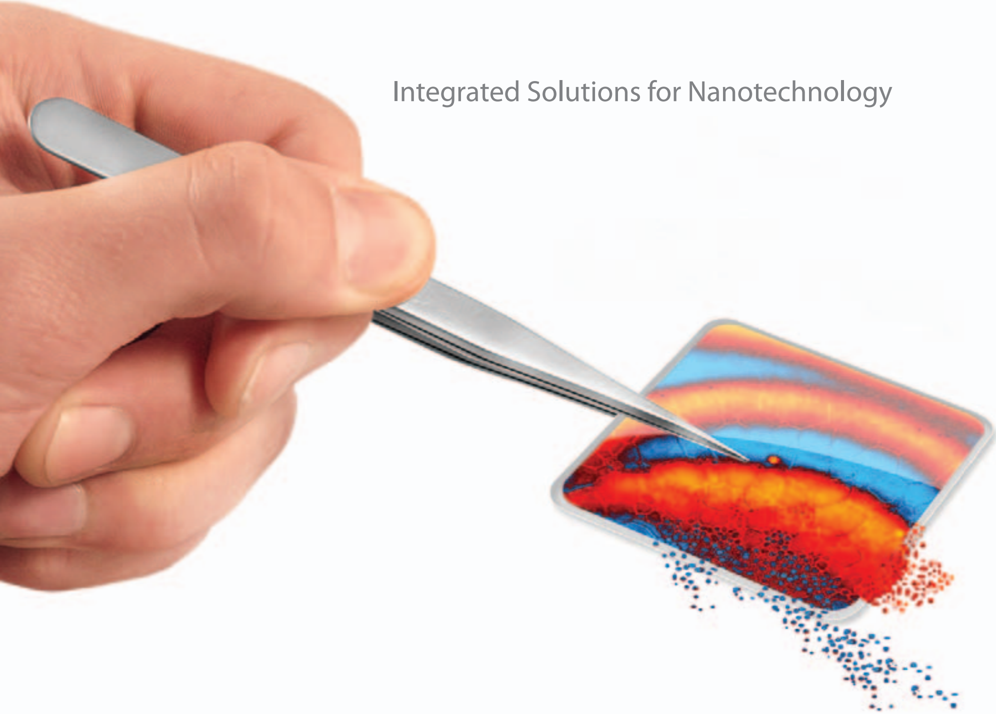
NT-MDT Company

AFM Probes & Accessories Catalogue



Integrated Solutions for Nanotechnology

NT-MDT

About Company

NT-MDT was founded in 1990 and enjoys a long history in instrumentation created specifically for nanotechnology research. Our company leads the field in originality, quality, and high tech development and our product lines are constantly expanding.

Today, we manufacture a wide range accessories and supplies for scanning probe microscopy, compatible with both our own systems and those of other manufacturers. Our own scanning probe systems cover the complete spectrum from simple atomic-force microscopes (AFM) for education, to multi-purpose, specialized AFMs for scientific research, industry, and nanotechnology centers. For example, our multi-purpose NTEGRA systems allow researchers to utilise the full range of modern AFM techniques, and facilitate the investigation of several fundamental scientific areas with a single machine. NT-MDT also produces modular nanofactories in order to bring to our customers the whole arsenal of tools and techniques necessary for creation, processing and quality assurance of devices and elements of micro- and nanoelectronics.

Please visit www.ntmdt.com to learn more about our products.

Contact the nearest representative center or visit
www.ntmdt-tips.com to choose among a broad spectrum of AFM probes, calibration standards and test samples.

Contents

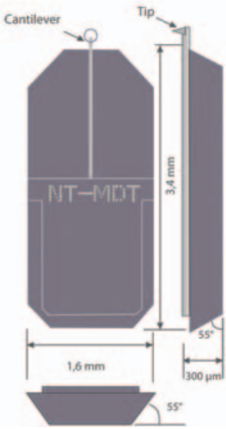
AFM «Golden» Silicon Probes

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 Ω-cm, Antimony doped.
- Standard chip size: 1.6×3.4×0.3 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.

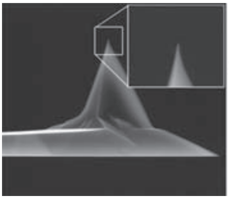


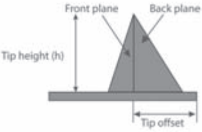
Cantilever

- 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 5-20 µm from the free cantilever end.

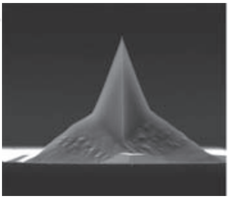
Tip

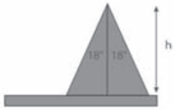
- Total tip shape is tetrahedral, the last 500 nm from tip apex is cylindrical.
- Tip height: 14 – 16 µm.
- Typical curvature radius of uncoated tips 6 nm, guaranteed 10 nm.
- Tip offset: 5 - 20 µm.
- Tip aspect ratio: 3:1 – 7:1.
- Front plane angle: 10°± 2°.
- Back plane angle: 30°± 2°.
- Side angle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





Tip side view





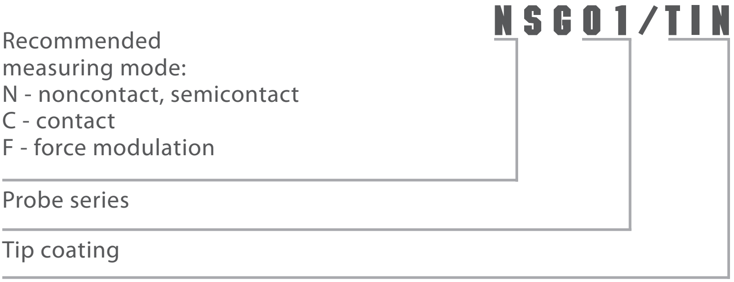
Tip front view

«Golden» Silicon Probes are available

- with Au or 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.*
Guaranteed product yield is better than 90 %.
Warranty: 1 year for uncoated probes, 6 months for probes with conductive coating, 3 months for probes with magnetic coating

Probe Series Name



Recommended measuring mode:
N - noncontact, semicontact
C - contact
F - force modulation

Probe series

Tip coating

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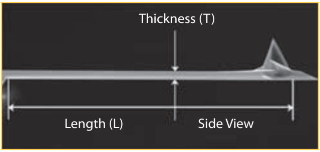
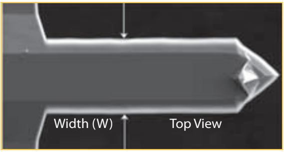
* GelPak® is a registered trade mark of Vichem Corporation

Semicontact / Noncontact Probes

NSG01 Series





Code for ordering

NSG01/15
15 separated chips

NSG01/50
50 separated chips

NSG01W
Minimum 410 chips

Substrate specification

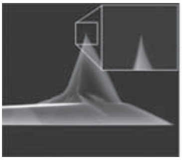
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au; magnetic CoCr
Available probes	Bare, with Al reflective coating

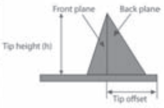
Cantilever specification

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

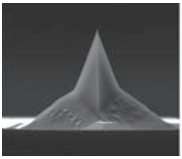
Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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

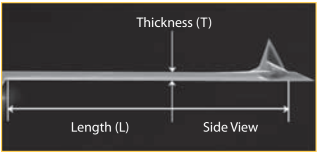
NSG03 Series

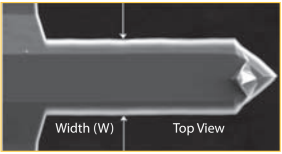
Code for ordering

NSG03/15
15 separated chips

NSG03/50
50 separated chips

NSG03W
Minimum 410 chips





Substrate specification

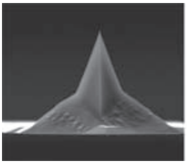
Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au
Available probes	Bare, with Al reflective coating

Cantilever specification

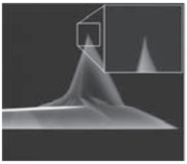
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
135	30	1.5	47	90	150	0.35	1.74	6.1

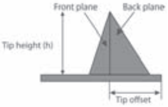
Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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°*



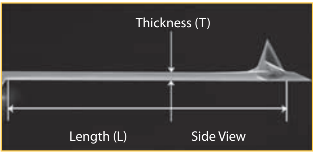
Tip front view

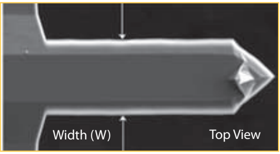




Tip side view

NSG10 series





Code for ordering

NSG10/15
15 separated chips

NSG10/50
50 separated chips

NSG10W
Minimum 410 chips

Substrate specification

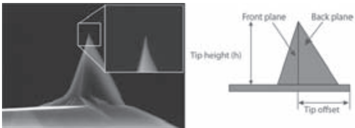
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au
Available probes	Bare, with Al reflective coating

Cantilever specification

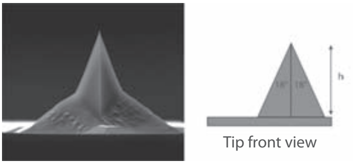
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
95	30	2.0	140	240	390	3.1	11.8	37.6

Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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°*

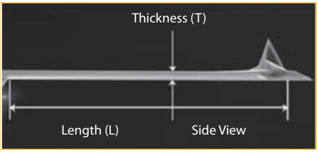


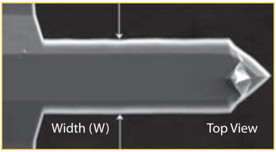
Tip side view



Tip front view

NSG30 series





Code for ordering

NSG30/15
15 separated chips

NSG30/50
50 separated chips

NSG30W
Minimum 410 chips

Substrate specification

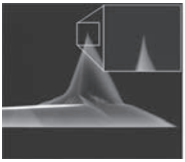
Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au
Available probes	Bare, with Al reflective coating

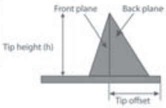
Cantilever specification

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

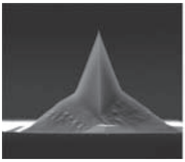
Tip specification

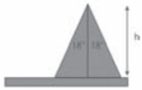
Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 nm*
Tip offset	*5 - 20 µm*
Tip aspect ratio	*3:1–7:1*
Front plane angle	*10°± 2°*
Back plane angle	*30°± 2°*
Side angle (half)	*18°± 2°*
Cone angle at the apex	*7°-10°*





Tip side view

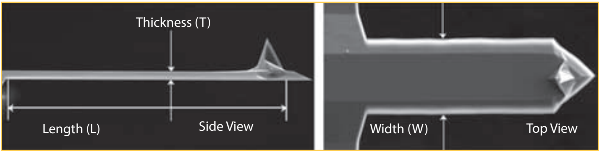




Tip front view

Force Modulation Probes

FMG01 series



Code for ordering

FMG03/15
15 separated chips

FMG03/50
50 separated chips

FMG03W
Minimum 410 chips

Substrate specification

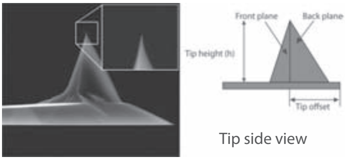
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au; magnetic CoCr
Available probes	Bare, with Al reflective coating

Cantilever specification

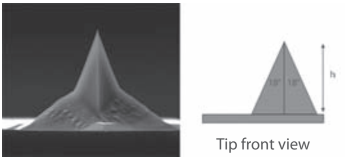
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	32	2.5	50	60	70	1	3	5

Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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°*



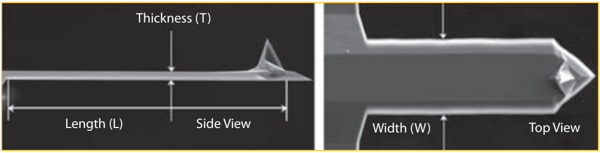
Tip side view



Tip front view

Contact Probes

CSG01 series



Code for ordering

CSG01/15
15 separated chips

CSG01/50
50 separated chips

CSG01W
Minimum 410 chips

Substrate specification

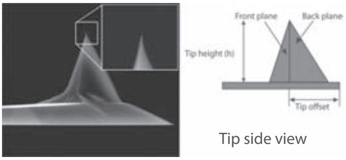
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au
Available probes	Bare, with Al reflective coating

