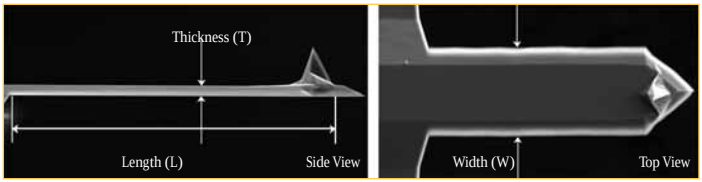
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au; magnetic CoCr
Available probes	bare, tipless, with Al reflective coating

Code for ordering

FMG03/15	15 separated chips
FMG03/50	50 separated chips
FMG03W	Minimum 410 chips

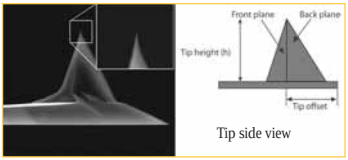
Cantilever specification

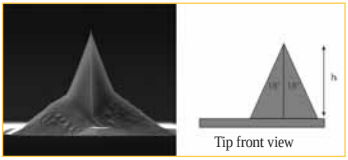
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	32	2.5	50	60	70	1	3	5



Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°





Contact probes

CSG01 series

Substrate specification

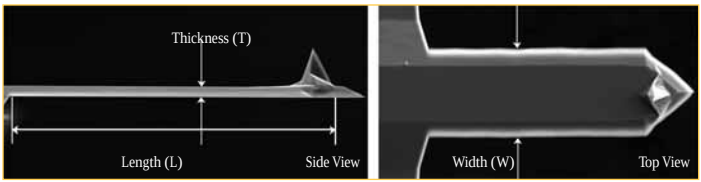
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au
Available probes	bare, tipless, with Al reflective coating

Code for ordering

CSG01/15	15 separated chips
CSG01/50	50 separated chips
CSG01W	Minimum 410 chips

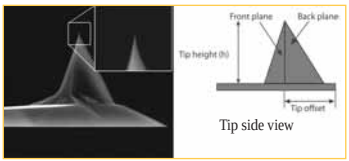
Cantilever specification

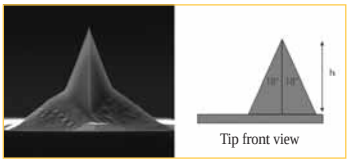
Cantilever length, L±15 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
350	30	1.0	4	9.8	17	0.003	0.03	0.13



Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°





CSG10 series

Substrate specification

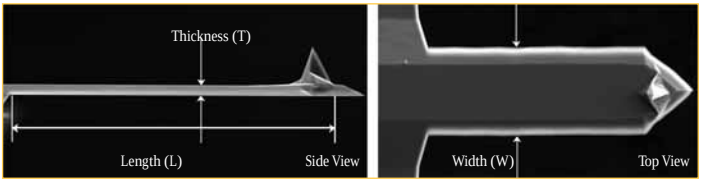
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ohm-cm, Antimony doped
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	conductive PtIr, TiN, Au
Available probes	bare, tipless, with Al reflective coating

Code for ordering

CSG10/15	15 separated chips
CSG10/50	50 separated chips
CSG10W	Minimum 410 chips

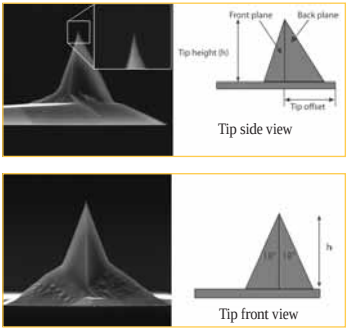
Cantilever specification

Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	30	1.0	8	22	39	0.01	0.11	0.5



Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°



Conductive probes

NT-MDT offers 4 conductive coatings: Au, PtIr, TiN, diamond doped.

- All noncontact/semicontact, force modulation and contact probes are available with Au, PtIr, TiN conductive coatings.
- Probes DCP20 and DCP11 are with diamond doped conductive coating (see detailed information about this product in the chapter "Diamond Coated Conductive Probes")

Tip coating	Thickness	Adhesion layer	Tip curvate radius
Au	35 nm	Ti(25A)	~ 35 nm
Pt	25 nm	Cr(25A)	
TiN	25 nm	No adhesion layer	

Contact probes with Au, Pt, TiN conductive coatings:

Conductive coating	Available with probe series	Code for ordering	
		15 separated chips	50 separated chips
Au	CSG10	CSG10/Au/15	CSG10/Au/50
	CSG01	CSG01/Au/15	CSG01/Au/50
PtIr	CSG10	CSG10/Pt/15	CSG10/Pt/50
	CSG01	CSG01/Pt/15	CSG01/Pt/50
TiN	CSG10	CSG10/TiN/15	CSG10/TiN/50
	CSG01	CSG01/TiN/15	CSG01/TiN/50

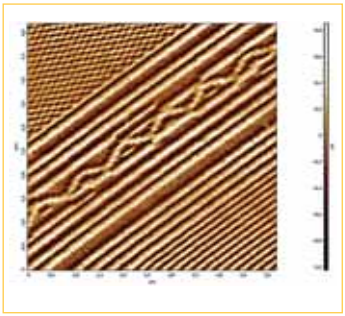
Semicontact/noncontact probes with conductive coatings:

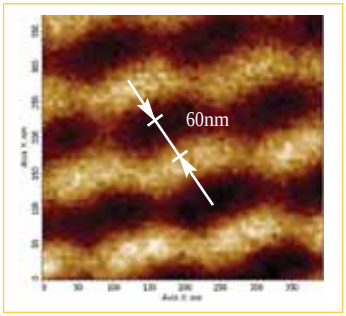
Conductive coating	Available with probe series	Code for ordering	
		15 separated chips	50 separated chips
Au	NSG10	NSG10/Au/15	NSG10/Au/50
	NSG01	NSG01/Au/15	NSG01/Au/50
	NSG30	NSG30/Au/15	NSG30/Au/50
	NSG03	NSG03/Au/15	NSG03/Au/50
	FMG01	FMG01/Au/15	FMG01/Au/50
PtIr	NSG10	NSG10/Pt/15	NSG10/Pt/50
	NSG01	NSG01/Pt/15	NSG01/Pt/50
	NSG30	NSG30/Pt/15	NSG30/Pt/50
	NSG03	NSG03/Pt/15	NSG03/Pt/50
	FMG01	FMG01/Pt/15	FMG01/Pt/50
TiN	NSG10	NSG10/TiN/15	NSG10/TiN/50
	NSG01	NSG01/TiN/15	NSG01/TiN/50
	NSG30	NSG30/TiN/15	NSG30/TiN/50
	NSG03	NSG03/TiN/15	NSG03/TiN/50
	FMG01	FMG01/TiN/15	FMG01/TiN/50

Magnetic probes

NT-MDT offers NSG01 and FMG01 probe series with Co/Cr magnetic coating.
Top Cr coating protects the magnetic layer from oxidation.
Thickness of magnetic coatings is about 40nm.
Tip curvature radius after coating is 30-40nm.

Coating	Type of magnetic coating	Available probe series
Co/Cr	middle	NSG01, FMG01





SPM magnetic image of hard disk (capacity 200GB)
obtained by probe NSG01/Co (resolution is about 60nm).

Substrate specification

Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ohm-cm, Antimony doped.
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular
Coating	CoCr magnetic coating

Cantilever specification

NSG01 series

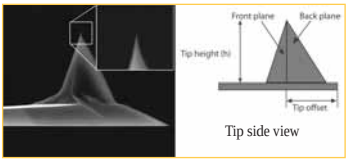
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
125	30	2.0	87	150	230	1.45	5.1	15.1

FMG01 series

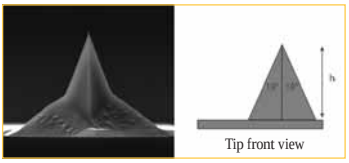
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	32	2.5	50	60	70	1	3	5

Tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical.
Tip height	14 – 16 µm
Curvature radius	~ 40 nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°



Tip side view



Tip front view

Code for ordering

NSG01/Co/15	15 separated chips with Co/Cr coating
FMG01/Co/15	
NSG01/Co/50	15 separated chips with Co/Cr coating
FMG01/Co/50	

Tipless probes

Probe series:

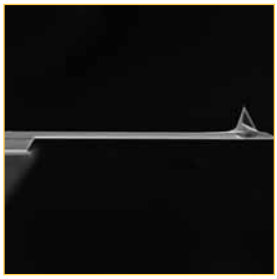
noncontact/semicontact	NSG10, NSG01, NSG30, NSG03
force modulation	FMG01
contact	CSG10, CSG01

are available without tips.

Code for ordering

Semicontact/noncontact	
NSG10/tipless/15	
NSG01/tipless/15	
NSG30/tipless/15	15 separated chips
NSG03/tipless/15	
NSG10/tipless/50	
NSG01/tipless/50	50 separated chips
NSG30/tipless/50	
NSG03/tipless/50	
Force modulation	
FMG01/tipless/15	15 separated chips
FMG10/tipless/50	50 separated chips
Contact	
CSG10/tipless/15	
CSG01/tipless/15	15 separated chips
CSG10/tipless/50	50 separated chips
CSG01/tipless/50	

Bare probes



Probe series:

noncontact/semicontact	NSG10, NSG01, NSG30, NSG03
force modulation	FMG01
contact	CSG10, CSG01

are available without any coatings (no reflective, no conductive coating).

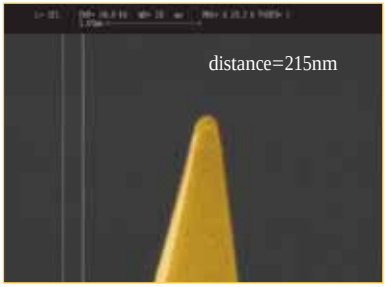
Code for ordering

Semicontact/noncontact	
NSG10/bare/15	15 separated chips
NSG01/bare/15	
NSG30/bare/15	
NSG03/bare/15	
NSG10/bare/50	50 separated chips
NSG01/bare/50	
NSG30/bare/50	
NSG03/bare/50	

Contact	
CSG10/bare/15	15 separated chips
CSG01/bare/15	
CSG10/bare/50	50 separated chips
CSG01/bare/50	

Force modulation	
FMG01/bare/15	15 separated chips
FMG10/bare/50	50 separated chips

Diamond coated conductive probes



The ideal probe for AFM Oxidation Nanolithography

Stable and nondestructive, wear resistant probe with conductive diamond coating allows you to make as many images as you want!

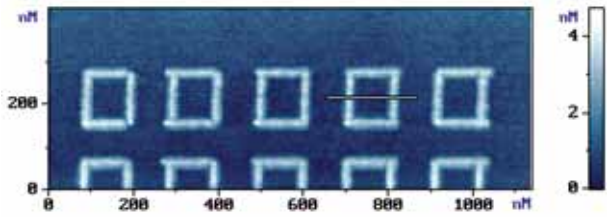
Coating Specification:

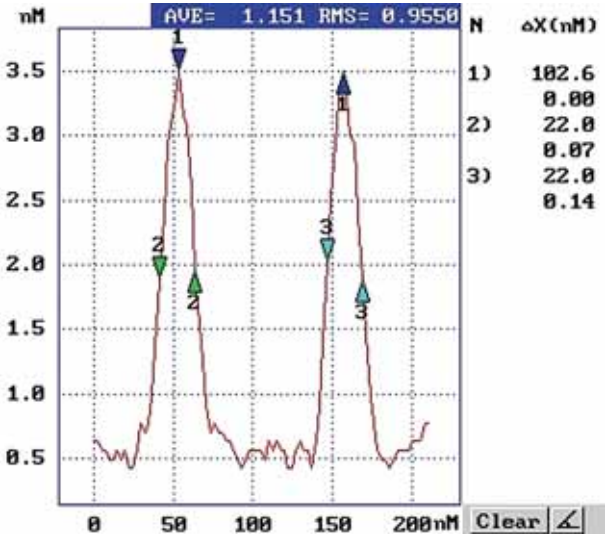
- Thickness of diamond coating is about 70nm.
- Diamond coating is doped with nitrogen.
- Film resistivity: 0,5-1 Ohm*cm
- Tip curvature radius after coating is about 50-70nm.
- Recommended for electrical modes
- Specially recommended for Oxidation Nanolithography*.

* We made a special "survival" test - almost 50 LAO Lithography images of Mona Lisa were obtained by using only one tip. It was not destroyed even after such a hard work. After 50 attempts it was still "alive".

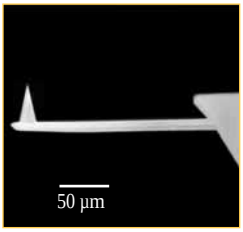
LAO Nanolithography was made on Ti film in Semicontact mode by NSG20 probe with conductive diamond coating, NTEGRA Aura system. Scan size: 8x8μm.

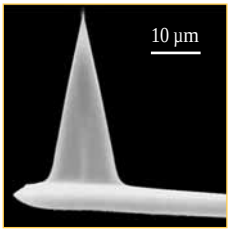
The thickness of lithography line is measured after the "survival" test. It is about 22nm.

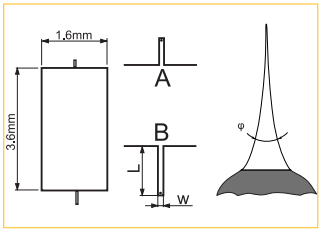




DCP11 series







Substrate specification

Chip size	3.6x1.6x0.4mm
Reflective side	Au
Cantilever number	2 rectangular
Coatings	Diamoned doped with nitrogen for conductivity
Thickness of diamond coating	~ 70nm

Cantilever specification

Cantilever length, L±5 µm	Cantilever width, W±3 µm	Cantilever thickness, µm			Resonant frequency, kHz			Force constant, N/m		
		min	typical	max	min	typical	max	min	typical	max
100	35	1.7	2.0	2.3	190	255	325	5.5	11.5	22.5
130	35	1.7	2.0	2.3	115	150	190	2.5	5.5	10

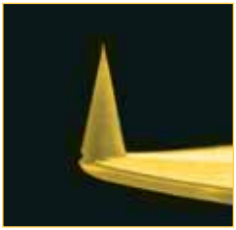
Tip specification

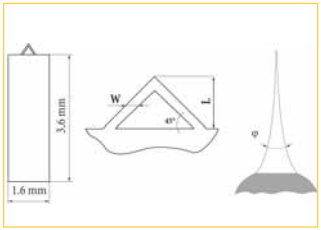
Aspect ratio	3:1
Tip height	10-15 µm
Tip cone angle φ	≤22°
Typical curvature radius	50-70nm

Code for ordering

DCP11/15	15 separated chips
DCP11/50	50 separated chips

DCP20 series





Chip specification

Chip size	3.6x1.6x0.4mm
Reflective side	Au
Cantilever number	1 triangular
Coating	diamond doped with nitrogen for conductivity
Thickness of diamond coating	~70nm

Cantilever specification

Cantilever length, L±5 µm	Cantilever width, W±3 µm	Cantilever thickness, µm			Resonant frequency, kHz			Force constant, N/m		
		min	typical	max	min	typical	max	min	typical	max
90	60	1.7	2.0	2.3	260	420	630	28	48	91

Tip specification

Aspect ratio	3:1
Tip height	10-15µm
Tip cone angle φ	≤22°
Typical curvature radius	50-70nm

Code for ordering

DCP20/15	15 separated chips
DCP20/50	50 separated chips

Etalon

NEW!!

the next generation of AFM probes

Advanced features:

- High aspect ratio tip
- Resonant frequency is specified with high accuracy
- Enhanced reflection
- Economic price

Why is the tip aspect ratio so high?