Cantilever specification

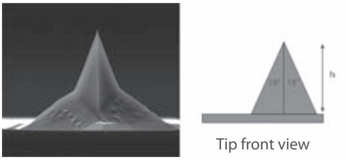
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
350	30	1.0	4	9.8	17	0.003	0.03	0.13

Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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°*

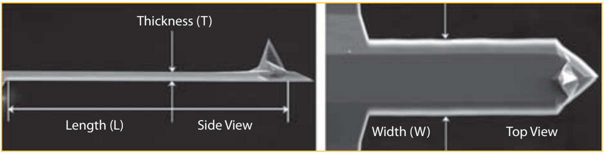


Tip side view



Tip front view

CSG10 series



Code for ordering

CSG10/15
15 separated chips

CSG10/50
50 separated chips

CSG10W
Minimum 410 chips

Substrate specification

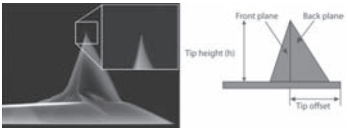
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr, TiN, Au
Available probes	Bare, with Al reflective coating

Cantilever specification

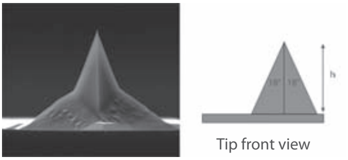
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	30	1.0	8	22	39	0.01	0.11	0.5

Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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°*

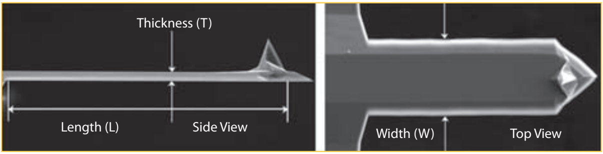


Tip side view



Tip front view

CSG30 series



Code for ordering

CSG30/15
15 separated chips

CSG30/50
50 separated chips

CSG30W
Minimum 410 chips

Substrate specification

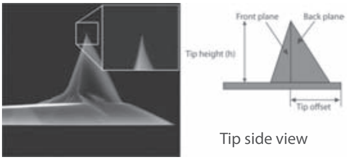
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Available coatings	Conductive PtIr
Available probes	Bare, with Al reflective coating

Cantilever specification

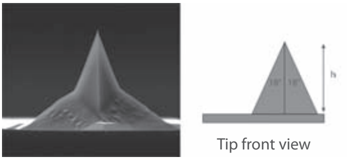
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
190	30	1.5	26	48	76	0.13	0.6	2

Tip specification

Tip shape	*tetrahedral, the last 500 nm from tip apex is cylindrical*
Tip height	*14 – 16 µm*
Curvature radius	*typical 6 nm, guaranteed 10 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



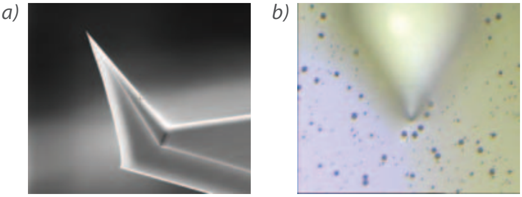
Tip front view

Top Visual Probes

VIT_P series

TOP VISUAL probes intended:

- For precise positioning of the tip over the point of interest and for direct real-time observation of sample scanning and modification (nanomanipulation) processes.
- For precise positioning of a tightly focused laser spot at the tip end – for investigations of optical effects between tip and sample (TERS, TEFS, SNOM etc).



a) SEM photo of TOP VISUAL probe

b) Image in optical microscope (TOP VISUAL probe is under the investigated sample)

Substrate specification

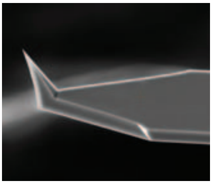
Material	Single Crystal Silicon, N-type, 0.01-0.025 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side coating	None
Front coating	None
Cantilever number	1 rectangular
Tip curvature radius	Typical 6 nm, guaranteed 10 nm
Tip shape	Pyramidal
Tip height	14-16 um
Availabes probes	With Pt reflective and/or conductive coating

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
140	50	5.0	200	300	400	25	50	95

Tip specification

Tip shape	*triangular pyramid*
Tip height	*14 – 16 μm*
Curvature radius	*typical 6 nm, guaranteed 10 nm*



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)	20÷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 CSG01	CSG10/Au/15 CSG01/Au/15	CSG10/Au/50 CSG01/Au/50
PtIr	CSG10 CSG01 CSG30	CSG10/Pt/15 CSG01/Pt/15 CSG30/Pt/15	CSG10/Pt/50 CSG01/Pt/50 CSG30/Pt/50
TiN	CSG10 CSG01	CSG10/TiN/15 CSG01/TiN/15	CSG10/TiN/50 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 NSG01 NSG30 NSG03 FMG01	NSG10/Au/15 NSG01/Au/15 NSG30/Au/15 NSG03/Au/15 FMG01/Au/15	NSG10/Au/50 NSG01/Au/50 NSG30/Au/50 NSG03/Au/50 FMG01/Au/50
PtIr	NSG10 NSG01 NSG30 NSG03 FMG01 VIT_P	NSG10/Pt/15 NSG01/Pt/15 NSG30/Pt/15 NSG03/Pt/15 FMG01/Pt/15 VIT_P/Pt/15	NSG10/Pt/50 NSG01/Pt/50 NSG30/Pt/50 NSG03/Pt/50 FMG01/Pt/50 VIT_P/Pt/50
TiN	NSG10 NSG01 NSG30 NSG03 FMG01	NSG10/TiN/15 NSG01/TiN/15 NSG30/TiN/15 NSG03/TiN/15 FMG01/TiN/15	NSG10/TiN/50 NSG01/TiN/50 NSG30/TiN/50 NSG03/TiN/50 FMG01/TiN/50

* For contact probes TiN (25 nm) / 2nm Ti / 20 nm Au.

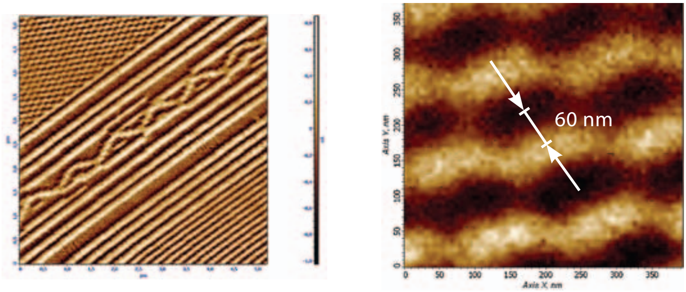
Magnetic Probes

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 40 nm.
Tip curvature radius after coating is ~40 nm.

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

Substrate specification

Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ω-cm, Antimony doped.
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular
Coatings	CoCr magnetic coating



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

Cantilever Specification

NSG01 series

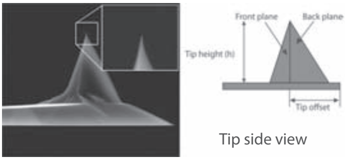
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
125	40	2.0	87	150	230	1.45	5.1	15.1

FMG01 series

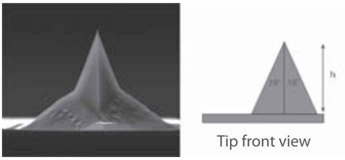
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	32	2.5	50	60	70	1	3	5

Tip specification

Tip shape	tetrahedral, the last 500 nm 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, FMG01/Co/15
15 separated chips with Co/Cr coating

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

Tipless Probes

Probe series:

noncontact/semicontact	NSG10, NSG01, NSG30, NSG03
force modulation	FMG01
contact	CSG10, CSG01, CSG30

are available without tips by request

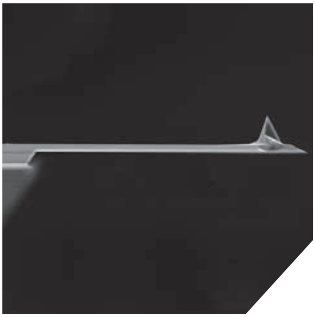
Code for ordering

Semicontact/noncontact	
NSG10/tipless/200	200 separated chips
NSG01/tipless/200	
NSG30/tipless/200	
NSG03/tipless/200	

Force modulation	
FMG10/tipless/200	200 separated chips

Contact	
CSG10/tipless/200	200 separated chips
CSG01/tipless/200	
CSG30/tipless/200	

Bare Probes



Probe series:

noncontact/semicontact	NSG10, NSG01, NSG30, NSG03
force modulation	FMG01
contact	CSG10, CSG01, CSG30

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

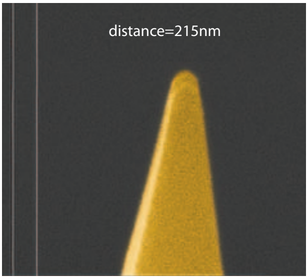
Code for ordering

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	
CSG30/bare/15	
CSG10/bare/50	50 separated chips
CSG01/bare/50	
CSG30/bare/50	

Semicontact/noncontact	
FMG01/bare/15	15 separated chips
FMG01/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 100 nm.
- Diamond coating is doped with nitrogen.
- Film resistivity: 0,5-1 Ω cm.
- Tip curvature radius after coating is about 100 nm.
- Recommended for electrical modes.
- Specially recommended for Oxidation Nanolithography*.

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

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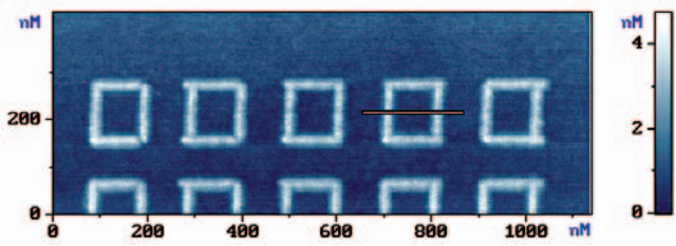
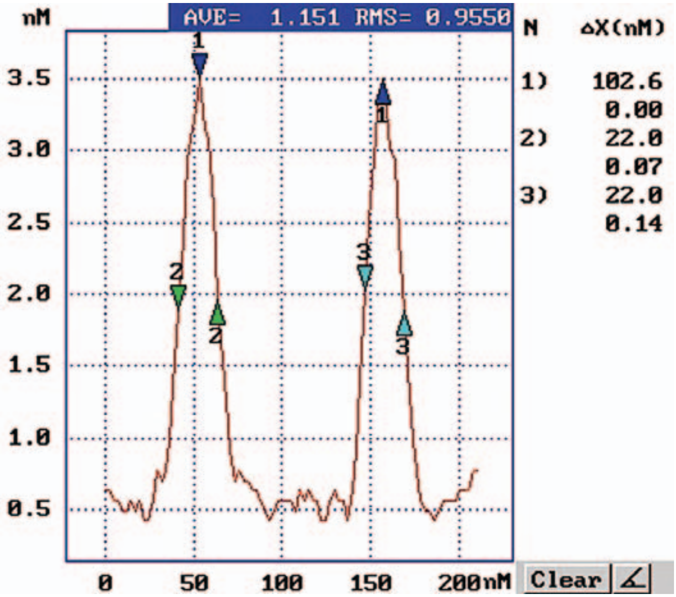
* We made a special «survival» test - almost 50 LAO Lithography images of Mona Lisa were obtained by using only one tip. It was not destroyed even after such a hard work. After 50 attempts it was still «alive».

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

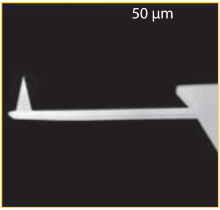


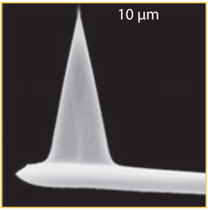


```
AVE=   1.151  RMS= 0.9550
```

```
N      ΔX(nM)
1)     102.6
        0.00
2)      22.0
        0.07
3)      22.0
        0.14
```

DCP11 series





Code for ordering

DCP11/15
15 separated chips

DCP11/50
50 separated chips

Substrate specification

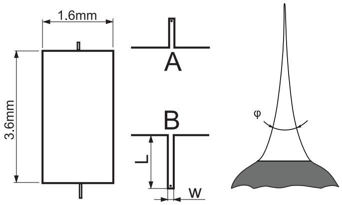
Chip size	3.6×1.6×0.4 mm
Reflective side	Au
Cantilever number	2 rectangular
Coatings	Diamoned doped with nitrogen for conductivity
Thickness of diamond coating	~ 100 nm

Substrate specification

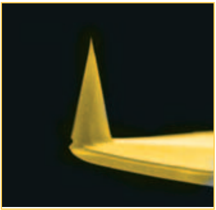
Cantilever length, L±5 µm	Cantilever width, W±3 µm	Cantilever thickness, µm			Resonant frequency, kHz			Force constant, N/m		
		min	typical	max	min	typical	max	min	typical	max
100	35	1.7	2.0	2.3	190	255	325	5.5	11.5	22.5
130	35	1.7	2.0	2.3	115	150	190	2.5	5.5	10

Tip specification

Aspect ratio	*3:1*
Tip height	*10-15 µm*
Tip cone angle φ	*≤22°*
Typical curvature radius	*~ 100 nm*



DCP20 series



Code for ordering

DCP20/15
15 separated chips

DCP20/50
50 separated chips

Tip specification

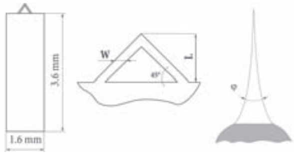
Chip size	3.6×1.6×0.4 mm
Reflective side	Au
Cantilever number	1 triangular
Coating	Diamond doped with nitrogen for conductivity
Thickness of diamond coating	~100 nm

Substrate 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	*10-15 µm*
Tip cone angle φ	*≤22°*
Typical curvature radius	*~ 100 nm*



Colloidal Probes

Too large radius of curvature of the AFM probe tip is not always only the drawback. A typical threshold for the local pressure that saves intact the living cell may be just a few kPa. It is substantially lower than the pressure that locally acts on the sample interacting with the sharp standard AFM probe. There is a tradeoff: the integrity of the object is stored at the expense of resolution. It can be reached with a so-called colloidal probe, in which instead of the needle, the smooth spherical colloidal particle of micron size is fixed on the cantilever. If the size of the particle is calibrated, the opportunity to conduct quantitative investigations of mechanical properties of the living cell, as well, such as of polymers is provided.

NT-MDT Co offers special colloidal probes, in which spherical particles calibrated by size are fixed on the very end of the needle tip, see Figure.1. The particles diameter may be a few hundred nanometers, what adds to noted above merits of colloidal probes the possibility to preserve the AFM resolution at the submicron level.

The results of AFM investigation of living cells line L41 by using the colloidal probes are shown in Figure 2. According to these data, the values of the living cell compliance (inverse stiffness) along the line marked in the AFM image are almost independent on the vertical dimensions of the cell. The values of compliances were determined as a steepness of deformation from load curves measured during indentation. Detecting constant level of the compliance was related with the fact that the maximum indentation depth did not exceed the radius of curvature of the probe and was almost an order of magnitude smaller than the height of the cell. I.e. the relatively thin surface layer of the living cell is responding to the indentation. Calculation of elastic modulusfor that surface layer gave the averaged value of 21±3 kPa.

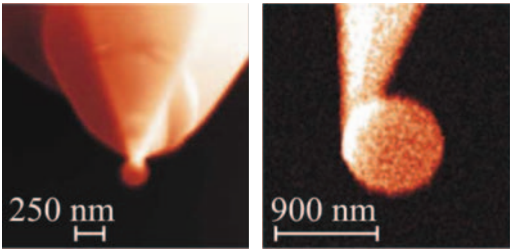


Figure 1. SEM image of the colloidal probes with 250 and 900 nm SiO2 granules fixed at the needle tip. Colloidal granules of calibrated sizes were manufactured at the laboratory of physics of amorphous semiconductors at Ioffe Institute, St. Petersburg.

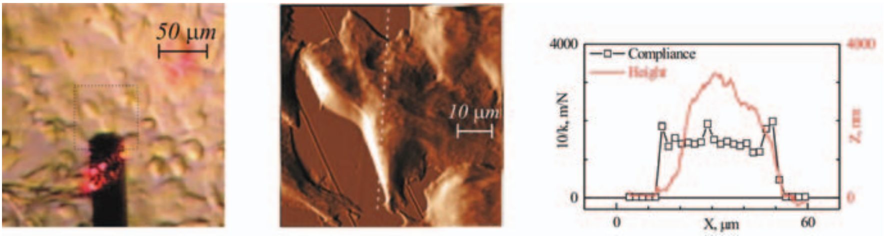


Figure.2. Investigation of living cell lymphoblastoid line L41. The optical image of the colony of cells in a Petri dish is shown in the left. In the center there is a tapping mode AFM image of the cells (gradient filter was applied for image processing). Scanning parameters: liquid cell, the colloidal probes with 650 nm SiO2 granule, the cantilever stiffness 0.4 N/m, resonance frequency of 16.3 kHz (in an air - 55.5 kHz), quality factor ≈3 (in accordance with the width of the thermal peak); a free and working amplitude is 22 nm and 14 nm, respectively. The compliance profile (the inverse of rigidity) and the height profile of the cell, measured along the line marked on the AFM image, are placed in the right of the Figure. Cell line L41 was cultivated at the laboratory of evolutionary variability of influenza viruses, Research Institute of Influenza, St. Petersburg

Due to the precisely known geometry of colloidal probes, they are useful to study the rheological characteristics of soft objects and e.g. to determine the Brinell hardness of soft coatings (with a tensile strength less than 10 MPa). Four almost circular pits on the surface of the polymer film were formed by the colloidal probe that indented the material under different deformation rate, see Figure 3. The pit's depth characterizes the level of inelastic deformation, and the presented data indicate that polymer behaves more elastically under rapid loading. According to information received, the Brinell hardness was in the range of 1.45 MPa to 2.05 MPa and increased with in-creasing indentation speed.

SiO2 granules 250 nm, 650 nm, 900 nm in diameter can be mounted on any efficient cantilever. Colloidal probes with calibrated granule can withstand loads of up to several µN.

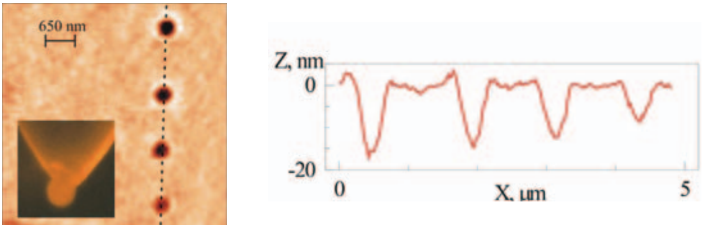


Figure 3. Tapping mode AFM surface topography image reveals the results of indentation testing of polysiloxane film. Both indentation and topography measurements were performed using the same colloidal probes with 650 nm SiO2 granule, SEM image of the colloidal probes is shown in the insertion. The insertion and the AFM image have the same scale. Indentation pits were formed with maximum force of about 300 nN and indentation depth of about 100 nm, but at different deformation rates: 3.5 (top one) and 7 (second from top), 20 (third from top) and 200 nm/s (at the bottom). The depth profile across the all four indentations is presented below the image. Polysi-loxane block copolymer was produced by Lebedev VNIISK, St. Petersburg.

NT-MDT offers 2 types of colloidal probes:

Cantilevers with submicron spheres attached to silicon tip	Cantilevers with micron spheres attached to tipless probes
Type of colloidal spheres: SiO2 Size : 250 nm, 650 nm, 900 nm with accuracy ±5%.	Type of colloidal spheres: Au, BSG, SiO2, PS Size : A - 5 µm to 9 µm, B - 10 µm to 14 µm C - 15 µm to 19 µm, D - 20 µm or more
Reflex side: Au Tip and Reflex side : Au/Au No coating - bare	Reflex Side: Al, Au Tip and Reflex side : Au-Au No coating - bare
Code for ordering: PROBE SERIES_SPHERES SIZE / COATING / ORDERING NUMBER	Code for ordering: PROBE SERIES_TYPE OF SPHERES – SIZE/ COATING / ORDERING NUMBER
For example: to order 5 probes of noncontact mode NSG01, 250 нм diameter SiO2 spheres with gold coating on reflective side.	For example: to order 5 probes of contact mode, 7 µm diameter SiO2 spheres colloidal probe with gold coating on both sides.
The part number will be: NSG01_Bio250 / Au / 5*	The part number will be: CPC_SiO2-A / Au / 5*

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* Minimum number is 5 probes per type ordered

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 is true when the height's difference is greater than the probe's dimensions.

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

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!

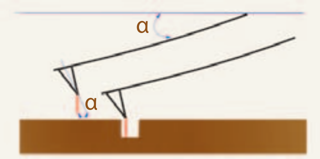


Fig. 2. Any angle of inclination a you need to match your AFM holder specification can be produced. Just specify the angle of inclination you want

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.

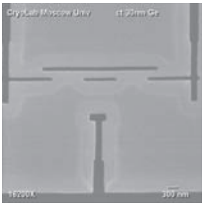
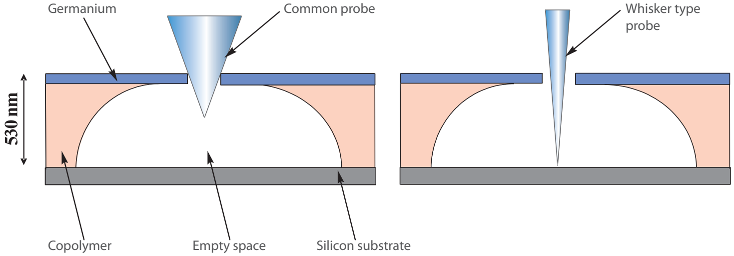


Fig. 3. SEM image of the structure. Dark places correspond to holes, while light colors correspond to absence of copolymer. Sample: E-beam lithography mask for fabrication SET devices by shadow evaporation technique. V. A. Krupenin, Cryoeletronics Lab., Physical department of MSU, Moscow, Russia.

Cantilever specification



On the Fig. 4. AFM 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!

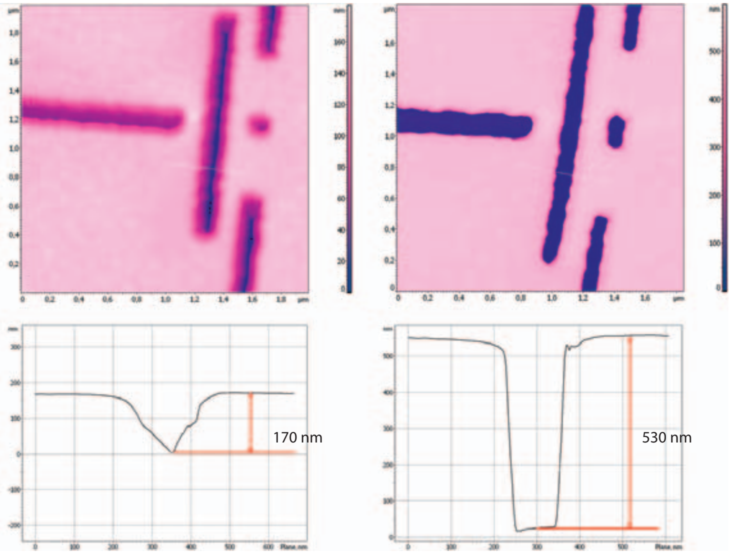
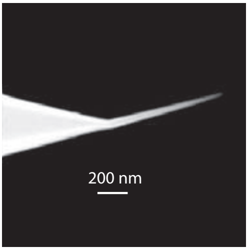


Fig. 4. On the left – results of imaging by the standard probe, the reached depth was only 170 nm. While the whisker achieved the bottom (530 nm) and showed a uniform distribution when standard probe fails even to reach the bottom!