Because the probe geometry allows to reduce significantly the tip basement diameter while maintaining the tip height.

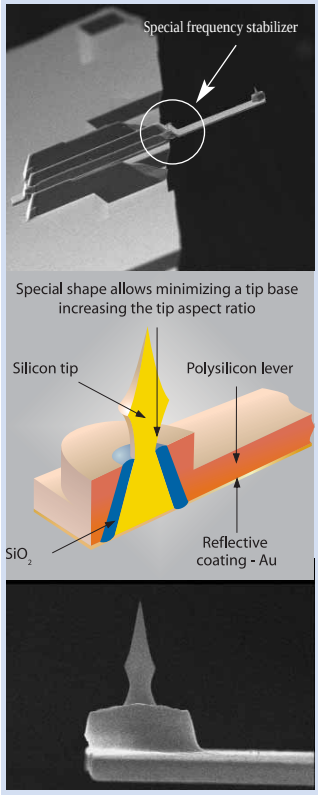
In addition the tip itself is sharp - typical curvature radius is 10 nm.

How is the resonance frequency specified with such high accuracy?

Because the patented technology applied for cantilever manufacturing allows strict control of the lever thickness (±0.07 μm only!).
Moreover a special frequency stabilizer guarantees a high accuracy of the lever length (±2 μm).

Why is the reflection so high?

Because the cantilever back-side is almost atomically smooth.
Roughness* is less than 2nm!
Reflection is further increased by Au coating.
*RMS on the area 20x20 μm as measured by AFM



The new High Accuracy "ETALON" probe series have polysilicon levers with silicon high resolution tips. Due to the technology used for lever manufacturing they have very reproducible parameters that leads to exact values for probe resonant frequency and force constant (typical dispersion ±20%).
Moreover the new High Accuracy "ETALON" probes have low noise when operating in contact and noncontact AFM modes. It is possible due to the fact that the polysilicon material in the lever is softer than the silicon one usually used for probes production. Polysilicon levers have a shorter length compared to silicon probes at the same force constant value.
High Accuracy "ETALON" probes have high aspect ratio silicon tips (cone angle φ22°) with a typical curvature radius of 10nm.

Comparison between polysilicon and silicon probes

Comparative parameters	Polysilicon	Silicon
Thickness deviation	± 0.07μm	±0.3μm
Roughness of reflective surface	2nm	20nm
Lever material	Soft, flexible	Fragile after dopping
Resonant frequency	Typical dispersion ± 20%	Till ±100%
Force constant	Typical dispersion ± 20%	Till ±100%

High Accuracy NONCONTACT "ETALON" probes HA_NC series

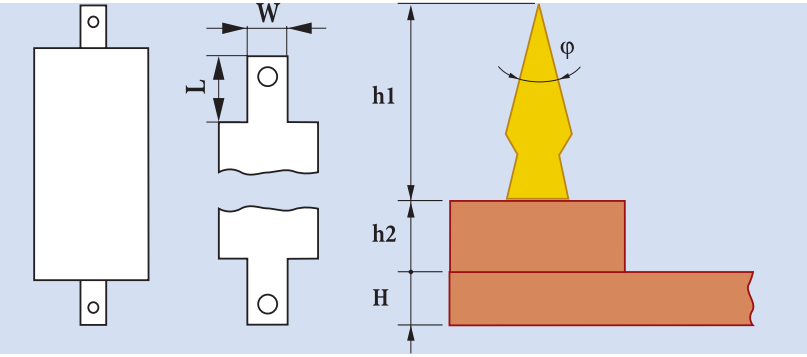
- Standard chip size: 1.6x3.6x0.45 mm.
- High reflective Au coating.
- Typical curvature radius of a tip: 10 nm.
- Total tip height : 9–16 μm.
- Each chip has two RECTANGULAR springs.
- Recommended for noncontact/semicontact modes.
- Packaged in GelPak® boxes.

GelPak® is a registered trade mark of Vichem Corporation

Unique color and NT-MDT logo on each cantilever chip

Specification for HA_NC probes

Chip thickness	0.45 mm
Reflective side	Au
Spring number	2
Tip height h1	5–10 μm
Tip base height h2	4–6 μm
Ratio h1/h2	>1
Tip aspect ratio	5:1
Cone angle φ	⩽22°
Curvature radius of a tip	typical 10 nm



Cantilever series	Spring	Cantilever lenght, L±2μm	Cantilever width, W±3μm	Cantilever thickness H, μm			Resonant frequency, kHz		Force constant, N/m	
				min	typical	max	Nominal	Typical dispersion	Nominal	Typical dispersion*
HA_NC	A	87	32	1.68	1.75	1.82	200	±10%	5.8	±20%
	B	117	32	1.68	1.75	1.82	120	±10%	3.4	±20%

Code for ordering

HA_NC/15	15 separated chips
HA_NC/50	50 separated chips

AFM "Whisker Type" Focused Electron Beam (FEB) Tips

Not even every surface of interest has a plain structure.Moreover, in most cases it may have a rather complicated topography, with many ups and downs. To investigate such features properly matching this task probe must be used.A standard probe has a limited size and in case of narrow gaps cannot fit them (too short and wide). Also it's true when the height's difference is greater than the probe's dimensions.

NT-MDT offers a special probe, designed for studying deep holes, trenches and narrow gaps. It differs from any standard probe by having at the very end a long and slim "whisker" (Fig. 1).
This small modification has a great impact in terms of making the probe a perfect instrument for investigation of narrow gaps. It gives the following advantages:
To profile a shape of sidewalls. Due to a variable angle of inclination (see Fig.2), no more mechanical restriction! The "whisker" tips go deeper inside narrow gaps when the standard cantilevers fail to measure!

For imaging of the trench's bottom. That is not possible using a standard probe due to its size's limitations, but because of the very high aspect ratio of "Whisker" tip we can do it easily.
Let's see how it works on a simple example.
The structure shown on the Fig.3 was investigated by two different probes – standard probe and probe with "Whisker" tip.

Fig. 1 "Whisker Type" probes specially designed for measurement of samples with near vertical sidewalls

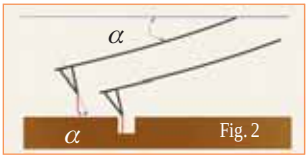


Fig. 2 Any angle of inclination α you need to match your SPM holder specification can be produced. Just specify the angle of inclination you want

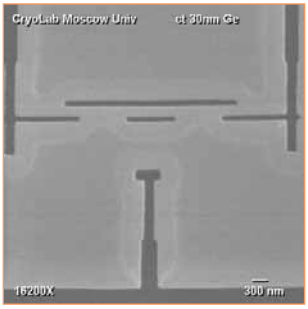
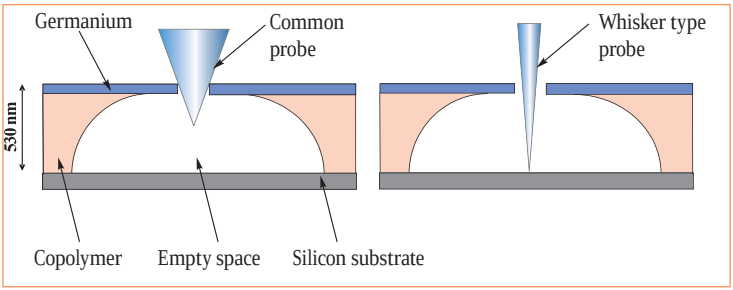


Fig. 3 SEM image of the structure. Dark places correspond to holes, while light colors correspond to absence of copolymer. Sample: E-beam lithography mask for fabrication SET devices by shadow evaporation technique. V.A. Krupenin, Cryoeletronics Lab., Physical department of MSU,Moscow, Russia

Graphical representation of the experiment



On the Fig.4 SPM images of the structure obtained by difrerent probes are shown – standard probe (on the left, Fig.4) and probe with "Whisker" tip(on the right, Fig.4). The width of gaps was about 100 nm.These images show the main advantage of the whisker: it goes much deeper and gives a uniform distribution of pattern, while the standard one fails even to reach the bottom!

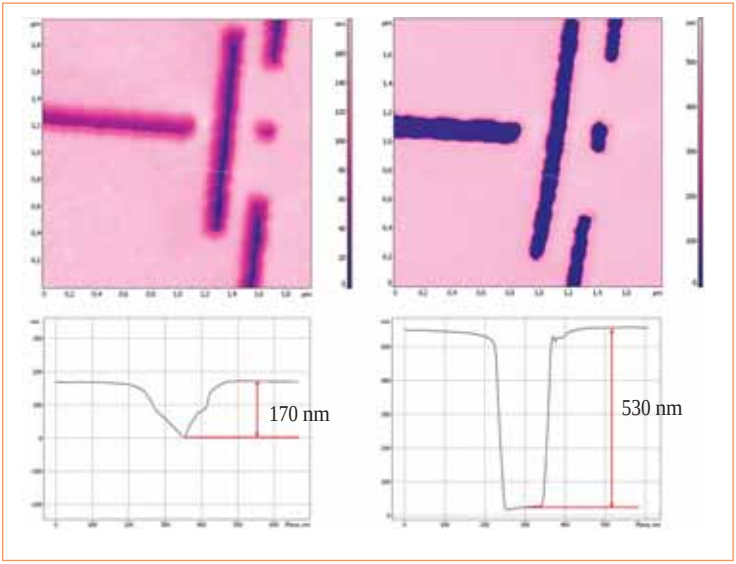
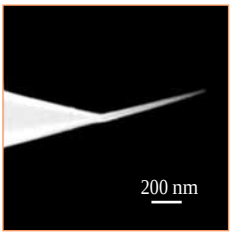


Fig. 4 On the left – results of imaging by the standard probe, the depth was only 170 nm reached.While the wisker achieved the bottom (530 nm) and showed a uniform distribution.

Calibrated SEM photos

Calibrated SEM photo for each "Whisker Type" tip is to let you know the real shape of the FEB tip.



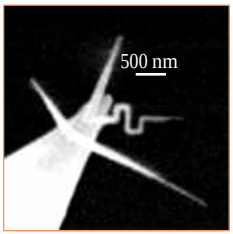
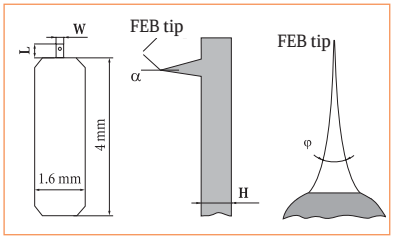


Fig. a: SEM image of FEB tip specially designed for measurement of samples with near vertical sidewalls.
Fig. b: SEM image of four FEB tips grown on the silicon tip in accordance with preset sketch.

FEB tip specification

Material	carbin (carbon modification)
Aspect ratio	better than 10:1
Angle φ	$\leq 10°$
Typical curvature radius	10nm
Angle of inclination α	$20° \pm 1°$; $10° \pm 1°$



Substrate specification

Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ohm-cm, Antimony doped.
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular

Cantilever specification

NSC05 series – for semicontact/noncontact mode

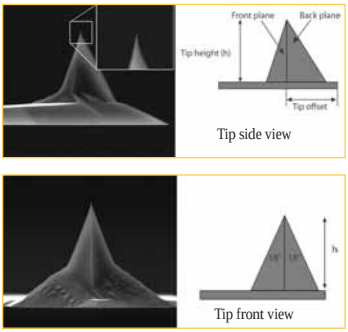
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
95	30	2,0	140	240	390	3,1	11,8	37,6

CSC05 series – for contact mode

Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	30	1,0	8	22	39	0,01	0,11	0,5

Silicon tip specification

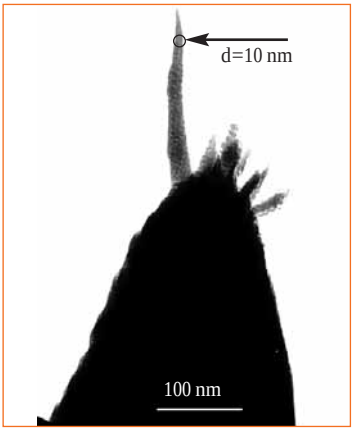
Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°



Code for ordering

NSC05/5	5 separated chips of "Whisker Type" probes for noncontact mode
CSC05/5	5 separated chips of "Whisker Type" probes for contact mode

AFM Super Sharp Diamond-like Carbon Tips



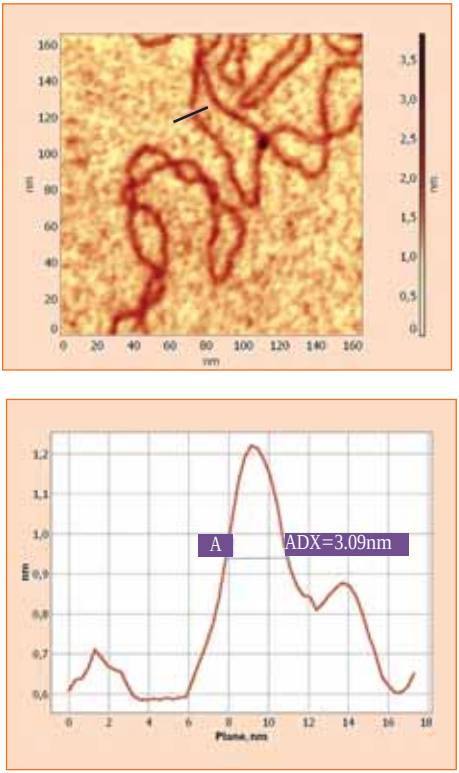
Super sharp diamond-like carbon (DLC) tips* with typical curvature radius 1nm are extremely useful for obtaining high resolution on objects with sizes of several nanometers. DLC tips have very long lifetime due to the high material durability.
To guarantee 20 nm working length of DLC tips TEM is used. 10% from total number of probes in the batch are selected for testing. At least 80% of those probes should have the only DLC tip which length is exceeded by 20nm others DLC tips on the same probe. In this case the whole batch is considered as passed the TEM test.