Calibrated SEM photos

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

a)



b)

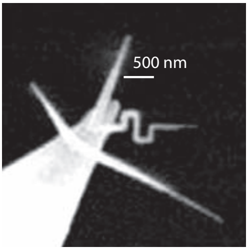


Fig. a: SEM image of FEB tip specially designed for measurement of samples with near vertical sidewalls.

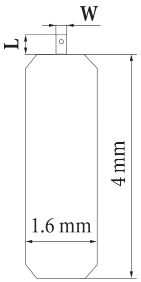
Fig. b: SEM image of four FEB tips grown on the silicon tip in accordance with preset sketch.

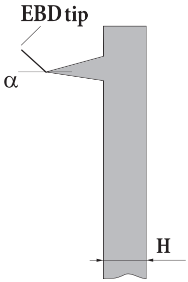
FEB tip specification

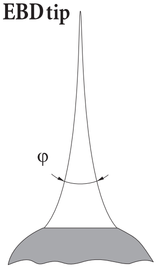
Material	Carbin (carbon modification)
Aspect ratio	Better than 10:1
Angle φ	≤10°
Typical curvature radius	10 nm
Angle of inclination α	20°±1°; 10°±1°

Substrate specification

Material	Single Crystal Silicon, N-type, 0.01- 0.025 Ω-cm, Antimony doped.
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular







Cantilever specification

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

NSC05 series – for semicontact/noncontact mode

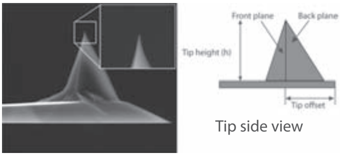
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
95	30	2.0	140	240	390	3.1	11.8	37.6

CSC05 series – for contact mode

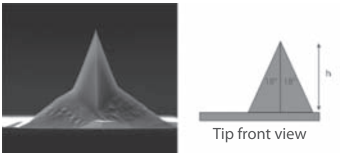
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
225	30	1.0	8	22	39	0.01	0.11	0.5

Silicon tip specification

Tip shape	tetrahedral, the last 500 nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10 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

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 20 nm 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
Working length	1-3 nm
Probe series for growing	≥20 nm
Cantilever number	NSG01, NSG10**

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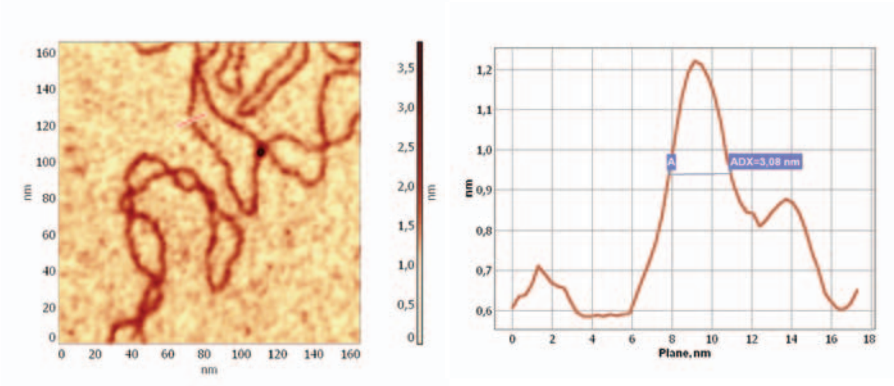
* Dmitry Klinov and Sergei Magonov, True molecular resolution in tapping-mode atomic force microscopy with high-resolution probes, Applied physics letters, 84 (14), (2004) 2697-2699.

** DLC tips can be grown on any other probe series by request

Cantilever specification

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



AFM 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 Ω-cm, Antimony doped
Chip size	3.4×1.6×0.3 mm
Reflective side	Au
Cantilever number	1 rectangular

Cantilever specification

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

NSG01_DLC series

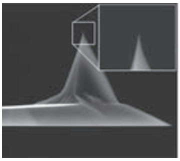
Cantilever length, L±10 µm	Cantilever width, W±5 µm	Cantilever thickness, T±0.5 µm	Resonant frequency, kHz			Force constant, N/m		
			min	typical	max	min	typical	max
125	30	2.0	87	150	230	1.45	5.1	15.1

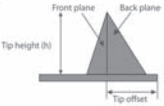
NSG10_DLC series

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

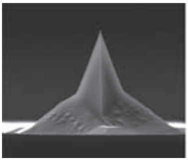
Silicon tip specification

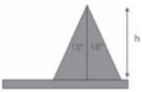
Tip shape	tetrahedral, the last 500 nm from tip apex is cylindrical
Tip height	14 – 16 µm
Curvature radius	typical 6 nm, guaranteed 10 nm
Tip offset	5 - 20 µm
Tip aspect ratio	3:1 – 7:1
Front plane angle	10°± 2°
Back plane angle	30°± 2°
Side angle (half)	18°± 2°
Cone angle at the apex	7°-10°





Tip side view



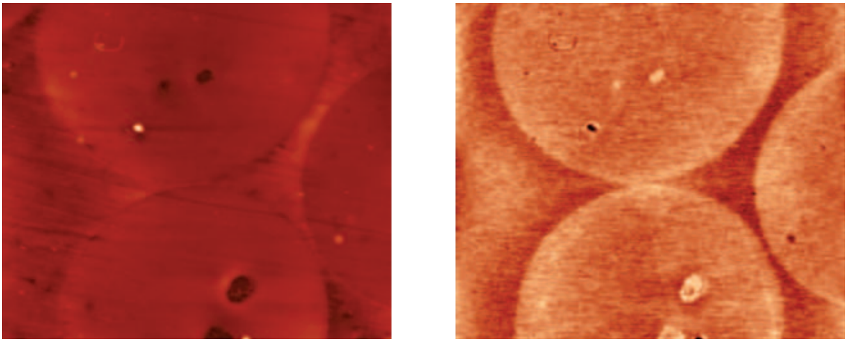


Tip front view

Probes for scanning thermal microscopy (SThM probes)

Scanning Thermal Microscopy (SThM) is an advanced AFM mode intended for simultaneous obtaining nanoscale thermal and topography images. NT-MDT's SThM kit is able to visualize temperature and thermal conductivity distribution at the sample surface. The SThM system hardware includes electronic controller, software, and probes.

SThM mode of operation with an AFM requires a specialized probe with a resistor built into the cantilever. NT-MDT's SThM module allows one to monitor the resistance changes correlated with the temperature at the end of the probe. So the system is able to monitor relative changes of sample temperature and thermal conductivity. NT-MDT's thermal probes provide better than 100 nm lateral resolution for both topography and thermal images.



topography image

thermal conductivity image

Sample	Optical Fiber in Epoxy
Scan size	6×6 µm

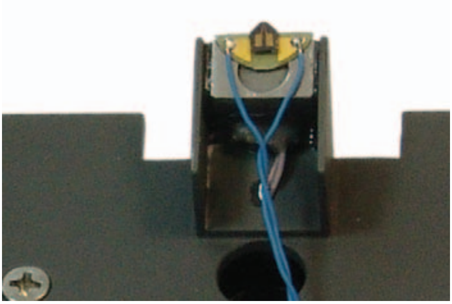
The specialized SThM cantilever, made of SiO_2 with a thin metal layer, is deposited on the probe in such a way that the highest resistance portion of the layer is concentrated near the tip apex.

Code for ordering

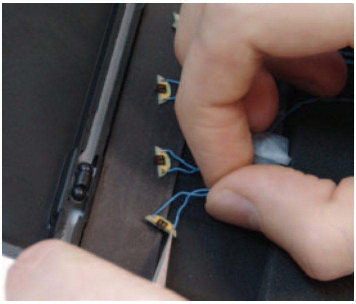
SThM_P/5
Set of 5 probes for Scanning Thermal Microscopy

Specifications:

Probe base	2×3 mm
Cantilever (thermal SiO2)	150×60×1 μm
Resistor metal	5 nm NiCr - 40 nm Pd
Track and pad metal	5 nm NiCr - 140 nm Au
Resistance	300-500 Ω
Tip radius	< 100 nm
Maximum temperature	160 C
Tip height	~ 10 μm
SiO2 Spring Constant	0.45 N/m
Fo	~ 48 kHz
Sensitivity	app. 1 Ω / deg C
Series resistors	2×100 Ω (+/- 25 Ω)



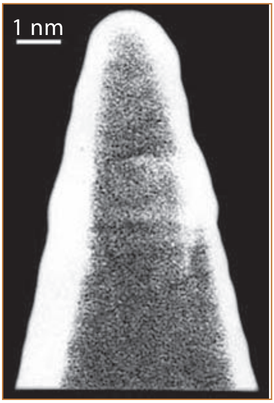
SThM probe in the cantilever holder



Set of SThM probes

SNOM probes and accessories

SNOM probes



Probe specification:

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

---

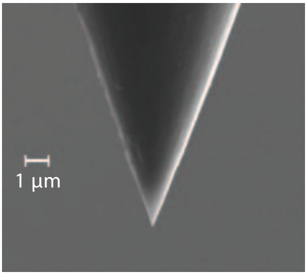
* This method gives the optical efficiency 102-104 times better than those obtained by mechanical pulling.

Geometrical & mechanical fiber specification:

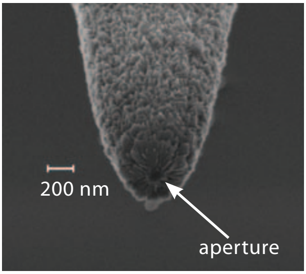
Clad Diameter	125.0 ± 1.5 µm
Coating Diameter	245 ± 15 µm
Core-Clad Concentricity	<0.5 µm
Coating/Clad Offset	≤5 µm
Coating Material	UV Cured, Dual Acrylate
Operating Temperature	-55 to +85 °C
Short-Term Bend Radius	≥ 6 mm
Long-Term Bend Radius	≥ 13 mm
Proof Test Level	≥ 200 kpsi (1.4 GN/m^2)

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 70 nm.

Code for ordering

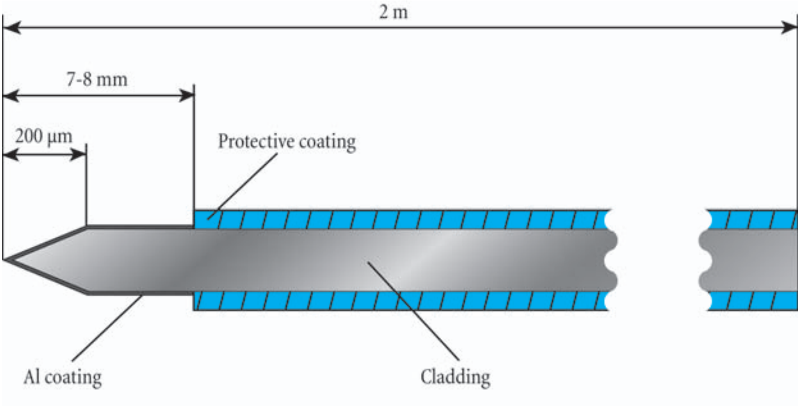
MF001
Set of 10 SNOM probes MF001 type without tuning forks

MF002
Set of 10 SNOM probes MF002 type without tuning forks

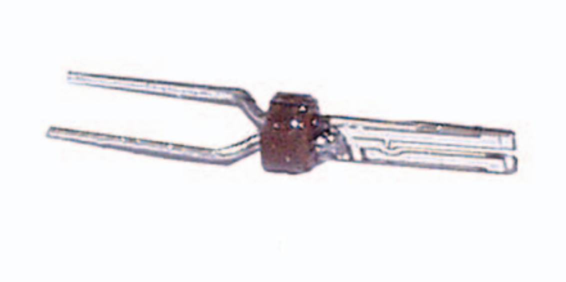
MF003
Set of 10 SNOM probes MF003 type without tuning forks

MF004
Set of 10 SNOM probes MF004 type without tuning forks

MF005
Set of 10 SNOM probes MF005 type without tuning forks



Tuning forks

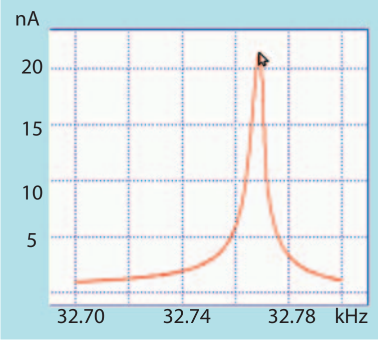


Code for ordering

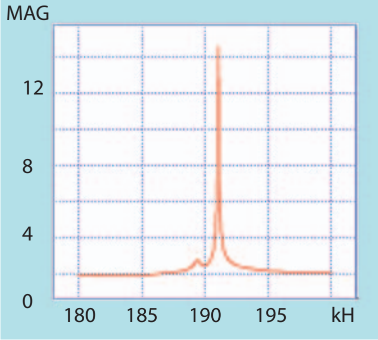
TF001/10
Set of 10 tuning forks

Tuning forks specification:

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



Resonant frequency - 32,77 kHz



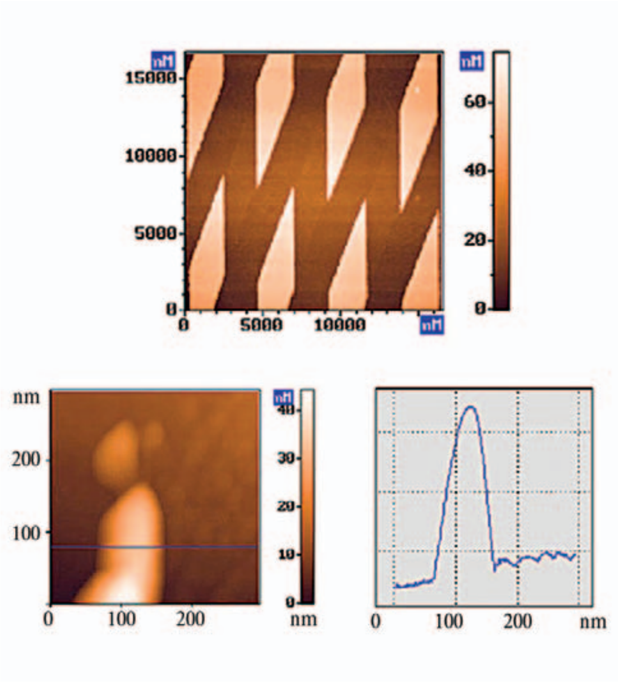
Resonant frequency - 191 kHz

SNOM test grating SNG01

Test Grating For Scanning Near-field Optical Microscope

Code for ordering

SNG01
SNOM Test grating

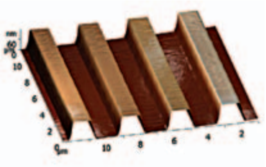


Grating description

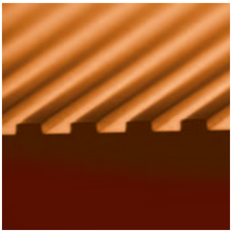
Substrate:	Quartz (0.5 mm thickness)
Substrate size:	10×10 mm
Rhomb material:	Vanadium
Thickness of vanadium layer	About 20-30 nm
Active area:	Central diameter 3 mm array
Transmission coefficient through metal coating (rhomb)	≤20 %
Reflection coefficient from metal coating (rhomb)	≥40 %
R curvature of rhomb	≤50 nm

Calibration gratings

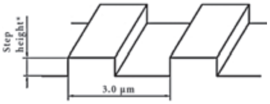
TGZ grating series



AFM 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 SiO2
Pattern types	1- Dimensional (in Z-axis direction)
Step height	TGZ1 - 20±1.5 nm* TGZ2 - 110±2 nm* TGZ3 - 520±3 nm* TGZ4 - 1400±10 nm*
Period	3.00±0.05 µm
Chip size	5×5×0.5 mm
Effective area	Central square 3×3 mm

Code for ordering

TGZ1
Height calibration grating (20±1.5 nm)

TGZ2
Height calibration grating (110±2 nm)

TGZ3
Height calibration grating (520±3 nm)

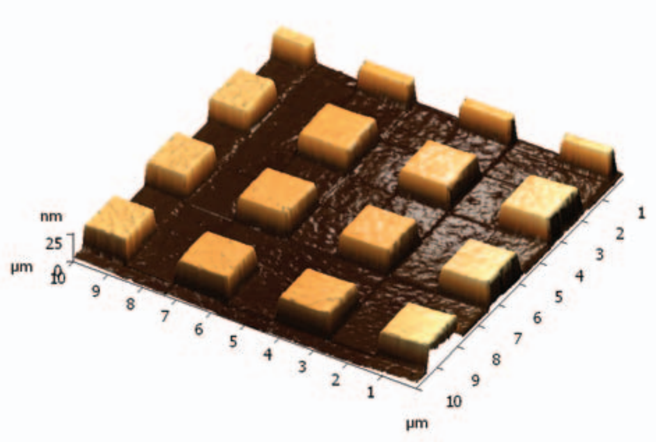
TGZ4
Height calibration grating (1400±10 nm)

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

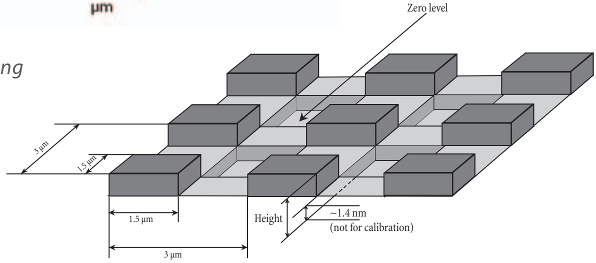
TGQ1 calibration grating

Code for ordering

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



AFM image of TGQ1 grating



Application:

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

Grating description

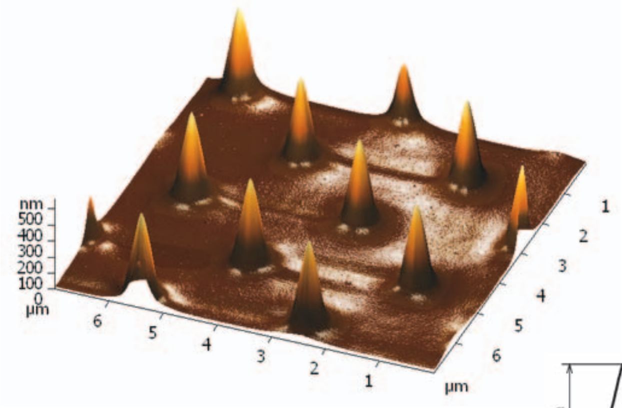
Structure	The grating is formed on Si wafer top surface
Pattern types	3-Dimensional array of rectangles
Period	3.00±0.05 mm
Height	20 nm ±1.5 nm*
Rectangle side sizes	1.5±0.25 mm
Chip size	5×5×0.5 mm
Effective area	Central square 3×3 mm

* 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±1.5 nm)

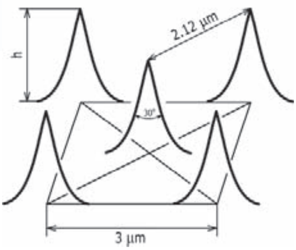
TGT1 grating for tip characterization

Code for ordering

TGT1
Tip characterization grating



AFM image of TGT1 grating



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

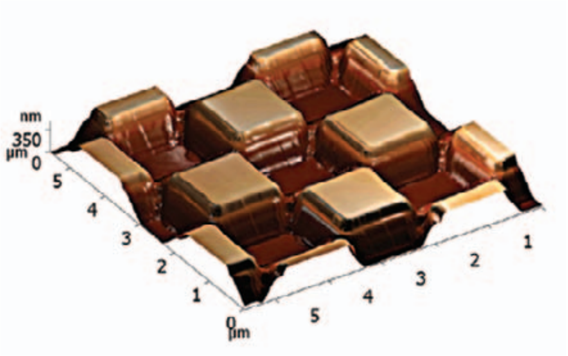
Structure:	The grating is formed on Si wafer top surface
Pattern types:	Array of sharp tips
Tip angle:	30 degrees
Tip curvature radius:	≤10 nm
Period:	3.00±0.05 µm
Diagonal period:	2.12 µm
Chip size:	5×5×0.5 mm
Effective area:	Central square 2×2 mm
Height, h:	0.3-0.7 µm

* 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

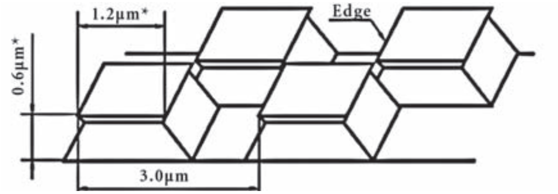
TGX1 square grating with negative angles

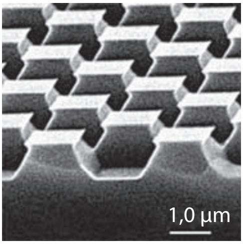
Code for ordering

TGX1
Square grating with negative angles



AFM image of TGX1 grating





SEM photo of grating TGX1 grating

Application:

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

Grating description

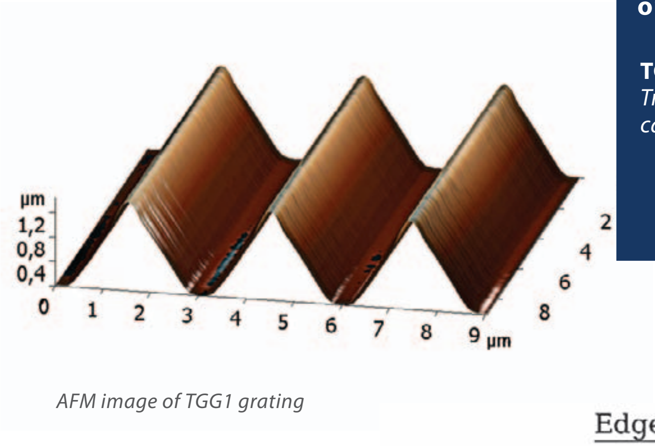
Structure	The grating is formed on Si wafer top surface
Pattern types	Chessboard-like array of square pillars with sharp
Period	Undercut edges
Height	3.00±0.05 μm
Rectangle side sizes	Less than 10 nm
Chip size	5×5×0.5 mm
Effective area	Central square 3×3 mm
Height	0.3-0.6 μm

* Not for callibration.

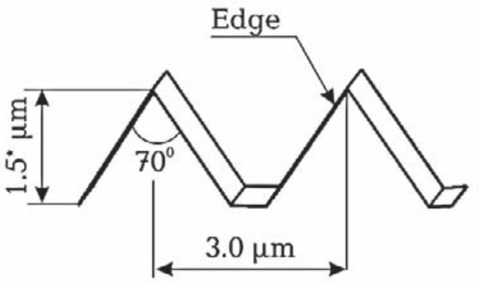
TGG1 triangular grating

Code for ordering

TGG1
Triangular calibration grating



AFM image of TGG1 grating



Application:

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

Grating description

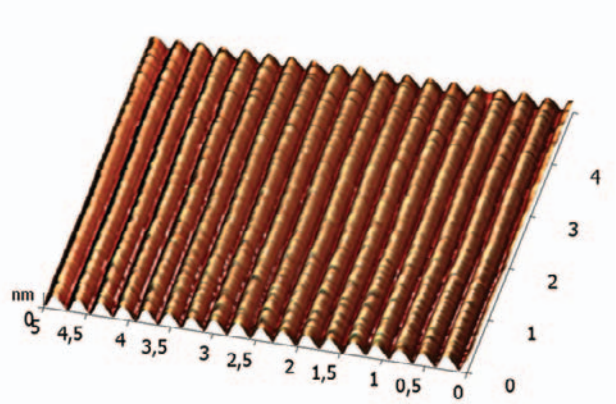
Structure:	The grating is formed on Si wafer top surface
Pattern types:	1- D array of triangular steps (in X or Y direction) having precise linear and angular sizes
Edge angle:	70±2 degrees
Edge radius:	≤10 nm
Period:	3.00±0.05 µm
Chip size:	5×5×0.5 mm
Effective area:	Central square 3×3 mm

* Not for callibration.