DLC tip specification:

Material	diamond-like carbon
Curvature radius	1-3nm
Working length	≥20nm
Probe series for growing	NSG01, NSG10**

*"Dmitry Klinov and Sergei Magonov, True molecular resolution in tapping-mode atomic force microscopy with high-resolution probes, Applied physics letters, 84 (14), (2004) 2697-2699."
** - DLC tips can be grown on any other probe series by request

SPM image of DNA deposited on HOPG is obtained by DLC tip.
DNA size (~3nm) is nearly equal to the real size!
Standard probes provide DNA imaging with size about 10-15nm



SPM image of unfolded DNA deposited on mica obtained by DLC tip by the NTEGRA Vita system

Substrate specification

Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ohm-cm, Antimony doped.
Chip size	3.4x1.6x0.3mm
Reflective side	Au
Cantilever number	1 rectangular

Cantilever specification

NSG01_DLC series

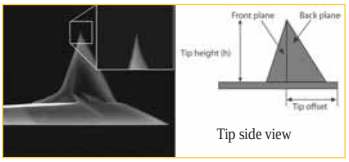
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
125	30	2,0	87	150	230	1,45	5,1	15,1

NSG10_DLC series

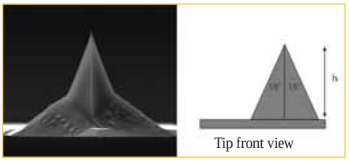
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0,5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
95	30	2,0	140	240	390	3,1	11,8	37,6

Silicon tip specification

Tip shape	tetrahedral, the last 500nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7° - 10°



Tip side view



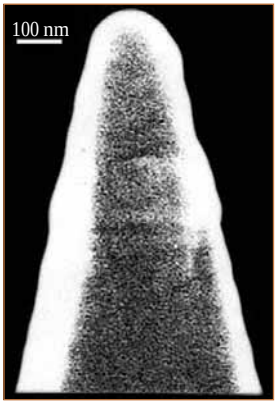
Tip front view

Code for ordering

NSG01_DLC/10 NSG10_DLC/10	10 separated chips for noncontact mode
NSG01_DLC/50 NSG10_DLC/50	50 separated chips for noncontact mode

SNOM probes and accessories

SNOM probes



SNOM probes specification:

Material	single mode optical fiber Nufern
Tip coating	vanadium (20nm) / aluminum (70nm).
Tip aperture (diameter uncoated by Al)	50/100 nm
Tip curvature radius	~100nm
Tip angler	25-30 degrees
Maximum optical input power	400 microwatt
Sharpening method	chemical etching *

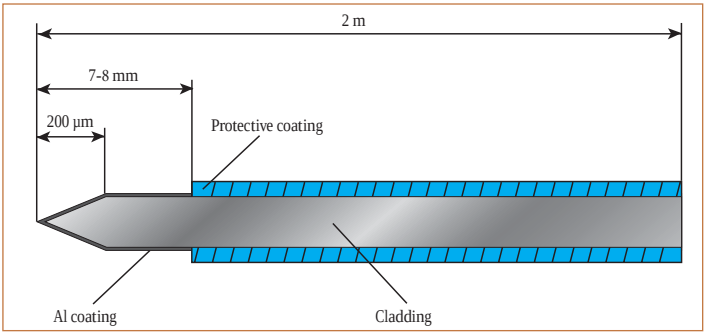
** This method gives the optical efficiency 10^{2} - 10^{4} times better than those obtained by mechanical pulling.*

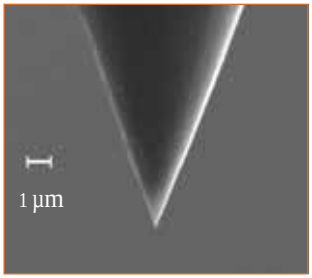
Geometrical & mechanical fiber specification:

Clad Diameter	125.0 ± 1.5 µm
Coating Diameter	245 ± 15 µm
Core-Clad Concentricity	<0.5 µm
Coating/Clad Offset	≤5 µm
Coating Material	UV Cured, Dual Acrylate
Operating Temperature	-55 to +85 °C
Short-Term Bend Radius	≥ 6 mm
Long-Term Bend Radius	≥ 13 mm
Proof Test Level	≥ 200 kpsi (1.4 GN/m²)

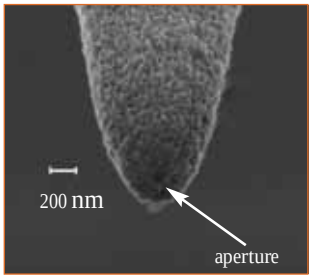
SNOM probe characteristics:

Characteristic	Probe type				
	MF001	MF002	MF003	MF004	MF005
Basic Nufern fiber	405-HP	460-HP	630-HP	780-HP	980HP
Operating wavelength, nm	400-550	450-600	600-770	780-970	980-1600
Mode Field Diameter	3.5 ± 0.5 µm @ 515 nm	3.5 ± 0.5 µm @ 515 nm	4.0 ± 0.5 µm @ 630 nm	5.0 ± 0.5 µm @ 850 nm	4.2 ± 0.5 µm @ 980 nm 6.8 ± 0.5 µm @ 1550 nm
Second Mode Cut-Off, nm	370 ± 20	430 ± 20	570 ± 30	730 ± 30	920 ± 30
Optical efficiency 100 nm aperture	$6x10^{-4}$	$4x10^{-4}$	$1x10^{-4}$	$4x10^{-5}$	$4x10^{-6}$
Optical efficiency 50 nm aperture	$6x10^{-5}$	$4x10^{-5}$	$1x10^{-5}$	$5x10^{-6}$	$4x10^{-7}$





Uncoated SNOM probe tip



Probe tip with Al coating. Aperture is about 70nm.

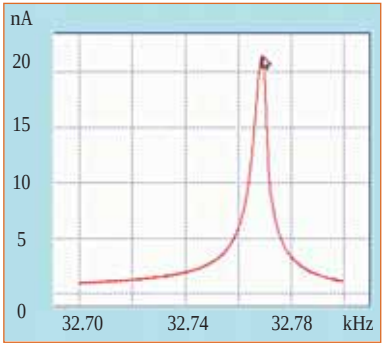
Code for ordering

MF001	Set of 10 SNOM probes MF001 type without tuning forks
MF002	Set of 10 SNOM probes MF002 type without tuning forks
MF003	Set of 10 SNOM probes MF003 type without tuning forks
MF004	Set of 10 SNOM probes MF004 type without tuning forks
MF005	Set of 10 SNOM probes MF005 type without tuning forks

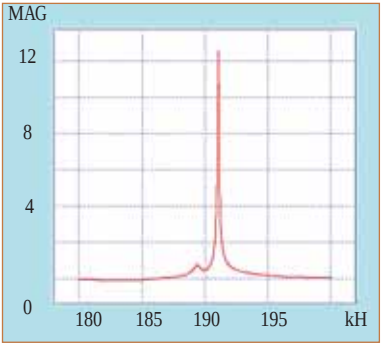
Tuning forks

Tuning forks specification:

Resonant frequency	32kHz, 190kHz
Q-factor	3000-5000 (for free tuning fork) 500-1000 (for glued tuning fork)



Resonant frequency - 32,77kHz



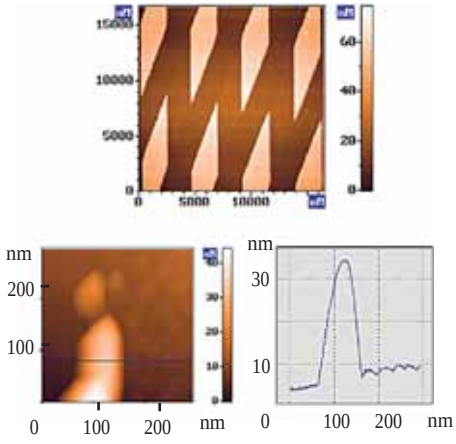
Resonant frequency - 191kHz

Code for ordering

TF001/10	Set of 10 tuning forks

SNOM test grating SNG01

Test Grating For Scanning Near Field Optical Microscope



Grating description

Substrate:	quartz (0.5 mm thickness)
Substrate size:	10x10mm
Rhomb material:	vanadium
Thickness of vanadium layer	about 10nm
Active area:	central diameter 3 mm array
Transmission coefficient through metal coating (rhomb)	≤20%
Reflection coefficient from metal coating (rhomb)	≥40%
R curvature of rhomb	≤50 nm

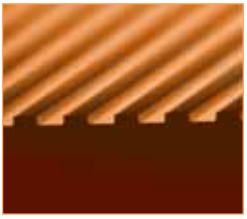
Code for ordering

SNG01	SNOM Test grating

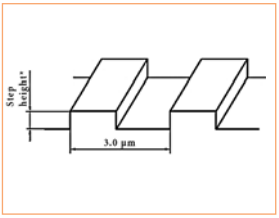
Calibration gratings

TGZ grating series

SPM image of grating TGZ series



SEM photo of grating TGZ series



Calibration gratings of TGZ series are intended for Z-axis calibration of scanning probe microscopes and nonlinearity measurements.

Grating description

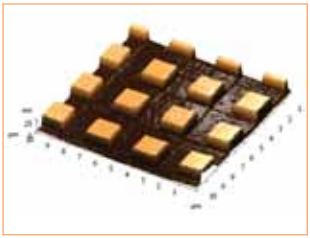
Structure	- Si wafer - the grating is formed on the layer of SiO_2
Pattern types	1- Dimensional (in Z-axis direction)
Step height	TGZ1 - 20±1.5nm* TGZ2 - 100±2nm* TGZ3 – 500±3nm *
Period	3.00±0.05µm
Chip size	5x5x0.5mm
Effective area	central square 3x3mm

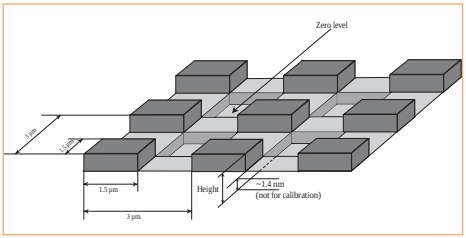
** the average meaning based on the measurements of 5 gratings with the same height (from the batch of 300 gratings) by SPM calibrated by PTB certified grating set TGS1.*
Basic step height can vary from the specified one within ±10% (for example TGZ1 grating can have step height 22±1.5nm)

Code for ordering

TGZ1	Height calibration grating (20±1.5nm)
TGZ2	Height calibration grating (100±2nm)
TGZ3	Height calibration grating (500±3nm)

TGQ1 calibration grating





SPM image of TGQ1 grating

Fields of application:

- simultaneous calibration in X, Y and Z directions;
- lateral calibration of SPM scanners;
- detection of lateral non-linearity, hysteresis, creep and cross-coupling effects.

Grating description

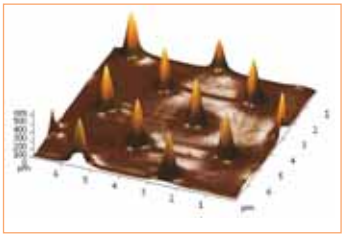
Structure	the grating is formed on Si wafer top surface
Pattern types	3-Dimensional array of rectangles
Period	3.00±0.05 mm
Height	20nm ±1.5 nm*
Rectangle side sizes	1.5±0.15 mm
Chip size	5x5x0.5 mm
Effective area	central square 3x3 mm

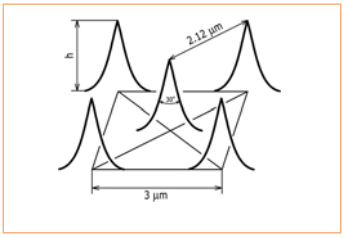
* the average meaning based on the measurements of 5 gratings (from the batch of 300 gratings) by SPM calibrated by PTB certified grating TGZ1.
Basic step height can vary from the specified one within ±10% (for example step height can be 22±1.5nm)

Code for ordering

TGQ1	Grating for simultaneous calibration in X, Y, Z directions

TGT1 grating for tip characterization





SPM image of TGT1 grating

Fields of application:

- for 3-D visualization of the scanning tip;
- determination of tip sharpness parameters (aspect ratio and curvature radius), tip degradation and contamination control*.

Grating description

Structure:	the grating is formed on Si wafer top surface
Pattern types:	array of sharp tips
Tip angle:	30 degrees
Tip curvature radius:	≤10nm
Period:	3.00±0.05µm
Diagonal period:	2.12µm
Chip size:	5x5x0.5mm
Effective area:	central square 2x2mm
Height, h:	0.3-0.7µm

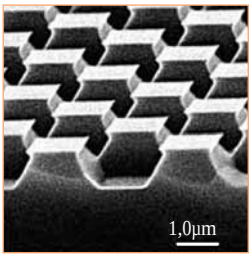
Code for ordering

TGT1	Tip characterization grating

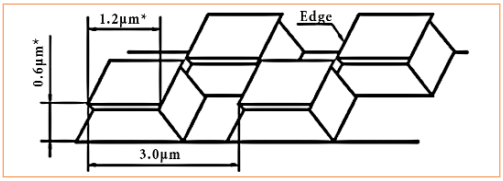
** - V. Bykov, A. Gologanov, V. Shevyakov. Test structure for SPM tip shape deconvolution. Applied Physics A Materials Science & Processing, Abstract Volume 66 Issue 5 (1998) pp 499-502*
Link to download: http://www.ntmdt.ru/Publications/1998/

TGX1 square grating with negative angles

SPM image of TGX1 grating



SEM photo of TGX1 grating



Fields of application:

- lateral calibration of SPM scanners;
- detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects;
- determination of the tip aspect ratio.

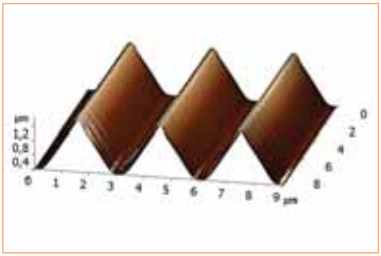
Grating description

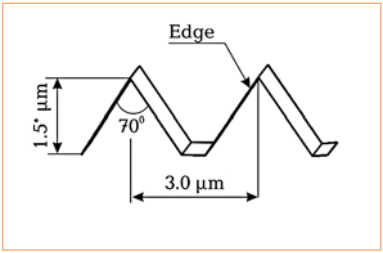
Structure	the grating is formed on Si wafer top surface
Pattern types	chessboard-like array of square pillars with sharp undercut edges
Period	3.00±0.05µm
Edge curvature radius	less than 10nm
Chip size	5x5x0.5mm
Effective area	central square 3x3mm
Height	0.3-0.6µm

Code for ordering

TGX1	Square grating with negative angles

TGG1 triangular grating





SPM image of TGG1 grating

Fields of application:

- SPM calibration in X or Y axis;
- detection of lateral and vertical scanner nonlinearity;
- detection of angular distortion;
- tip characterization.