TDG01 diffraction grating

Code for ordering

TDG01
Diffraction calibration grating



AFM image of TDG01 grating.

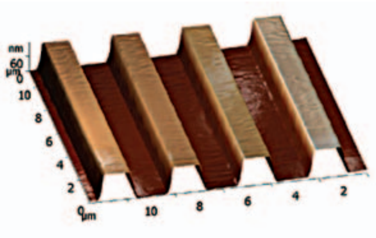
Diffraction grating TDG01 is intended for submicron calibration of scanning probe microscopes in the X or Y direction.

Grating description

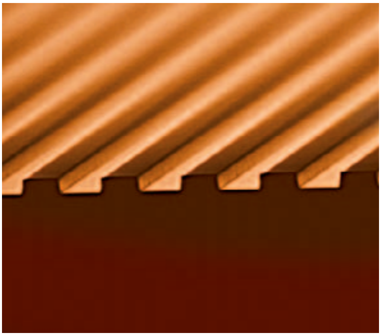
Structure:	Glass wafer The grating is formed on the layer of chalcagenid glass The grating top surface is aluminium
Pattern types:	1- Dimensional (in the X or Y direction)
Pattern height:	> 55 nm and provides good image contrast
Geometry:	Parallel ridges
Period:	278 nm (3600 periods/mm)
Accuracy:	±1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

Calibration grating sets

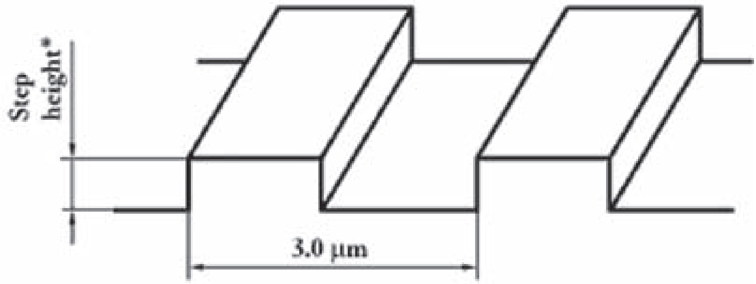
TGS1 and TGS1F grating sets



AFM image of grating TGZ series



SEM photo of grating TGZ series



Calibration grating sets TGS1 and TGS1F are intended for Z-axis calibration of scanning probe microscopes and nonlinearity measurements.
Grating set TGS1 contains 3 gratings TGZ1, TGZ2, TGZ3 with different step heights.
Grating set TGS1F contains 4 gratings TGZ1, TGZ2, TGZ3, TGZ4 with different step heights.

Grating description

Code for ordering

TGS1
Calibration grating set

TGS1F
Calibration grating set

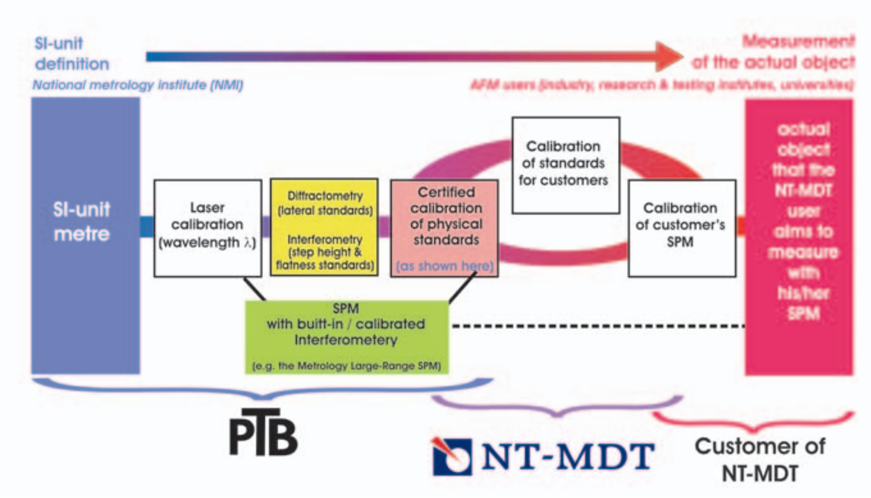
Structure	Si wafer The grating is formed on the layer of SiO2
Pattern types	1- Dimensional (in Z-axis direction)
Step height	TGZ1 - 20±1.5 nm*
	TGZ2 - 110±2 nm*
	TGZ3 - 520±3 nm*
	TGZ4 - 1400±10 nm*
Period	3.00±0.05 µm
Chip size	5×5×0.5 mm
Effective area	Central square 3×3 mm

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

PTB traceable TGZ grating 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 AFM 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

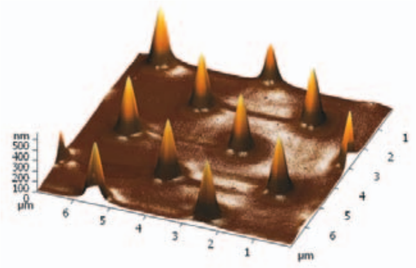
Code for ordering

TGS1_PTB
Calibration grating set

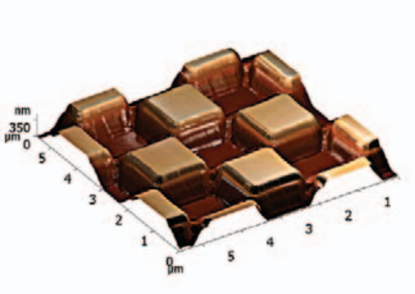
Structure	Si wafer The grating is formed on the layer of SiO2
Pattern types	1- Dimensional (in Z-axis direction)
Step height	TGZ1 - 20±1 nm*
	TGZ2 - 110±1.2 nm*
	TGZ3 – 520±1.5 nm*
Period	3.00±0.05 µm*
Chip size	5×5×0.5 mm
Effective area	Central square 3×3 mm

* 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 % depending on the batch (for example TGZ1 grating can have step height 22±1 nm)

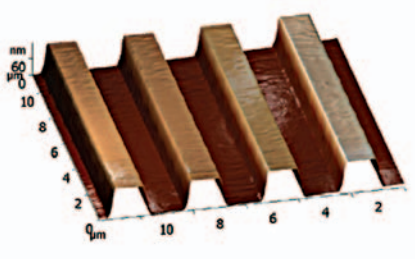
TGS2 grating set



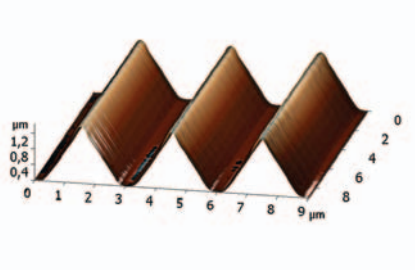
TGT1 grating



TGX1 grating



Gratings TGZ series



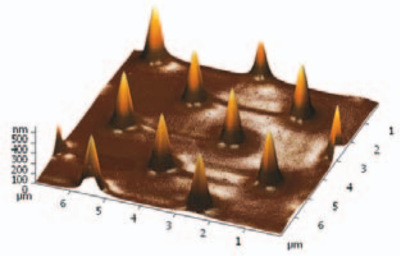
TGG1 grating

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

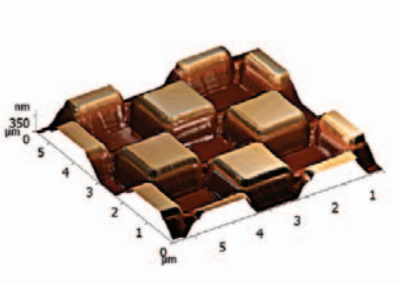
Application:

- 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.

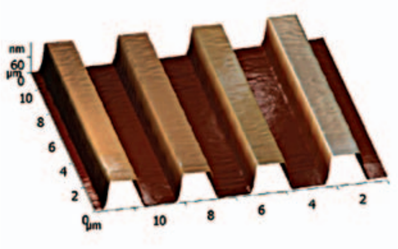
TGSFull grating set



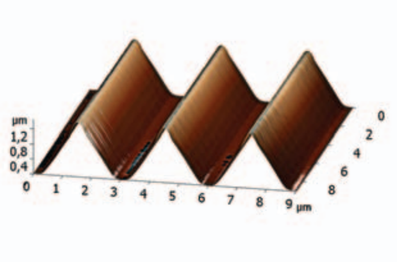
TGT1 grating



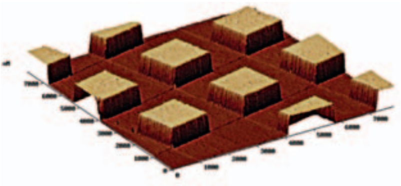
TGX1 grating



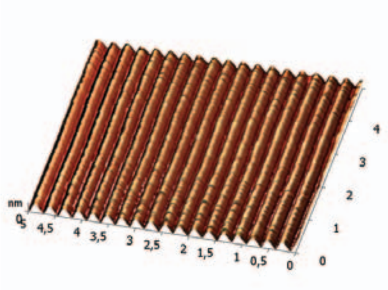
Gratings TGZ series



TGG1 grating



TGQ1 grating



TDG01 grating

Code for ordering

TGSFull
Calibration grating set

Full set of calibration standards for AFM 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.

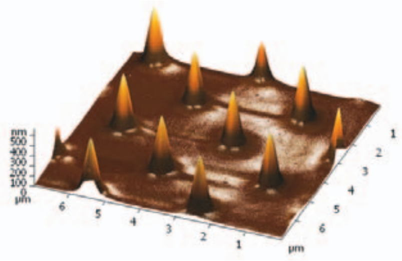
Grating set TGSFull consists of 8 calibration gratings:

- TGZ1
- TGZ2
- TGZ3
- TGX1
- TGG1
- TGT1
- TGQ1
- TDG01

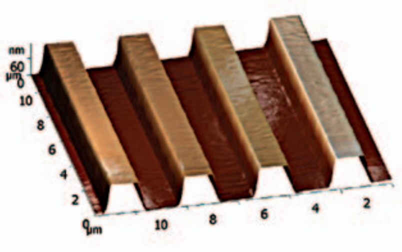
Application:

- AFM 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

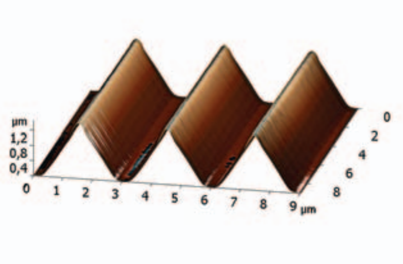
TGS_Cert grating set with International Calibration Certificates



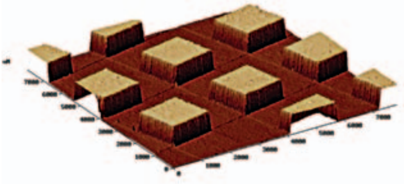
TGT1 grating



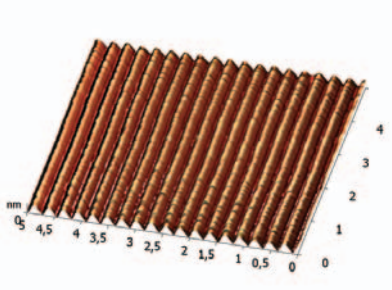
Gratings TGZ series



TGG1 grating



TGQ1 grating



TDG01 grating

Grating set TGS_Cert includes 7 calibration gratings:

- TGZ1
- TGZ2
- TGZ3
- TGG1
- TGT1
- TGQ1
- TDG01

Code for ordering

TGS_Cert
Grating Set with International Calibration Certificate for each grating.

Grating set TGS_Cert can be used for:

- AFM simultaneuos calibration in X, Y and Z directions;
- submicron AFM 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.

NT-MDT calibration gratings (TGS1, TGT1, TGG1, TGQ1, TDG01) where added to the state register in November 2009.
Their numbers:

41676-09	TDG01
41677-09	TGG1
41678-09	TGZ1, TGZ2, TGZ3
41679-09	TGT1
41680-09	TGQ1

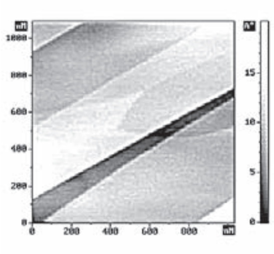
Gratings verification and calibration are made by The Russain Research Institute of Metrological Service (VNIIMS).