Grating description

Structure:	the grating is formed on Si wafer top surface
Pattern types:	1- D array of triangular steps (in X or Y direction) having precise linear and angular sizes
Edge angle:	70 degrees
Edge radius:	≤10nm
Period:	3.00±0.05µm
Chip size:	5x5x0.5mm
Effective area:	central square 3x3mm

Code for ordering

TGG1	Triangular calibration grating

TDG01 diffraction grating

SPM image of TDG01 grating

Diffraction grating TDG01 is intended for submicron calibration of scanning probe microscopes in the X or Y direction.

Grating description

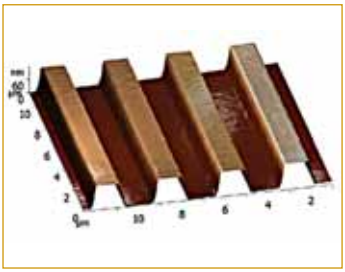
Structure:	- glass wafer - the grating is formed on the layer of chalcagenid glass - the grating top surface is aluminium
Pattern types:	1- Dimensional (in the X or Y direction)
Pattern height:	> 55 nm and provides good image contrast
Geometry:	parallel ridges
Period:	278 nm (3600 periods/mm)
Accuracy:	±1nm
Size:	diameter 12.5 mm, thickness - 2.5 mm
Effective area:	central diameter 9 mm

Code for ordering

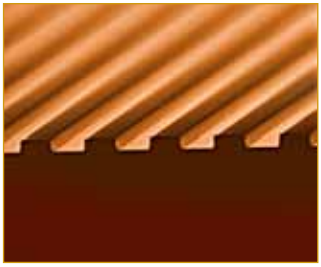
TDG01	Diffraction calibration grating

Calibration grating sets

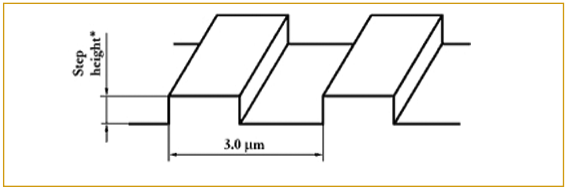
TGS1 grating set



SPM image of grating TGZ series



SEM photo of grating TGZ series



Calibration grating set TGS1 is intended for Z-axis calibration of scanning probe microscopes and nonlinearity measurements.
Grating set contains 3 gratings TGZ1, TGZ2, TGZ3 with different step heights.

Grating description

Structure	- Si wafer
	- the grating is formed on the layer of SiO2
Pattern types	1- Dimensional (in Z-axis direction)
Step height	TGZ1 - 20±1.5nm*
	TGZ2 - 100±2nm*
	TGZ3 – 500±3nm *
Period	3.00±0.05µm
Chip size	5x5x0.5mm
Effective area	central square 3x3mm

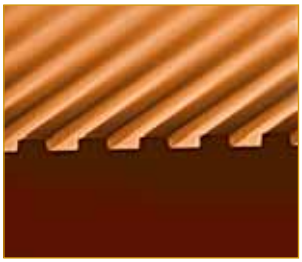
** the average meaning based on the measurements of 5 gratings with the same height (from the batch of 300 gratings) by SPM calibrated by PTB certified grating set TGS1.*
Basic step height can vary from the specified one within ±10% (for example TGZ1 grating can have step height 22±1.5nm)

Code for ordering

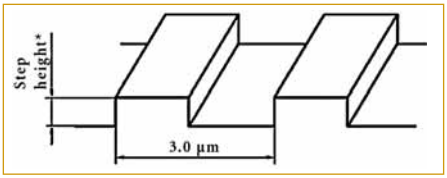
TGS1	Calibration grating set

PTB traceable TGZ grating series

SPM image of grating TGZ series

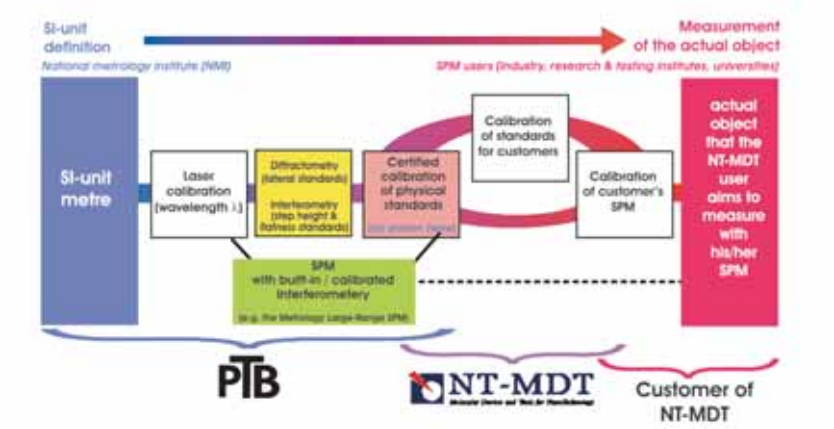


SEM photo of grating TGZ series



Calibration set TGS1 which consists of three gratings TGZ1, TGZ2, TGZ3 is available with PTB traceable certificate (TGS1_PTB).
The gratings TGS1_PTB are measured on the SPM which has been preliminary calibrated using the PTB certified grating set TGS1.

Procedure of grating certification.



Grating set TGS1_PTB is intended for Z-axis calibration of scanning probe microscopes and nonlinearity measurements.
In comparison with TGS1 grating set you will have height meanings with less uncertainties that will help to obtain more reliable scans.
Grating set contains 3 gratings TGZ1, TGZ2, TGZ3 with different step heights.

Grating description

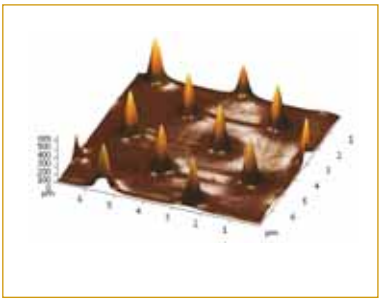
Structure	- Si wafer
	- the grating is formed on the layer of SiO2
Pattern types	1- Dimensional (in Z-axis direction)
Step height	TGZ1 - 20±1nm*
	TGZ2 - 100±1.2nm*
	TGZ3 – 500±1.5nm *
Period	3.00±0.05µm*
Chip size	5x5x0.5mm
Effective area	central square 3x3mm

** the average meaning based on the measurements in 5 points of each grating by SPM calibrated by PTB certified grating set TGS1.*
Basic step height can vary from the specified one within ±10% (for example TGZ1 grating can have step height 22±1nm)

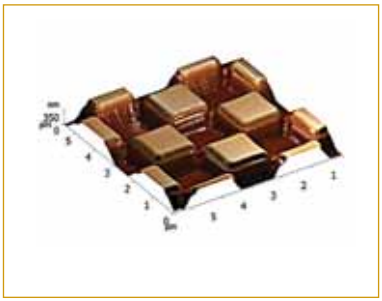
Code for ordering

TGS1_PTB	Calibration grating set

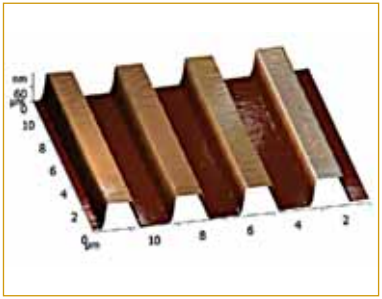
TGS2 grating set



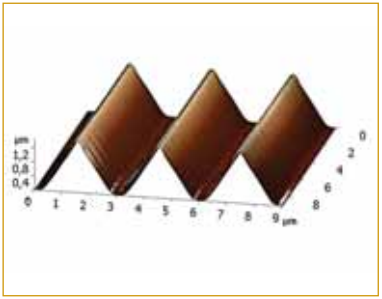
TGT1 grating



TGX1 grating



Gratings TGZ series



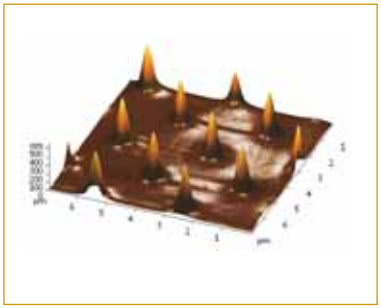
TGG1 grating

Grating set TGS2 consists of 6 calibration gratings:
TGZ1, TGZ2, TGZ3, TGX1, TGG1, TGT1.

Fields of application:

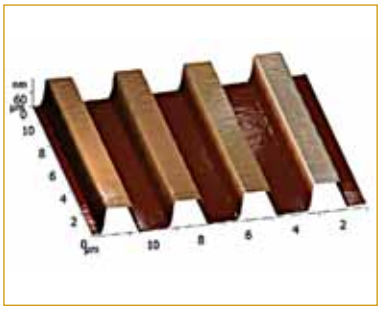
- lateral and vertical calibration;
- detection of lateral non-linearity;
- detection of hysteresis, creep, and cross-coupling effects;
- detection of angular distortion;
- for 3-D visualization of the scanning tip;
- determination of tip sharpness parameters (aspect ratio and curvature radius), tip degradation and contamination control.

TGSFull grating set

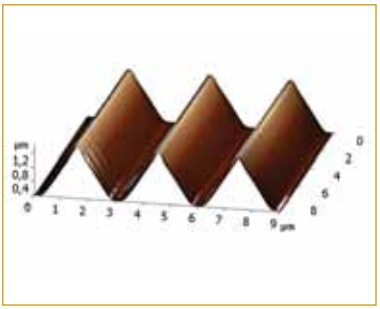


TGT1 grating

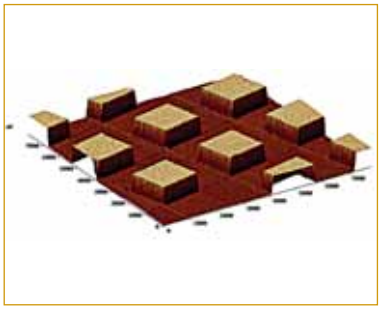
TGX1 grating



Gratings TGZ series



TGG1 grating



TGQ1 grating

TDG01 grating

Grating set TGSFull consists of 8 calibration gratings:
TGZ1, TGZ2, TGZ3, TGX1, TGG1, TGT1, TGQ1, TDG01.

Full set of calibration standards for SPM lateral and vertical calibration (including submicron calibration and simultaneuos calibration in X, Y and Z directions) , detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip shape.

Fields of application:

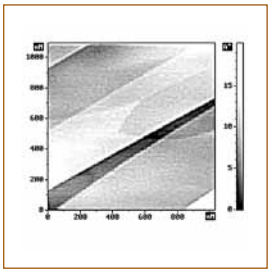
- SPM simultaneuos calibration in X, Y and Z directions;
- submicron SPM calibration in X or Y direction;
- lateral and vertical calibration;
- detection of lateral non-linearity;
- detection of hysteresis, creep, and cross-coupling effects;
- detection of angular distortion;
- for 3-D visualization of the scanning tip;
- determination of tip sharpness parameters (aspect ratio and curvature radius), tip degradation and contamination control

Code for ordering

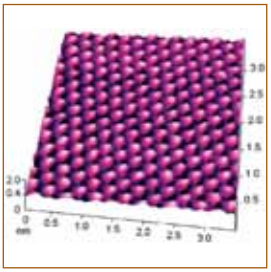
TGSFull	Calibration grating set

Test samples

Highly Oriented Pyrolitic Graphite (HOPG) for SPM applications



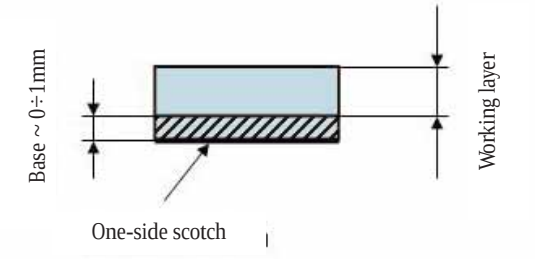
SPM image of atomic steps on HOPG



STM atomic resolution on HOPG

Fields of application:

- obtaining critical Z resolution;
- atomic resolution;
- atomic smooth substrate for customer's objects;
- conductive samples for STM.



HOPG ZYA Quality - Typical Mosaic Spread: 0.4–0.7 degree

HOPG piece has a **top working layer** with mosaic spread **0.4-0.7 degree** and a base layer (0÷1mm) with not specified mosaic spread quality. To mark the non-working HOPG piece side the one-side scotch is used.

Ordering code	Size*, mm^2	Nominal thickness, mm
GRAS/1.5	10x10	1.5±0.2
GRAS/1.2	10x10	1.2±0.2

**Available piece size - up to 12x12mm²*

HOPG ZYB Quality - Typical Mosaic Spread: 0.8–1.2 degrees

HOPG piece has a **top working layer** with mosaic spread **0.8-1.2 degrees** and a base layer (0÷1mm) with not specified mosaic spread quality. To mark the non-working HOPG piece side the one-side scotch is used.

Ordering code	Size**, mm^2	Nominal thickness, mm
GRBS/2.0	10x10	2.0±0.2
GRBS/1.7	10x10	1.7±0.2
GRBS/1.2	10x10	1.2±0.2

***Available piece size - up to 12x12mm²*

HOPG ZYH Quality - Typical Mosaic Spread: 3.5–5.0 degrees

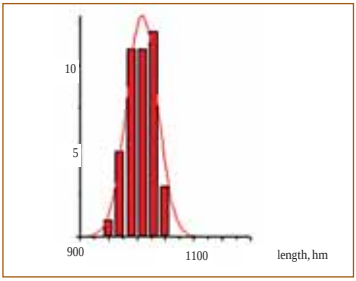
HOPG piece has a **top working layer** with mosaic spread **3.5-5 degrees** and a base layer (0÷1mm) with not specified mosaic spread quality. To mark the non-working HOPG piece side the one-side scotch is used.

Ordering code	Size***, mm^2	Nominal thickness, mm
GRHS/2.0	10x10	2.0±0.2
GRHS/1.5	10x10	1.7±0.2
GRHS/1.2	10x10	1.2±0.2

****Available piece size - up to 30x30mm²*

DNA Test Sample

Typical AFM image of the DNA test sample (obtained in contact mode, humidity 1-10%, Solver BIO, NT-MDT Co.).



Histogram indicating distribution of DNA length, mean value - 1009 nm, standard deviation - 27nm.*

DNA01 is Plasmid pGem7zf+ (Promega), which is linearized with the SmaI endonuclease. Linear DNA molecules (3000 b. p.) are deposited at the freshly cleaved mica. Molecules are uniformly distributed over the surface with the molecular density - 0.5-7 molec./m^2. The typical DNA length is 1009nm. Recommended humidity for obtaining a good image is 3-5%.

Fields of application:

- Getting started with your work on AFM;
- Example of how to prepare your own DNA samples;
- Estimation of probe tip curvature;
- Humidity test;
- Z-resolution test.