VNIIMS fulfils functions of the head organization of the Federal Agency for Technical Regulation and Metrology (Rosstandart) in the area of international cooperation.

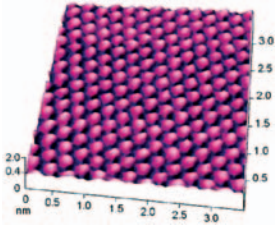
In 2007 Russian Research Institute for Metrological Service VNIIMS was qualified by International Committee of Weights and Measures (CIPM) and got legal right to apply logo of CIPM MRA – agreement on mutual recognition of national standards, calibration and measures certificates issued by national metrology institutes, as evidence of the high quality of the measurements on its calibration certificates.

Test samples

Highly Oriented Pyrolitic Graphite (HOPG) for SPM applications



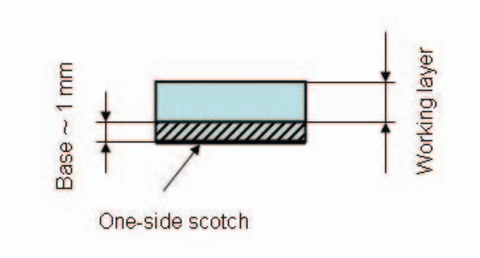
AFM image of atomic steps on HOPG



STM atomic resolution on HOPG

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÷1 mm) 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	10×10	1.5±0.2
GRAS/1.2	10×10	1.2±0.2

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÷1 mm) 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	10×10	2.0±0.2
GRBS/1.7	10×10	1.7±0.2
GRBS/1.2	10×10	1.2±0.2

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÷1 mm) 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	10×10	2.0±0.2
GRHS/1.7	10×10	1.7±0.2

*Available piece size - up to 12×12 mm2

DNA Test Sample

Code for ordering

DNA01
DNA Test Sample

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 1009 nm. Recommended humidity for obtaining a good image is 3-5.

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.

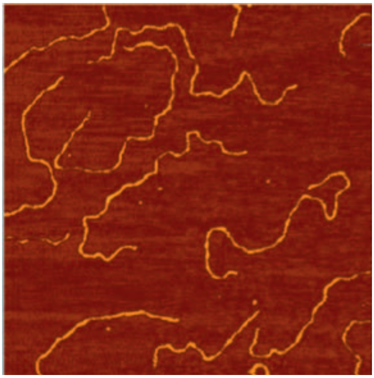


Fig. 1. Typical AFM image of the DNA test sample (obtained in contact mode, humidity 1-10%, SOLVER BIO, NT-MDT Co.).

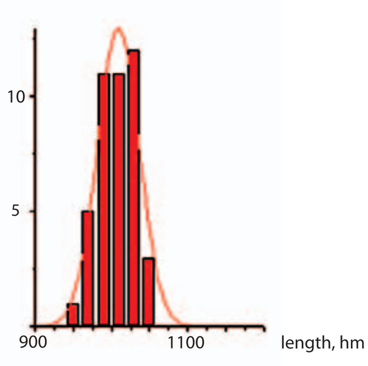


*Fig. 2. Histogram indicating distribution of DNA length.**

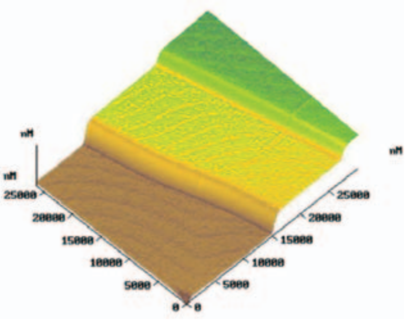
*Mean value - 1009 nm, standard deviation - 27 nm.

Silicon Test Echeloned Pattern (STEPP)

Code for ordering

STEPP
Test sample

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 - 1×4×0.3 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:

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

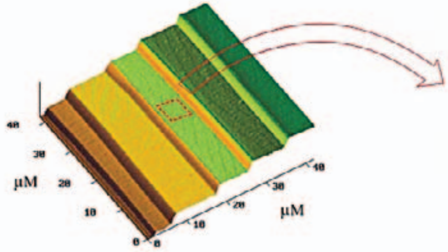


Fig. 1. 43×43 µm topographic AFM image of STEPP surface with step bunches (echelones)

Fig. 2. 5×5 µm topographic AFM image of STEPP “Plane Subtractions”

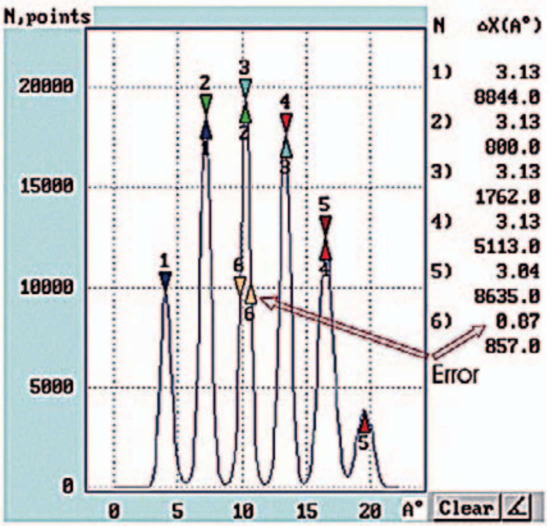


Fig. 3. Height spectra. Interpeak distance ~0.31 nm. Experimental error ~0.09 nm.

SiC Calibration Samples

6H-SiC(0001) based calibration sample is designed to perform easy calibrations of AFM scanner vertical movement in several nanometers interval. The simplicity of calibration process is provided by nearly uniform distribution of half-monolayer high (0.75 nm) or monolayer high (1.5 nm) steps on the sample surface demonstrating chemical and mechanical stability. The step height corresponds to the half of lattice constant (SiC/0.75) and lattice constant (SiC/1.5) of 6H-SiC crystal in [0001] direction.

Specification:

SiC/1.5

Chip size	5×5×0.3 mm^2
Average interstep distance	0.2-0.5 µm
Misorientation of surface	~ 0,3^0
Single step height	1.5 nm
Average roughness of the area between steps (terraces)	0.09 nm

SiC/0.75

Chip size	5×5×0.3 mm^2
Average interstep distance	0.15-0.4 µm
Misorientation of surface	~ 0,2^0
Single step height	0.75 nm
Average roughness of the area between steps (terraces)	0.09 nm

Calibration in 3 Steps

To calibrate AFM scanner movements along the Z axis the following operations are to be performed (on example of SiC/1.5 sample):

- Place the SiC/1.5 calibration sample on the flat horizontal working area under the AFM probe.
- Approach the AFM probe to the sample surface and make topography scanning in the height measure mode using the scan size of about 10 µm (Fig. 1).
  Make sure that there are no impurities on the image and choose for further measurements the area about 1.5x1.5 µm^2

- After obtaining good quality AFM-image of the sample surface with several steps use the software filter to flatten image so that every single step becomes horizontal (Fig. 2).

Choose the area on AFM-image for obtaining height spectra by using possibilities of AFM software. Pleace, choose the area with maximum number of steps for better statistics. After obtaining height spectra with peaks corresponding to each step, measure the interpeak distances. Note that distances between neighboring peaks may vary a little (see Fig. 3), so it is useful to average distances between peaks by measuring distance between far standing peaks and dividing the measured value by the number of included interpeak distances (A-A on Fig. 3). Change the scanner calibrating constant while average interpeak distance becomes 1.5 nm.

Code for ordering

SiC/1.5
Test sample with step height 1.5 nm

SiC/0.75
Test sample with step height 0.75 nm

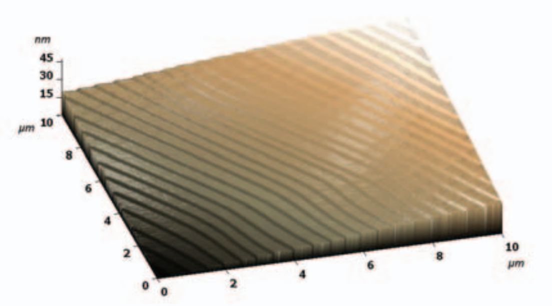


Fig. 1. 3D AFM image 10×10 µm

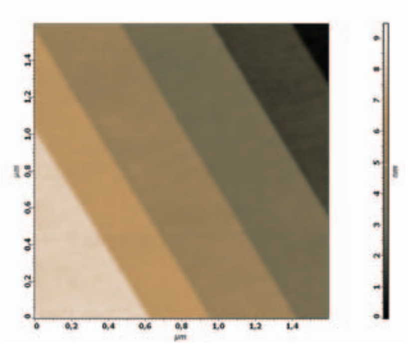


Fig. 2. AFM image 1.6×1.6 µm

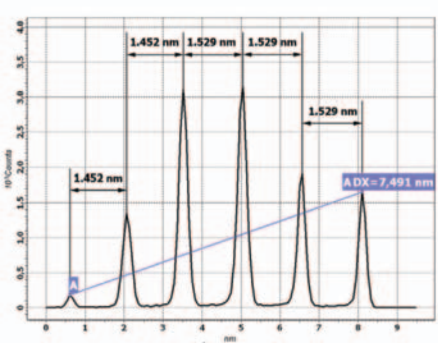


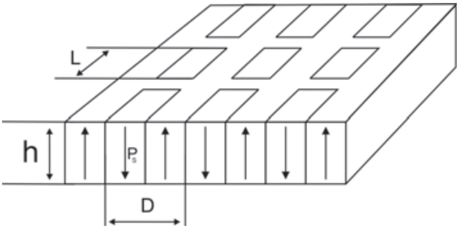
Fig. 3. Height spectra

PFM03 Test Pattern for Piezoresponse Force Microscopy

Periodically poled lithium niobate

Test pattern PFM03 is intended for

- Setting of the Piezoresponse Force Microscopy (PFM) mode;
- Optimization of the modulation voltage parameters (frequency, phase and amplitude);
- Test measurements in the PFM mode.



Sample description

Lithium niobate ($LiNbO_3$) single-crystalline 500-µm-thick plate with roughness less than 10 nm cut normal to the polar axis.
A regular domain structure with period D was created in the sample. The spontaneous polarization has the opposite direction in the neighboring domains. The polarization direction determines the sign of piezoelectric coefficient. Analysis of the local piezoelectric response during application of the modulation voltage allows to reveal the domain pattern.

Specification

Sample size	5×5 mm
Sample thickness, h	500 µm
Period, D	7 µm
Dash length, L	100 µm

Fixed on a metal substrate by conductive epoxy.

Quick Start Guide

The sample is fixed on the SPM holder and its bottom electrode is grounded. The measurements are held in contact mode. AC voltage with a frequency f_{mod} is applied to SPM tip. The sample surface oscillates with the same frequency. This response is analyzed using the lock-in amplifier. The domain walls contrast can be obtained in the amplitude of the piezoresponse signal, and domain contrast – in the phase of the signal. The typical images obtained by PFM mode are shown in Figure 1.

Code for ordering

PFM03
Test pattern for Piezoresponse Force Microscopy

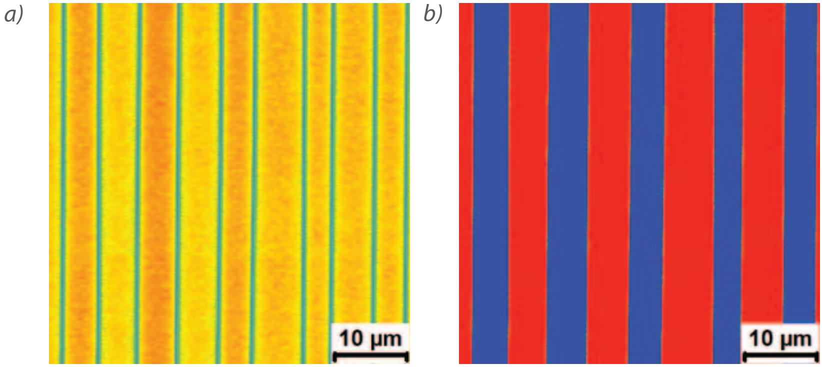


Figure 1.
The typical domain pattern obtained in the sample by PFM mode:

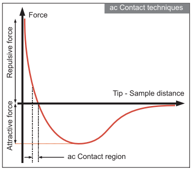
(a) amplitude and
(b) phase of piezoresponse signal.