Code for ordering

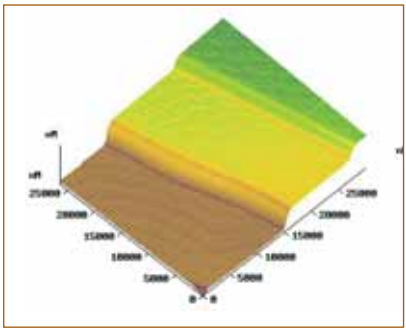
DNA01	DNA test sample

** software for DNA length calculation can be ordered with code DNA_calc.*
Download free DEMO version: http://www.ntmdt.com/Products/Software/product83.html

Silicon Test Echeloned Pattern (STEPP)

The Silicon Test Echeloned Pattern STEPP for AFM is designed on the base of silicon (111) surface with verified distribution of monatomic steps as main calibrating units for the complex control of AFM set up:

- Height calibration in angstrom and single nanometer intervals on the monatomic steps;
- Using as a substrate for investigations of bio and other objects;
- Precision imaging of nanoobjects.



Specification:

- Chip size - 1x4x0.3 mm
- Average interstep distance ~ 0.5-2 µm
- Dislocation of surface from the (111) plate ~ 1°
- Single monatomic step height 0.314 nm
- Average roughness of the area without monatomic steps - 0.06 nm

Instruction manual:

To calibrate AFM on the Z axis the following procedure is to be performed:

1. Fix the STEPP in the sample holder.
2. Approach to the STEPP surface and make a topography AFM image with the scan size 20x20µm or larger. After obtaining the image with step sequences (Fig.1) choose the area ~5x5 µm between any two steps and get AFM-image with regular monatomic steps only.
3. Use the software filter "Plane Subtraction" to the image. (Fig.2)
4. Now get height spectra using possibilities of your AFM software.

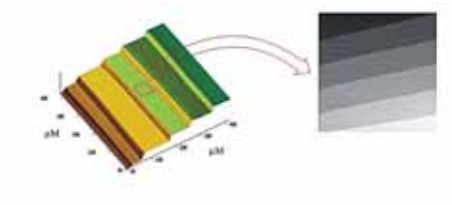


Fig.1. 43x43µm topographic AFM-image of STEPP Full...

Fig.2. 5x5µm topographic AFM-image of STEPP Plane Subtractions

5. Measure the inter-peak distance. To calibrate your AFM change the calibration constant while inter-peak distance becomes 0.31 nm. Please, remember that the experimental error of your measurement is the half width of the peaks on their half height, try to obtain the peak as narrow as possible! (Fig.3)

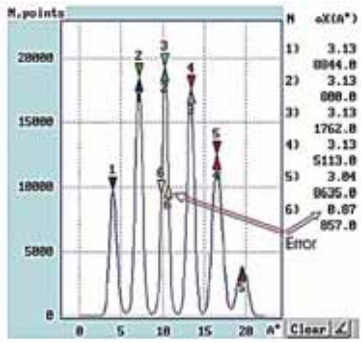


Fig.3. Height spectra. Interpeak distance ~0.31nm.
Experimental error ~0.09nm.

Code for ordering

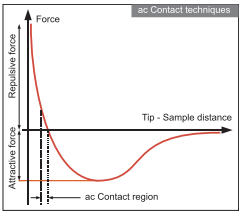
STEPP	Test sample

Short glossary

Short glossary

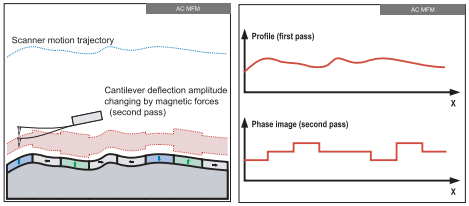
AC Contact (AFM) techniques

AFM modes when the probe is enforced to oscillations being all the time in contact with the surface. In this case the surface area in the closest proximity of the probe becomes oscillating as well.



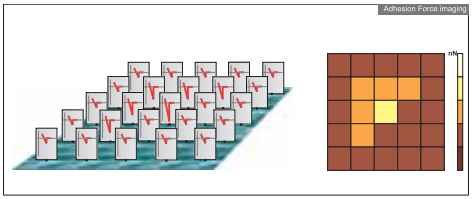
AC Magnetic Force Microscopy (AFM mode)

Two?pass AFM technique when magnetic probe oscillation parameters change due to the sample?probe magnetic interactions forming an image contrast.



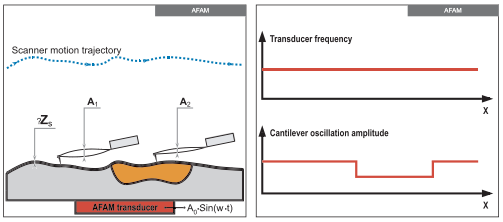
Adhesion Force Imaging

A type of spectroscopy?based imaging when force?distance curves are determined for each point of the surface. In this case the surface adhesion can be mapped since it causes substantial differences between f?d curves when approaching and retracting the probe.



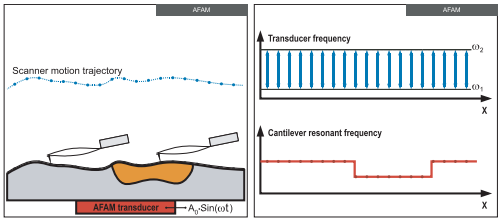
Atomic Force Acoustic Microcopy (AFAM)

AC Contact AFM mode when the sample is enforced to out?of?plane vibrations while the probe is in contact with the surface. Vibration frequency is adjusted to be close to the resonance. Changes of cantilever oscillation amplitude caused by differences in local stiffness provide an image contrast.



AFAM resonance spectroscopy

AC Contact AFM mode when the sample is enforced to out of plane vibrations while the probe is in contact with the surface. During scanning the resonance frequency (or first mode frequenies) of supported cantilever vibration is registered in each point. It allows calculation and nano?scale mapping of the sample Young modulus.

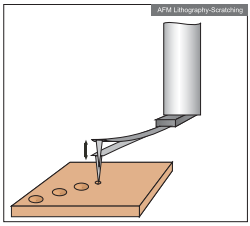


Atomic Force Microcopy (AFM)

A type of scanning probe microscopy based on registration of atomic forces that act on a sharp tip (sometimes specially coated) in very close proximity to the surface.

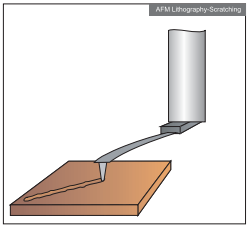
AFM lithography dynamic plowing

A type of nano?scale surface modifications when the AFM probe is used to pick the surface in semicontact mode.



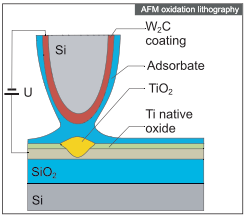
AFM lithography ? scratching

A type of nano?scale surface modifications when the AFM probe is used to scratch the surface in contact mode.



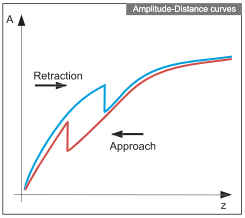
AFM oxidation lithography

A type of nano?scale surface modifications when the current?conducting AFM tip is used for local electro?chemical surface oxidation. Often the tip?formed oxide protrudes from the surface thus new surface topography can be engineered.



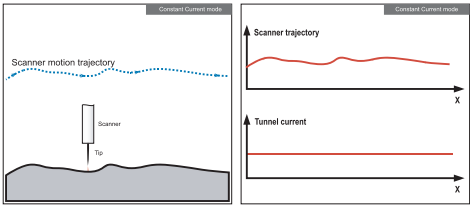
Amplitude distance curves

A plot of probe oscillation amplitude variation when the probe is approached to or retracted from the sample surface.



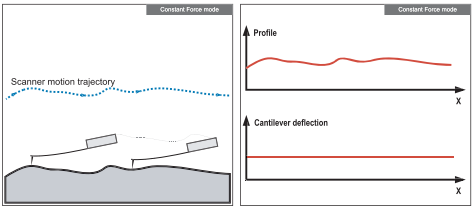
Constant Current STM mode

STM mode when the feed?back mechanism makes the tunnel current constant between the probe and the surface; feed?back signal value in this case is used to image the surface topography.



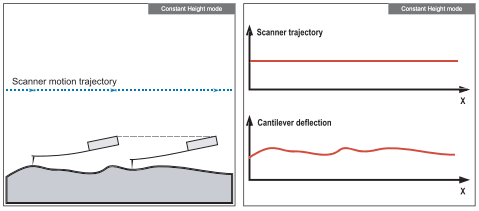
Constant Force AFM mode

AFM mode when the system drives the probe over the surface so that it's deflection does not change (thus the force applied to the surface remains constant); feed?back signal value is used to image the surface topography.



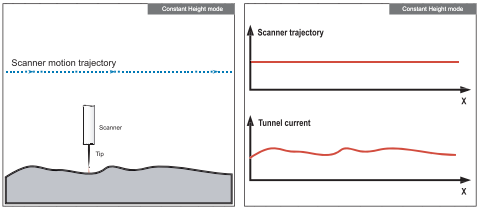
Constant Height AFM mode

AFM mode when the feed?back mechanism is disconnected and the scanner drives the probe over the surface at constant z?signal; cantilever deflection is used to monitor the surface topography.



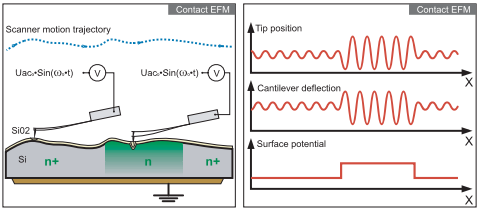
Constant Height STM mode

STM mode when the feed?back mechanism is disconnected and the scanner drives the probe over the surface at constant z?signal; the value of tunnel current is used to image the surface topography.



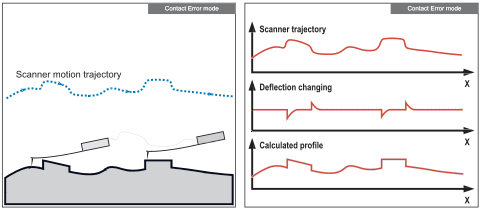
Contact Electric Force Microscopy (AFM mode)

AC Contact AFM mode when AC voltage is applied to the probe while scanning. Changes in the amplitude of cantilever oscillations caused by first harmonic of the capacitive force form an image that reflects the distribution of surface potential.



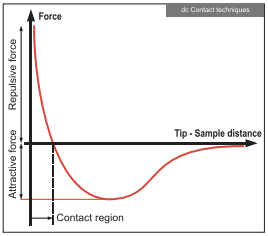
Contact Error AFM mode

Derivative of the Constant Force AFM mode. When surface relief changes are too abrupt, short?term differences occur between the probe signal, which is in fact registered, and the set?point signal. These differences are used to form an image contrast in this technique.



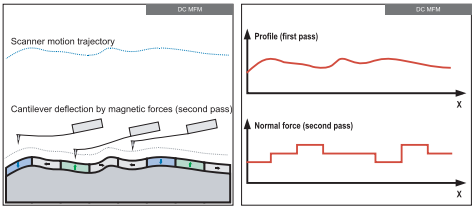
DC Contact (AFM) techniques

AFM modes when the probe moves over the surface in a constant contact with it without any oscillations.



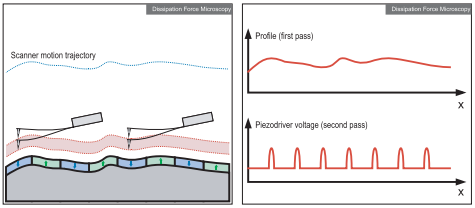
DC Magnetic Force Microscopy (AFM mode)

Two?pass AFM technique when changes in deflection of the cantilever caused by the any tip?sample magnetic interactions form an image contrast.



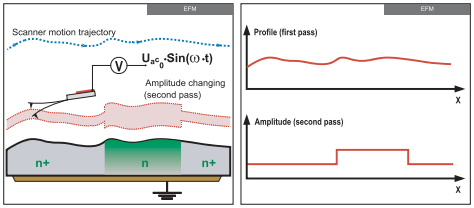
Dissipation Force Microscopy (AFM mode)

Two?pass AFM technique when any tip?sample interactions cause damping of the probe oscillations. It is quantified and used to build an image.



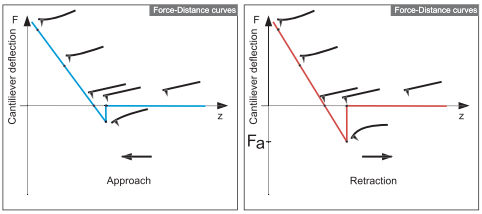
Electric Force Microscopy (AFM mode)

Two?pass AFM technique when the oscillating probe follows the pre?determined surface landscape in a non?contact manner; the surface potential and associated charges can modulate oscillation parameters (amplitude and phase), and their differences form an image contrast.



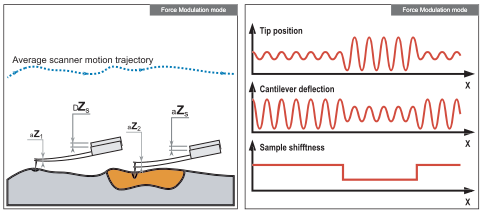
Force?distance curves

A plot of distance dependence on the forces that act to the tip in the close proximity to the surface. These forces are recorded when the tip is approached to the surface or retracted from it.



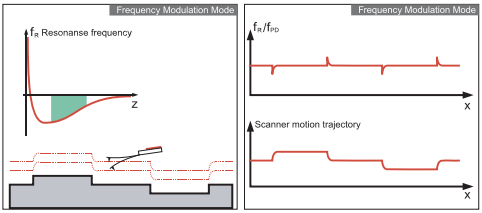
Force modulation AFM mode

AC Contact AFM mode when the oscillating tip pushes down a local surface area to a depth depending on the local stiffness of the sample.



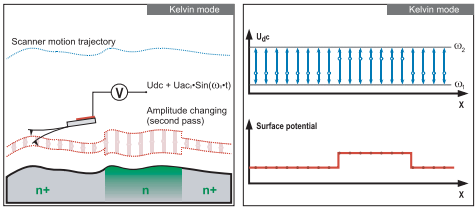
Frequency modulation AFM mode

Non?contact AFM technique when the frequency of the probe oscillation influenced by non?contact tip?sample interaction serves as the feed?back parameter.



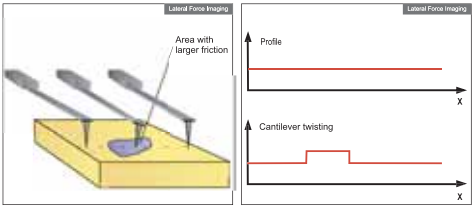
Kelvin Probe Microscopy (AFM mode)

Two?pass AFM technique when the DC and AC potentials are applied to the tip oscillating in non?contact mode, the DC potential is adjusted to compensate the surface potential nulling the amplitude of the probe oscillation. Recording of the nulling potential applied for each point presents the map of surface potential distribution.



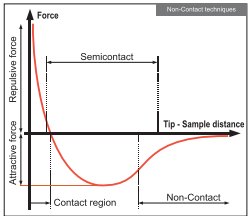
Lateral Force Imaging AFM mode

DC Contact AFM technique when the cantilever torsion is detected during the scanning. Scanning is performed across the cantilever long axis.



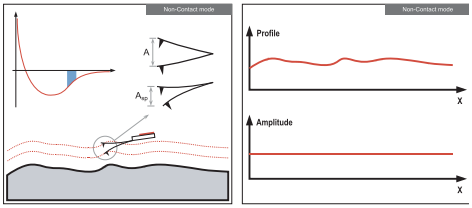
Non?contact AFM techniques

AFM techniques with the probe oscillating close to the surface without touching it.



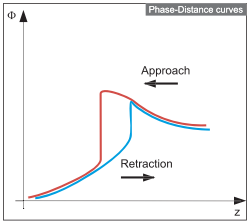
Non?contact AFM mode

Non?contact AFM mode when the probe oscillation amplitude influenced by non?contact tip?sample interactions remains constant; the feed?back signal forms an image contrast reflecting surface topography.



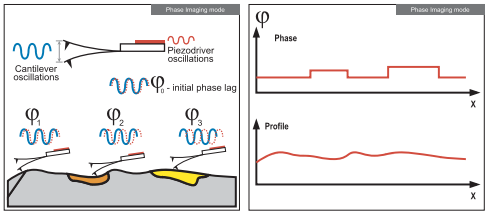
Phase?distance curves

A plot of the probe oscillation phase variation when the probe is approached to or retracted from the sample surface.



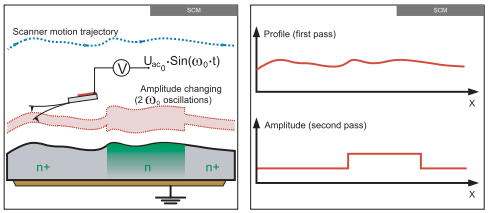
Phase imaging AFM mode

Semicontact AFM technique when a phase shift of the probe oscillation is used to form an image contrast; the phase changes for surface areas of different stiffness, adhesion, and so on.



Scanning Capacitance Microscopy (noncontact AFM mode)

Two?pass AFM technique when AC potential is applied to the probe oscillation is used to form an image contrast; the phase changes for surface and the surface distribution of the tip?sample capacitance derivative can be mapped by the oscillating probe following pre?determined surface landscape in a non?contact mode; second harmonic of cantilever oscillations amplitude variations is detected.

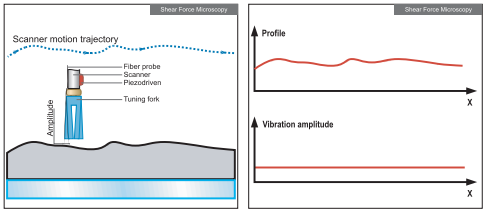


Scanning Capacitance Microscopy (contact AFM mode)

A metallic or metallized AFM tip is used for imaging the wafer topography in conventional contact mode. The tip also serves as an electrode for simultaneous measuring of the metal?silicon?oxide?semiconductor (MOS) capacitance.

Shear?force microscopy

A type of scanning probe microscopy when laterally oscillating probe (optical fiber) undergoes crucial changes in oscillation amplitude in the close proximity to the sample surface. When performing the feed?back control to maintain the oscillation amplitude constant the feed?back signal can be used to image the surface topography.
Shear?force technology is the most common way to bring the optical fiber very close to the surface to perform the SNOM measurements.

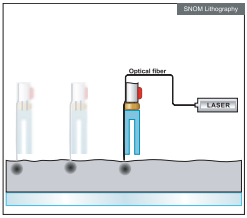


SNOM

A type of scanning probe microscopy based on the registration of a neg-ligible light passed trough a sub?wave diaphragm in a close proximity to the object (at the distance of several nanometers where near?field effects occur); allows nano?scale object optical investigation overcoming the optics diffraction limits.

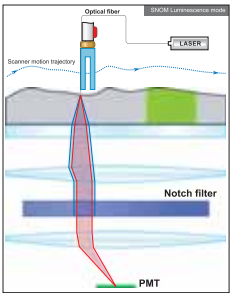
SNOM lithography

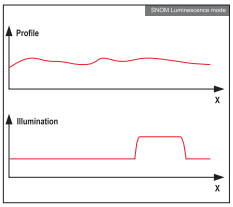
A type of nano?scale surface modifications when the laser?emitted light is applied to photosensitive surface layers by the SNOM technology.



SNOM luminescence mode

Scanning Near?field Optical Microscopy mode when the light brought by the optical fiber excites the luminescence of the sample; emitted luminescence photons are then gathered and detected.

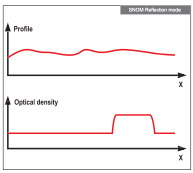


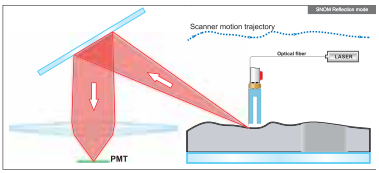


Scanning Near?field Optical Microscopy mode when the light brought by the optical fiber is reflected by non?transparent sample and is then gathered and detected.

SNOM reflection mode

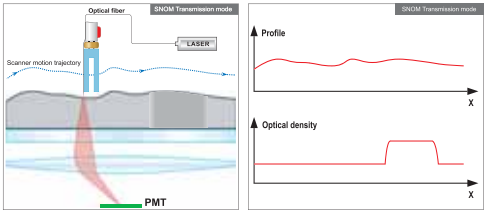
Scanning Near?field Optical Microscopy mode when the light brought by the optical fiber goes through the transparent sample and is then gathered and detected.





SNOM transmission mode

Scanning Near?field Optical Microscopy mode when the light brought by the optical fiber goes through the transparent sample and is then gathered and detected.



Scanning Probe Microscopy (SPM)

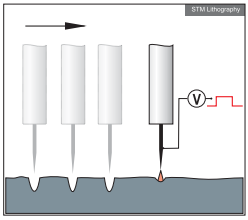
Group of modern microscopy methods – the sample surface properties are studied by point by point scanning.

Scanning Tunneling Microscopy (STM)

A type of scanning probe microscopy based on registration of tunneling current that occurs between a very sharp conductive tip and an object in a close proximity of the object surface.

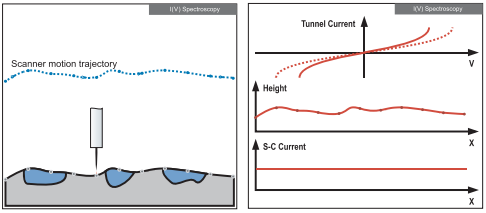
STM lithography

A type of nano?scale surface modifications when the STM probe is used for surface modification. The common way is to burn out the sample with high?current pulses locally.

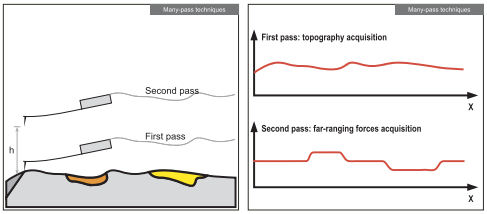


STM spectroscopy

Different methods in the STM (like Barrier Height imaging, Density of States imaging, I(z) Spectroscopy, or I(V) Spectroscopy) used to characterize the electron properties of a surface or to make contrast images based on differences in these properties.

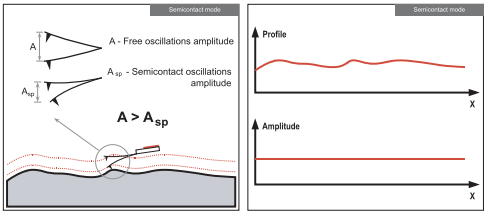


Two?pass (many?pass) AFM techniques



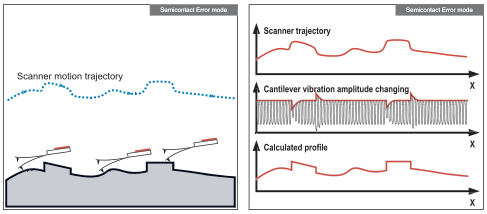
Methods for complex AFM characterization of object. The first pass is performed in contact or semicontact mode to determine the surface topology. The subsequent pass(es) obtain additional information, for example, electrical, magnet or some other sample properties. Usually second pass scanning is performed in a non?contact mode when the probe follows the predetermined surface topography but moves a bit higher without touching the sample.

Semicontact AFM mode (Intermittent mode)



Semicontact AFM technique when the probe oscillates above the surface contacting it intermittently; the difference in oscillation frequency creates an image contrast.

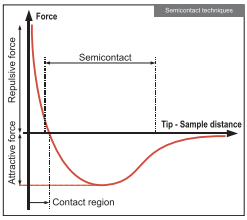
Semicontact error AFM mode



Semicontact AFM imaging technique based on a feed?back "error" signal: when surface topography changes are too abrupt, short?term differences occur between the probe signal, which is in fact registered, and the set?point signal. This difference is used to form an image contrast.

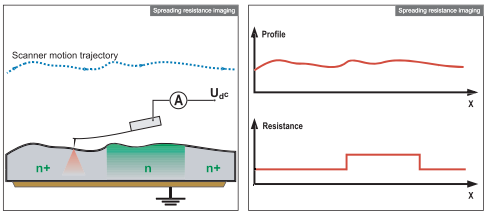
Semicontact techniques

AFM techniques with the oscillating tip contacting ("touching") the surface periodically in the extreme points of its trajectory.



Spreading Resistance Imaging

DC Contact AFM technique when bias voltage is applied to the conducting tip; resulting current through the sample is measured.



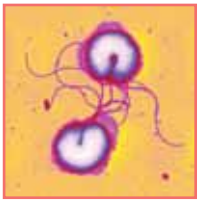
Scan gallery and probe selection guide

Topography imaging

Name: Porcine kidney Cell
SPM principle: Contact Error mode
Scan size: 27x27 um
Contact error mode AFM image of a part of living porcine kidney proximal tubule epithelial cell (LLC-PK1). The cytoskeleton of the cell is clearly visible. Image was obtained in the contact mode in a buffer solution at 37C. Sample courtesy of Prof. Tang Ming-Jer, Department of Physiology.
National Cheng Kung University Medical College, Tainan, Taiwan (ROC).

Name: Glass-matrix of high-temperature coating
SPM Principle: Semicontact mode
Scan size: 2x2 um
Gas-proof coating for the protection of carbon materials at extreme applications at temperatures above 1400oC. The bubble prolonged after the gas exit is presented. Image and sample courtesy of Golubev K.S., Pugatchiov K. E., Efimenko L.P., Institute of Silicate Chemistry RAS, Russia, Saint-Petersburg.

Name: Helicobacter pylori
SPM principle: Semicontact mode
Scan Size: 7.2x7.2 um
Conversion of two cells of bacterium Helicobacter pylori into coccoid forms. Polished silicone covered by polymer. Image courtesy of Budashov I.A., Moscow State University, Institute of Biochemical Physics. Sample courtesy of Momynaliev K.T., Scientific Research Institute of Physical-Chemical Medicine, Moscow.



Name: DNA
SPM principle: Non-Contact mode
Scan Size: 220x220 nm
Non-contact AFM phase contrast image of poly(dG)–poly(dG)–poly(dC) triplex DNA. Image courtesy of Lemeshko S., Klinov D., NT-MDT, Russia, Moscow.

Topography	
Contact mode	*CSG01, CSG10*
Non-contact mode	*NSG01, NSG10, NSG03, NSG30*
Semi-contact mode	

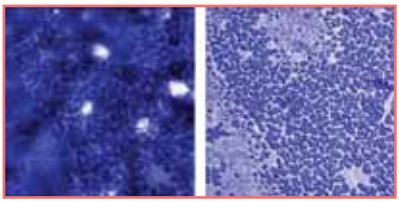
High resolution topography imaging

Name: Plasmid DNA
SPM principle: Semicontact mode
Size: 0.25x0.25 um
Circular plasmid DNA (pEGFP, 3.4 kb) with local single-stranded loops deposited on HOPG substrate by using graphite modifier (GM).
The image was obtained with Ntegra SPM in semicontact mode in air. Super-sharp NSG01_DLC probe was used.
Image courtesy of Savvateev M, NT-MDT, Moscow, Russia. The sample was kindly given by I. I. Agapov and E.A. Tonevitsky, Institute for transplantation and artificial organs, Moscow, Russia.

High Resolution	
Contact mode	*CSG01, CSG10, CSC05*
Non-contact mode	*NSG01_DLC, NSG10_DLC, NSC05, NSG01, NSG10, NSG03, NSG30*
Semi-contact mode	

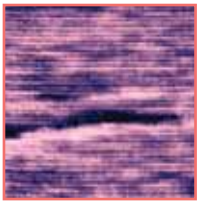
Elastic properties

Phase imaging:



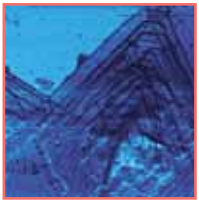
Name: Polyphenylenevinylene
SPM principle: Phase Imaging mode
Size: 3x3 um
Mixture of two different types of PPV (see m. Ringed PPV molecules). Initially PPV blend film was deposited on another polymer and then removed by floating. Resulted structure is explained by dewetting (structure on topography) and demixing (pronounced phase contrast) on the interface between layer of two PPVs and substrate.

Force Modulation:



Name: AlGaN/GaN superlattice cross-section
SPM principle: Force Modulation mode
Size: 500x500 nm
AFM image of AlGaN/GaN superlattice with 74 Angstroms pitch made in local elasticity (force modulation) mode.
Image courtesy of Alexander Ankudinov and M. Dunaevsky (group of A.Titkov), Ioffe Physico-Technical Institute, St. Petersburg, Russia.

AFAM:



Name: Crystals of polyethylene
SPM principle: AFAM
Size: 5.6x5.6 um
Single crystals of polyethylene on mica imaged with amplitude detecting AFAM. The sample was kindly given by Dr. M. Tian (NTI-Europe, The Netherlands). Image courtesy of A. Alexeev.

Lateral force Microscopy:

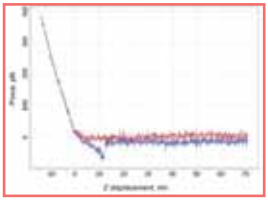
Name: Pseudomonas bacteria
SPM principle: Lateral Force Imaging
Size: 2.3x2.3x0.1 um
LFM image of pseudomonas bacteria obtained in air.
Image courtesy of M.N. Savvateev, NT-MDT.

Elastic properties	
Phase imaging	*NSG01, NSG10, NSG03, NSG30*
AFAM	
Force Modulation	*FMG01, CSG01 CSG10*
Lateral force Microscopy	

Spectroscopy

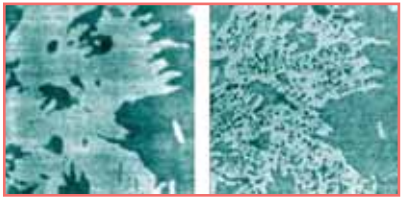
Force Distance Curves:

Name: Force curve
SPM principle: Force-distance curves
Force curve for single biotin-streptavidin interaction. Unbinding force of 45 pN was measured between probe, modified with PEG-tethered biotin, and streptavidin covered mica surface.
Image courtesy of M.Savvateev, NT-MDT, Moscow, Russia .



Adhesion Force Imaging:

Name: Force curve
SPM principle: Force-distance curves
Force curve for single biotin-streptavidin interaction. Unbinding force of 45 pN was measured between probe, modified with PEG-tethered biotin, and streptavidin covered mica surface.
Image courtesy of M.Savvateev, NT-MDT, Moscow, Russia .

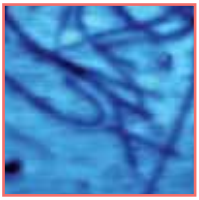


Spectroscopy
Force Distance Curves — *CSG01, CSG10, FMG01, NSG01, NSG03*
Adhesion Force Imaging — *CSG01 CSG10*

Electrical properties

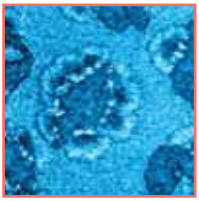
Many-pass techniques

Electric Force Microscopy:



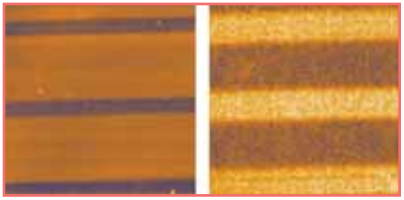
Name: The EFM image of carbon nanotubes
SPM principle: EFM
Size: 1700x1700 nm
The electrostatic force microscopy image of carbon nanotubes. Scan size is 1,7 um. Image courtesy of Dr. A.Temiryazev, NT-MDT, Moscow, Russia.

Kelvin Probe Microscopy:



Name: Photo-sensitive polymer on PCBM film
SPM principle: Kelvin Probe Microscopy
Size: 8x8 um
Topography (left) and SKM image (right) of film cast from solution of photo-sensitive polymer film and PCBM.
Image courtesy of Evgeny Kuznetsov. The sample was kindly given by Dr. Igor Sokolik, Konarka Technologies Inc.

Scanning capacitance Microscopy:



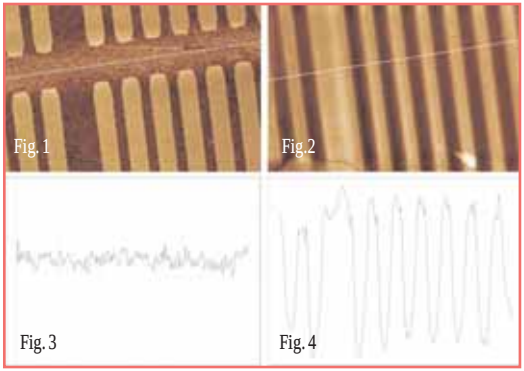
Name: Test grating with different doping stripes
SPM principle: Scanning Capacitance Microscopy
Size: 10.8x10.7 nm
Test grating on the silicon wafer with concentration Nn=1015 cm-3, step 3µm, height 0,1µm from SiO2. Ion implantation by boron with E=30 keV and dose 150mkCoulomb/cm2, then pressing during 60 minutes under temperature T=1000 C and finally SiO2 etch removal have been done. As result the following structure was obtained: left image - topography, right image - SCM.
Image courtesy of A.Iconnicov, State Research Institute of Physical Problems & NT-MDT, Moscow, Russia.

Many-pass techniques
Electric Force Microscopy
Kelvin Probe Microscopy
Voltage Modulation
Scanning capacitance Microscopy

NSG01 NSG10 NSG03, FMG01 - with Au/Pt/TiN

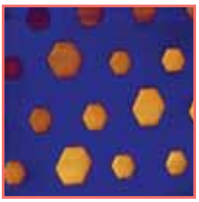
Contact techniques

Contact Scanning Capacitance Microscopy:



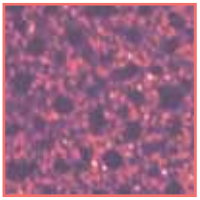
Name: Test structure
SPM principle: Contact Scanning Capacitance Microscopy
Size: 18x28 um
Test structure on the base of SiO2 stripes height 0.1µm grating on the silicon wafer. Ion implantation by boron with E=100 keV, annealing and SiO2 layer etching was employed. On the resulting structure following images were obtained: Fig. 1 - Topography of test structure (contact mode AFM), Fig. 2. - Profile of test structure, Fig. 3. - Contact SCM image of the same area, Fig. 4. - Profile of Contact SCM image.
Image courtesy of V. Polyakov, NT-MDT, Moscow, Russia.

AcContact Piezoresponse Force Microscopy:



Name: Lithiumniobate
SPM principle: Piezoresponse Force Microscopy
Size: 62x62 um
Lithiumniobate is an important nonlinear optical material. Periodically poled crystals can be used for efficient second harmonic generation.
The sample was kindly given by C. Gawith Optoelectronics Research Centre University of Southampton. Image courtesy of T. Jung, A. Hoffmann, E. Soergel University of Bonn.

Spreading Resistance Imaging:



Name: Distribution of current on the surface of two semiconducting polymer blend.
SPM principle: Spreading Resistance Imaging
Size: 2.7x2.7 um
Distribution of current on the surface of two semiconducting polymer blend. The sample was kindly given by Dr. M.M. Koetse, Dr. J. Loos (Eindhoven University of Technology, The Netherlands). Image courtesy of A. Alexeev. (NT-MDT).

Contact techniques
Contact Scanning Capacitance Microscopy
AcContact Piezoresponse Force Microscopy
Spreading Resistance Imaging

CSG01, CSG10, FMG01 - with Au/Pt/TiN

Surface Modulation

AFM Oxidation Lithography

Name: Thin Ti film
SPM principle: AFM Oxidation Lithography
Size: 2x2 um
The image was made by local anodic oxidation nanolithography of a thin Ti film on SPM Solver P47 Pro in semicontact mode, by using NSG 11 cantilevers with conducting W2C covering, at relative humidity of 70 %.
Image courtesy of Smirnov V.A., Taganrog Technological Institute Of Southern Federal University.

AFM Lithography – Scratching

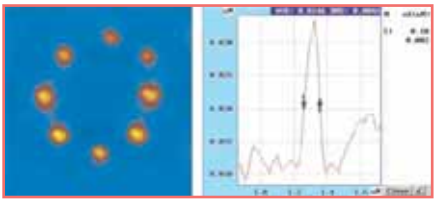
Name: Al surface
SPM Principle: AFM Scratching Lithography
Scan size: 1.6 x 1.6 um
Scratched with 100 nN/m cantilever polished Al surface.

AFM Lithography – Dynamic Plowing

Name: AFM Resonant Mode Lithography
SPM principle: AFM Lithography - Dynamic Plowing
Size: 1.2x2.3 um
Resonance SPM modification of polycyanoacrylate film on silicon.
Word "Science" in Chineese.

AFM Lithography – Dynamic Plowing

Name: SNOM lithography
SPM principle: SNOM Lithography
Size: 16x16 um
SNOM lithography on the positive photoresist.
Resolution 100nm.
Images courtesy of Igor Dushkin, NT-MDT.



Surface Modulation
AFM Oxidation Lithography
AFM Lithography – Scratching
AFM Lithography – Dynamic Plowing
SNOM Lithography

DCP11, DCP20;
NSG01, NSG10, NSG30 - with Pt/TiN

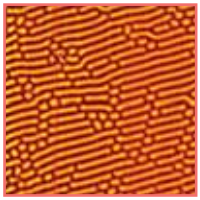
SNOM probes

Optical properties

Shear Force Microscopy

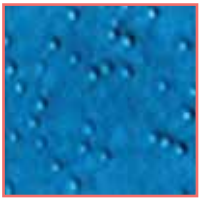
Name: DNA shear-force image
SPM principle: Shear Force Microscopy
Size: 1.3x1.3 nm
DNA plasmid pGem7zf+ (Promega) 3000 b. p. linearized with the SmaI endonuclease deposited on freshly cleaved mica. DNA01 test sample was measured by Solver P47H using the Shear Force head. Humidity - 1-10%.

Transmission Mode



Name: Ferrite-garnet film
SPM principle: Transmission mode
Size: 105x105 um
Magneto-optical image (transmission mode) of ferrite-garnet film. Images courtesy of Igor Dushkin, NT-MDT.

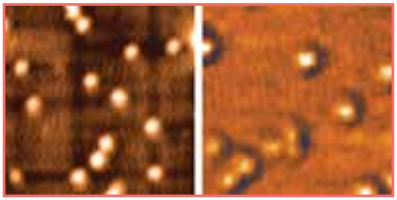
Reflection Mode



Name: Quantum dots
SPM principle: SNOM
Size: 7x7 um
Shear Force (topography) (a) and reflection (b) images of In-Ga quantum dots made with the use of He-Cd 442 nm laser.
Images courtesy of Igor Dushkin, NT-MDT.

Lumenscence Mode

Name: Latex balls
SPM Principle: Lumenscence
Latex balls Upper picture - latex ball images obtained in Shear Force mode, lower picture - latex balls image obtained in Luminescence mode.

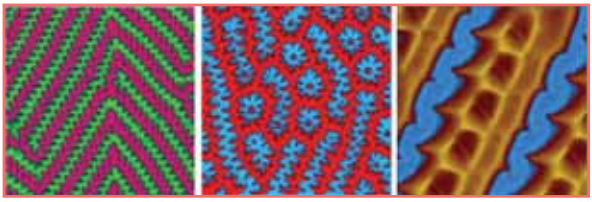


Optical properties
- Shear Force Microscopy
- Transmission Mode
- Reflection Mode
- Lumenscence Mode

MF001, MF002, MF003, MF004, MF005

Magnetic properties

Shear Force Microscopy

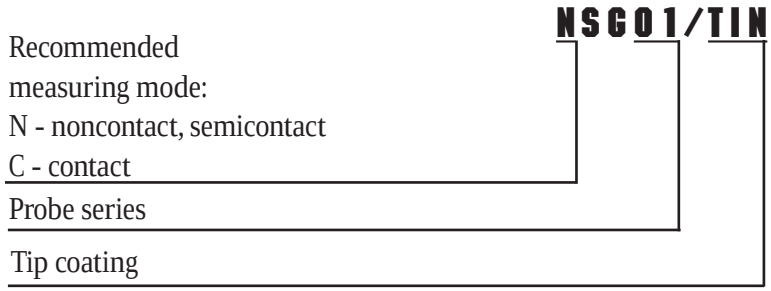


Name: Magnetic domains of Yttrium Iron Garnet
SPM principle: AC MFM
Size: 60x60 um
Different surface domain structures of inhomogenious films of Yttrium Iron Garnet (YIG). YIG film has substantial variation of anisotropy field across the film thickness. Images courtesy of A.G. Temiryazev and M.P. Tikhomirova, Institute of Radioengineering & Electronics RAS, Fryazino, Russia. A.G. Temiryazev et al. Proceedings of SPM-2002, Nizhnii Novgorod, Russia, 129-131.

Magnetic properties
AC MFM
DC MFM
NSG01/Co, FMG01/Co

Table of available probes

Probe series name:



Probe short specification:

Probe series	Shape	Typical Force Constant, N/m	Typical Resonant Frequency, kHz
CSC01	Rect	0.03	9.8
CSG10	Rect	0.11	22
CSC05	Rect	0.11	22
NSG01	Rect	5.1	150
NSG10	Rect	11.8	240
NSG30	Rect	40	320
NSG03	Rect	1.74	90
FMG01	Rect	3	60
NSC05	Rect	11.8	240
DCP11	Rect	5.5	150
	Rect	11.5	255
DCP20	Triang	48	420

Available probes

Type*	NSG10	NSG01	NSG30	NSG03	FMG01	CSG10	CSG01
Uncoated	NSG10	NSG01	NSG30	NSG03	FMG01	CSG10	CSG01
PtIr coated	NSG10/Pt	NSG01/Pt	NSG30/Pt	NSG03/Pt	FMG01/Pt	CSG10/Pt	CSG01/Pt
TiN coated	NSG10/TiN	NSG01/TiN	NSG30/TiN	NSG03/TiN	FMG01/TiN	CSG10/TiN	CSG01/TiN
Au coated	NSG10/Au	NSG01/Au	NSG30/Au	NSG03/Au	FMG01/Au	CSG10/Au	CSG01/Au
Co/Cr coated		NSG01/Co			FMG01/Co		
Whisker type	NSC05					CSC05	
DLC	NSG10_DLC	NSG01_DLC					
Bare	NSG10/Bare	NSG01/Bare	NSG30/Bare	NSG03/Bare	FMG01/Bare	CSG10/Bare	CSG01/Bare
Tipless	NSG10/Tipless	NSG01/Tipless	NSG30/Tipless	NSG03/Tipless	FMG01/Tipless	CSG10/Tipless	CSG01/Tipless

** - all probes (except for bare probes) have Au reflective coating, any coating from the table is on the probe tip side*

Recommended probe characteristics for scanning modes

Scanning mode	Operation mode	Air (Vacuum) ambience		Coating on the tip side	Reflective side coating
		Force constant, N/m	Res.frequency, kHz		
Contact	Topography	0.1-2	10-20	NC	NC, Au
	Lateral Force (LFM)	0.01-0.1	10-20	NC	NC, Au
	Force modulation	1-5	60-100	NC	NC, Au
	Adhesion Force	0.1-2	10-40	NC	NC, Au
	Spreading Resistance (SRM)	0.1-5	10-100	TiN, PtIr	NC, Au
	AFAM	1-5	5-100	NC	NC, Au
Noncontact\ Seminontact	Topography	5-50	100-400	NC	NC, Au
	Phase Imaging	5-50	100-400	NC	NC, Au
	Electrostatic Force (EFM)	1-5	50-100	TiN, PtIr	NC, Au
	Scanning Capacitance, Scanning Kelvin (SCM, SKM)	1-5	50-100	TiN, PtIr	NC, Au
	Magnetic Force (MFM)	1-5	50-100	CoCr	NC, Au
		Liquid ambience			
Contact	Topography	0.1-2	10-20	NC	NC, Au
	Lateral Force (LFM)	0.01-0.1	10-20	NC	NC, Au
	Force modulation	1-5	60-100	NC	NC, Au
	Adhesion Force	0.1-2	10-40	NC	NC, Au
Noncontact	Topography	5-50	100-400	NC	NC, Au
	Phase Imaging	5-50	100-400	NC	NC, Au

NC - uncoated

Quick selection table by applications

Contact modes

	Air					Liquid			
	Topography	LFM	Force Modulation	Adhesion Force	SRM	Topography	LFM	Force Modulation	Adhesion Force
CSG01	●	●		●		●	●	●	
CSG01/Pt					●				
CSG01/TiN					●				
CGS01/Au				●					●
CSG10	●		●	●		●		●	●
CSG10/Pt					●				
CSG10/TiN					●				●
CGS010/Au						●			
CSG05	●		●			●			
NSG03/Pt					●				
NSG03/TiN					●				
NSG01/Pt					●				
NSG01/TiN					●				
FMG01			●						
FMG01/Pt					●				
FMG01/TiN					●				

Noncontact modes

	Air									Liquid	
	Topography	1nm resolution Topography	Deep Narow Holes Topography	Phase Imaging	LAO LIthography	EFM	SCM, SKM	MFM	Semicontact Error Mode	Topography	Phase Imaging
NSG01	●			●						●	●
NSG01_DLC	●	●									
NSG01/Pt					●	●	●				
NSG01/TiN					●		●				
NGS01/Au							●				
NSG01/Co								●			
NSG10	●			●							
NSG10_DLC	●	●									
NSG10/Pt					●		●				
NSG10/TiN					●		●				
NGS10/Au							●				
NSG30									●	●	●
NSG30/Pt					●						
NSG30/TiN					●						
NSG30/Au					●						
NSG03	●										
NSG03/Pt						●	●				
NSG03/TiN						●					
NSC05	●		●	●							
DCP20, DCP11					●						
FMG01	●			●						●	●
FMG01/Pt						●	●				
FMG01/TiN						●	●				
FMG01/Au						●	●				
FMG01/Co								●			
HA_NC	●			●						●	●

Products by groups

High Resolution "Golden" silicon AFM probes

Product	Description	Page
CSG01/15	15 chips for contact mode CSG01 series, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	11
CSG01/50	50 chips for contact mode CSG01 series, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	11
CSG01/Au/15	15 chips of Contact SPM probes CSG01 series with Au conductive coating, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	13
CSG01/Au/50	50 chips of Contact SPM probes CSG01 series with Au conductive coating, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	13
CSG01/Pt/15	15 chips of Contact SPM probes CSG01 series with Pt conductive coating, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	13
CSG01/Pt/50	50 chips of Contact SPM probes CSG01 series with Pt conductive coating, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	13
CSG01/TiN/15	15 chips of Contact SPM probes CSG01 series with TiN conductive coating, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	13
CSG01/TiN/50	50 chips of Contact SPM probes CSG01 series with TiN conductive coating, resonant frequency 4-17kHz, force constant 0,003-0,13N/m.	13
CSG10/15	15 chips for contact mode CSG10 series, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	12
CSG10/50	50 chips for contact mode CSG10 series, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	12
CSG10/Au/15	15 chips of Contact SPM probes CSG10 series with Au conductive coating, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	13
CSG10/Au/50	15 chips of Contact SPM probes CSG10 series with Au conductive coating, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	13
CSG10/Pt/15	15 chips of Contact SPM probes CSG10 series with Pt conductive coating, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	13

CSG10/Pt/50	50 chips of Contact SPM probes CSG10 series with Pt conductive coating, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	13
CSG10/TiN/15	15 chips of Contact SPM probes CSG10 series with TiN conductive coating, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	13
CSG10/TiN/50	50 chips of Contact SPM probes CSG10 series with TiN conductive coating, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	13
NSG01/15	15 chips for noncontact/semicontact modes NSG01 series, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	6
NSG01/50	50 chips for noncontact/semicontact modes NSG01 series, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	6
NSG01/Au/15	15 chips of Noncontact SPM probes NSG01 series with Au conductive coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	13
NSG01/Au/50	50 chips of Noncontact SPM probes NSG01 series with Au conductive coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	13
NSG01/Co/15	15 chips of Noncontact SPM probes NSG01 series with CoCr magnetic coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	14
NSG01/Co/50	50 chips of Noncontact SPM probes NSG01 series with CoCr magnetic coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	14
NSG01/Pt/15	15 chips of Noncontact SPM probes NSG01 series with Pt conductive coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	13
NSG01/Pt/50	50 chips of Noncontact SPM probes NSG01 series with Pt conductive coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	13
NSG01/TiN/15	15 chips of Noncontact SPM probes NSG01 series with TiN conductive coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	13
NSG01/TiN/50	50 chips of Noncontact SPM probes NSG01 series with TiN conductive coating, resonant frequency 87-230kHz, force constant 1,45-15,1N/m.	13
NSG03/15	15 chips for noncontact/semicontact modes NSG03 series, resonant frequency 47-150kHz, force constant 0,35-5,1N/m.	7
NSG03/50	50 chips for noncontact/semicontact modes NSG03 series, resonant frequency 47-150kHz, force constant 0,35-5,1N/m.	7
NSG03/Pt/15	15 chips of Noncontact SPM probes NSG03 series with Pt conductive coating, resonant frequency 47-150kHz, force constant 0,35-5,1N/m.	13
NSG03/Pt/50	50 chips of Noncontact SPM probes NSG03 series with Pt conductive coating, resonant frequency 47-150kHz, force constant 0,35-5,1N/m.	13
NSG03/TiN/15	15 chips of Noncontact SPM probes NSG03 series with TiN conductive coating, resonant frequency 47-150kHz, force constant 0,35-5,1N/m.	13
NSG03/TiN/50	50 chips of Noncontact SPM probes NSG03 series with TiN conductive coating, resonant frequency 47-150kHz, force constant 0,35-5,1N/m.	13

NSG10/15	15 chips for noncontact/semicontact modes NSG10 series, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	8
NSG10/50	50 chips for noncontact/semicontact modes NSG10 series, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	8
NSG10/Au/15	15 chips of Noncontact SPM probes NSG10 series with Au conductive coating, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	13
NSG10/Au/50	50 chips of Noncontact SPM probes NSG10 series with Au conductive coating, resonant frequency 140-390kHz, force constant 3,1-37,6N/m..	13
NSG10/Pt/15	15 chips of Noncontact SPM probes NSG10 series with Pt conductive coating, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	13
NSG10/Pt/50	50 chips of Noncontact SPM probes NSG10 series with Pt conductive coating, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	13
NSG10/TiN/15	15 chips of Noncontact SPM probes NSG10 series with TiN conductive coating, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	13
NSG10/TiN/50	50 chips of Noncontact SPM probes NSG10 series with TiN conductive coating, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	13
NSG30/15	15 chips for noncontact/semicontact modes NSG30 series, resonant frequency 240-440kHz, force constant 22-100N/m.	9
NSG30/50	50 chips for noncontact/semicontact modes NSG30 series, resonant frequency 240-440kHz, force constant 22-100N/m.	9
NSG30/Au/15	15 chips of Noncontact SPM probes NSG30 series with Au conductive coating, resonant frequency 240-440kHz, force constant 22-100N/m.	13
NSG30/Au/50	50 chips of Noncontact SPM probes NSG30 series with Au conductive coating, resonant frequency 240-440kHz, force constant 22-100N/m.	13
NSG30/Pt/15	15 chips of Noncontact SPM probes NSG30 series with Pt conductive coating, resonant frequency 240-440kHz, force constant 22-100N/m.	13
NSG30/Pt/50	50 chips of Noncontact SPM probes NSG30 series with Pt conductive coating, resonant frequency 240-440kHz, force constant 22-100N/m.	13
NSG30/TiN/15	15 chips of Noncontact SPM probes NSG30 series with TiN conductive coating, resonant frequency 240-440kHz , force constant 22-100N/m.	13
NSG30/TiN/50	50 chips of Noncontact SPM probes NSG30 series with TiN conductive coating, resonant frequency 240-440kHz, force constant 22-100N/m.	13
FMG01/15	15 chips for noncontact/semicontact modes FMG01 series, resonant frequency 50-70kHz, force constant 1-5N/m.	10
FMG01/50	50 chips for noncontact/semicontact modes FMG01 series, resonant frequency 50-70kHz, force constant 1-5N/m.	10
FMG01/Au/15	15 chips of Noncontact SPM probes FMG01 series with Au conductive coating, resonant frequency 50-70kHz, force constant 1-5N/m.	13

FMG01/Au/50	50 chips of Noncontact SPM probes FMG01 series with Au conductive coating, resonant frequency 50-70kHz, force constant 1-5N/m.	13
FMG01/Co/15	15 chips of Noncontact SPM probes FMG01 series with CoCr magnetic coating, resonant frequency 50-70kHz, force constant 1-5N/m.	14
FMG01/Co/50	50 chips of Noncontact SPM probes FMG01 series with CoCr magnetic coating, resonant frequency 50-70kHz, force constant 1-5N/m.	14
FMG01/Pt/15	15 chips of Noncontact SPM probes FMG01 series with Pt conductive coating, resonant frequency 50-70kHz, force constant 1-5N/m.	13
FMG01/Pt/50	50 chips of Noncontact SPM probes FMG01 series with Pt conductive coating, resonant frequency 50-70kHz, force constant 1-5N/m.	13
FMG01/TiN/15	15 chips of Noncontact SPM probes FMG01 series with TiN conductive coating, resonant frequency 50-70kHz, force constant 1-5N/m.	13
FMG01/TiN/50	50 chips of Noncontact SPM probes FMG01 series with TiN conductive coating, resonant frequency 50-70kHz, force constant 1-5N/m.	13

“Whisker Type” probes

Product	Description	Page
CSC05/5	5 chips “Whisker Type” probes for contact modes, resonant frequency 8-39kHz, force constant 0,01-0,5N/m.	25
NSC05/5	5 chips “Whisker Type” probes for noncontact/semicontact modes, resonant frequency 140-390kHz, force constant 3,1-37,6N/m.	25

SNOM probes

Product	Description	Page
MF001/10	Set of 10 SNOM probes (wavelength 400-550nm), without turning forks	32
MF002/10	Set of 10 SNOM probes (wavelength 450-600nm), without turning forks.	32
MF003/10	Set of 10 SNOM probes (wavelength 600-770nm), without turning forks.	32
MF004/10	Set of 10 SNOM probes (wavelength 780-970nm), without turning forks.	32
MF005/10	Set of 10 SNOM probes (wavelength 980-1600nm), without turning forks	32
TF001/10	Set of 10 tuning forks	35

Super Sharp DLC tips

Product	Description	Page
NSG01_DLC/10	10 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1nm grown on the cantilever series NSG01.	29
NSG01_DLC/50	50 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1nm grown on the cantilever series NSG01.	29
NSG10_DLC/10	10 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1nm grown on the cantilever series NSG10.	29
NSG10_DLC/50	50 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1nm grown on the cantilever series NSG10.	29

Diamond Coated Conductive Probes

Product	Description	Page
DCP20/15	15 chips of Diamond Coated Conductive Probes, resonant frequency 260-630kHz, force constant 28-91N/m.	21
DCP20/50	50 chips of Diamond Coated Conductive Probes, resonant frequency 260-630kHz, force constant 28-91N/m.	21
DCP11/15	15 chips of Diamond Coated Conductive Probes, resonant frequency 190-325kHz, 115-190kHz, force constant 5,5-22,5N/m, 2,5-10N/m.	20
DCP11/50	50 chips of Diamond Coated Conductive Probes, resonant frequency	20

Calibration Gratings

Product	Description	Page
SNG01	Standard test sample for Scanning Near Field Optical Microscope	36
TDG01	Diffraction grating TDG01 is intended for submicron calibration scanning probe microscopes in the X or Y direction.	42
TGG1	Test grating TGG1 is intended for SPM calibration in X or Y axis, detection of lateral and vertical scanner nonlinearity, detection of angular distortion, tip characterization.	41
TGQ1	Calibration grating TGQ1 is intended for simultaneous calibration in X,Y,and Z directions.	38
TGS1	Grating set for Z-axis SPM calibration with three different height range –20±1.5nm, 100±2nm, 500±3nm.	43
TGS1_PTB	Calibration grating set TGS1 (consists of three gratings TGZ1, TGZ2, TGZ3) with PTB traceable certificate (step heights 20±1nm, 100±1.2nm, 500±1.5nm).	45
TGS2	Grating set for SPM lateral and vertical calibration, detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip shape.	47
TGSFull	Full set of calibration standards for SPM lateral and vertical calibration (including submicron calibration and simultaneous calibration in X, Y and Z directions) , detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip shape.	48
TGT1	Test grating TGT1 is intended for for 3-D visualization of the scanning tip, determination of tip sharpness parameters, tip degradation and contamination control.	39
TGX1	Test grating TGX1 is intended for lateral calibration of SPM scanners, detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip aspect ratio.	40
TGZ1	Calibration grating TGZ1 for SPM Z-axis calibration (step height 20±1nm).	37
TGZ2	Calibration grating TGZ2 for SPM Z-axis calibration (step height 100±2nm).	37
TGZ3	Calibration grating TGZ1 for SPM Z-axis calibration (step height 500±3nm).	37

HOPG (Highly Oriented Pyrolitic Graphite)

Product	Description	Page
GRAS/1.2	HOPG ZYA Quality, piece thickness 1,2±0,2mm, mosaic spread 0.4-0.7 degrees	50
GRAS/1.5	HOPG ZYA Quality, piece thickness 1,5±0,2mm, mosaic spread 0.4-0.7 degrees	50
GRBS/1.2	HOPG ZYB Quality, piece thickness 1,2±0,2mm, mosaic spread 0.8-1.2 degrees	50
GRBS/1.7	HOPG ZYB Quality, piece thickness 1,7±0,2mm, mosaic spread 0.8-1.2 degrees	50
GRBS/2.0	HOPG ZYB Quality, piece thickness 2,0±0,2mm, mosaic spread 0.8-1.2 degrees	50
GRHS/1.2	HOPG ZYH Quality, piece thickness 1,2±0,2mm, mosaic spread 3.5-5.0 degrees	50
GRHS/1.7	HOPG ZYH Quality, piece thickness 1,7±0,2mm, mosaic spread 3.5-5.0 degrees	50
GRHS/2.0	HOPG ZYH Quality, piece thickness 2,0±0,2mm, mosaic spread 3.5-5.0 degrees	50

Test samples

Product	Description	Page
DNA01	Long-life, stable and indestructible biological test sample for AFM investigation in air.	52
STEPP	STEPP is a Silicon Test Echeloned Pattern for AFM height calibrating in angstrom and single nanometer intervals by the naturally calibrated monoatomic silicon step with the height 0.31nm.	53