Diamond coated conductive tip DCP11.
AC voltage amplitude 7.5 V, f_{mod} = 17 kHz.

Short glossary

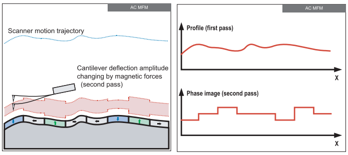
AC Contact (AFM) Techniques

AFM modes where 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.



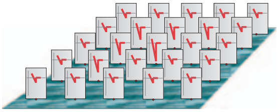
AC Magnetic Force Microscopy (AFM mode)

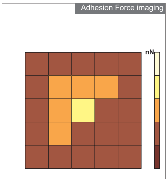
Two pass AFM technique where magnetic probe oscillation parameters change due to the sample probe magnetic interactions forming an image contrast.



Adhesion Force Imaging

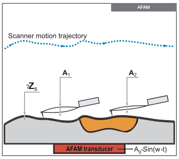
A type of spectroscopy-based imaging where force-distance curves are determined for each point of the surface. In this case the surface adhesion can be mapped since it causes substantial differences between f-d curves when approaching and retracting the probe.

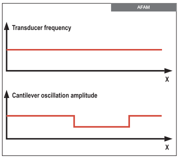




Atomic Force Acoustic Microcopy (AFAM)

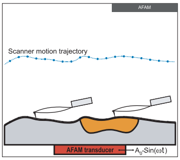
AC Contact AFM mode where the sample is enforced to out-of-plane vibrations while the probe is in contact with the surface. Vibration frequency is adjusted to be close to the resonance. Changes of cantilever oscillation amplitude caused by differences in local stiffness provide an image contrast.

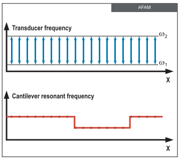




AFAM Resonance Spectroscopy

AC Contact AFM mode where 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 frequencies) of supported cantilever vibration is registered in each point. It allows calculation and nanoscale mapping of the sample Young modulus.



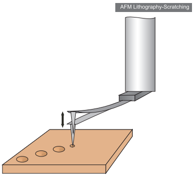


Atomic Force Microcopy (AFM)

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.

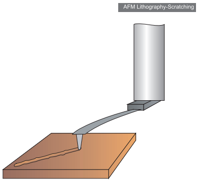
AFM Lithography Dynamic Plowing

A type of nano-scale surface modification where the AFM probe is used to pick the surface in semicontact mode.



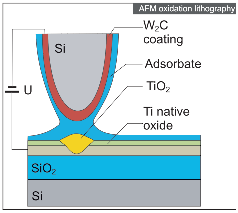
AFM Lithography G Scratching

A type of nano-scale surface modification where the AFM probe is used to scratch the surface in contact mode.



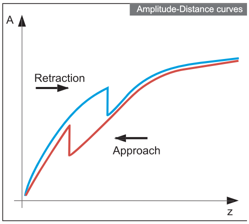
AFM Oxidation Lithography

A type of nano-scale surface modification where 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.



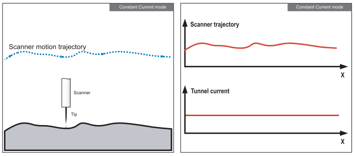
Amplitude Distance Curves

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



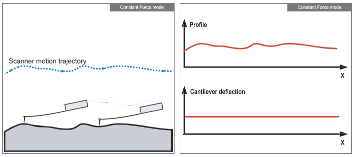
Constant Current STM Mode

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



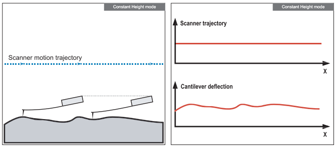
Constant Force AFM Mode

AFM mode where 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); feedback signal value is used to image the surface topography.



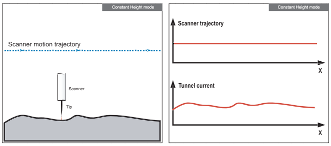
Constant Height AFM Mode

AFM mode where the feedback 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.



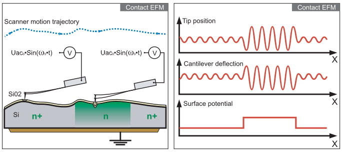
Constant Height STM Mode

STM mode where the feedback 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.



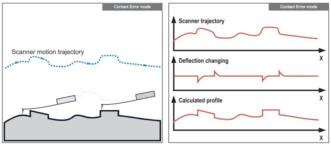
Contact Electric Force Microscopy (AFM Mode)

AC Contact AFM mode where 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.



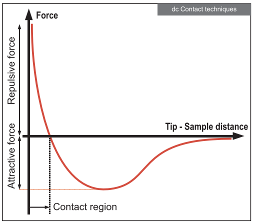
Contact Error AFM Mode

Derivative of the Constant Force AFM mode. Where 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.



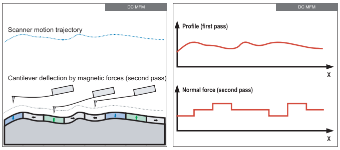
DC Contact (AFM) Techniques

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



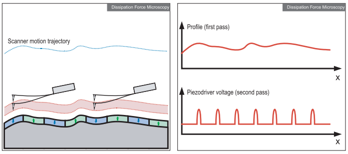
DC Magnetic Force Microscopy (AFM Mode)

Two-pass AFM technique where changes in deflection of the cantilever are caused by magnetic tip and sample interactions. The result will form an image contrast.



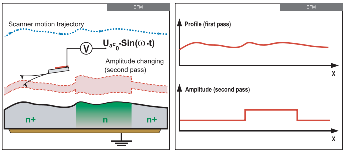
Dissipation Force Microscopy (AFM Mode)

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



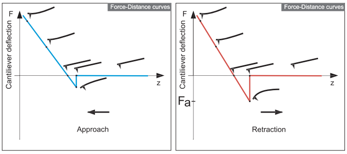
Electric Force Microscopy (AFM Mode)

Two-pass AFM technique where 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



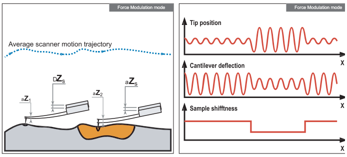
Force Distance Curves

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.



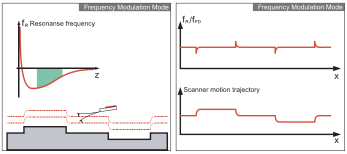
Force Modulation AFM Mode

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



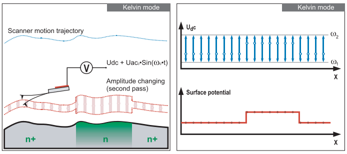
Frequency Modulation AFM Mode

Non-contact AFM technique where the frequency of the probe oscillation influenced by non-contact tip-sample interaction serves as the feedback parameter.



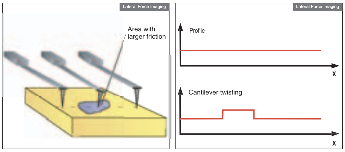
Kelvin Probe Microscopy (AFM Mode)

Two-pass AFM technique where 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.



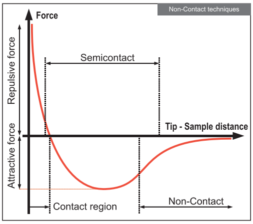
Lateral Force Imaging AFM Mode

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



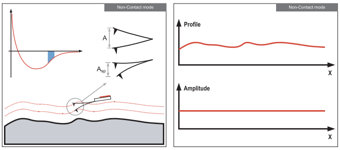
Non-contact AFM Techniques

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



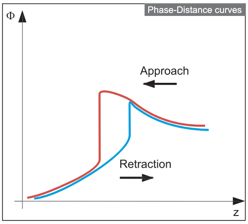
Non-contact AFM Mode

Non-contact AFM mode where the probe oscillation amplitude influenced by non-contact tip-sample interactions remains constant; the feedback signal forms an image contrast reflecting surface topography.



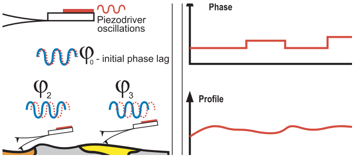
Phase Distance Curves

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



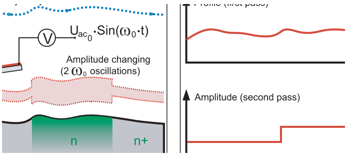
Phase Imaging AFM Mode

Semicontact AFM technique where 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 where AC potential 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.

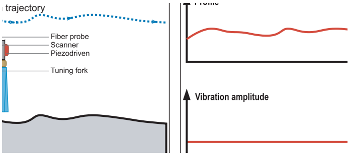


Scanning Capacitance Microscopy (Contact AFM Mode)

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 where laterally oscillating probe (optical fiber) undergoes crucial changes in oscillation amplitude in the close proximity to the sample surface. When performing the feedback control to maintain the oscillation amplitude constant the feedback 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.

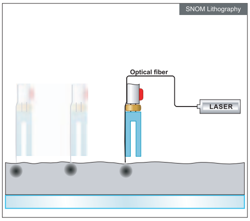


SNOM

A type of scanning probe microscopy based on the registration of a negligible light passed trough a sub-wave diagram 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.

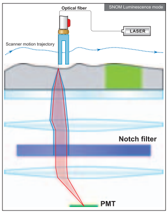
SNOM Lithography

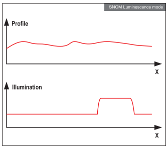
A type of nano-scale surface modifications where the laser-emitted light is applied to photosensitive surface layers by the SNOM technology.



SNOM Luminecence Mode

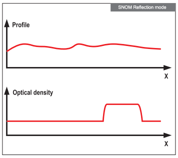
Scanning Near-field Optical Microscopy mode where the light brought by the optical fiber excites the luminescence of the sample; emitted luminescence photons are then gathered and detected. Scanning Near-field Optical Microscopy mode when the light brought by the optical fiber is reflected by non-transparent sample and is then gathered and detected.

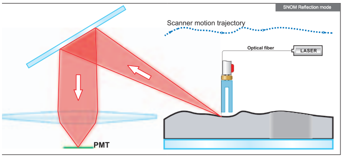




SNOM Reflection Mode

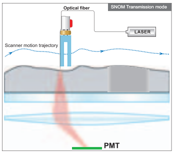
Scanning Near-field Optical Microscopy mode where the light brought by the optical fiber goes through the transparent sample and is then gathered and detected.

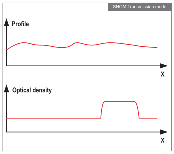




SNOM Transmission mode

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





Scanning Probe Microscopy (SPM)

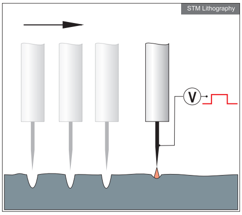
Group of modern microscopy methods – the sample surface properties are studied by point by point scanning.

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.

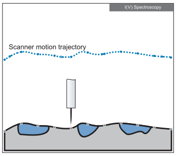
STM Lithography

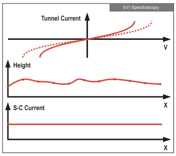
A type of nano-scale surface modification where the STM probe is used for surface modification. The common way is to burn out the sample with high-current pulses locally.



STM Spectroscopy

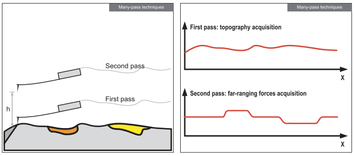
Different methods in the STM (like Barrier Height imaging, Density of States imaging, I(z) Spectroscopy, or I(V) Spectroscopy) used to characterize the electron properties of a surface or to make contrast images based on differences in these properties.





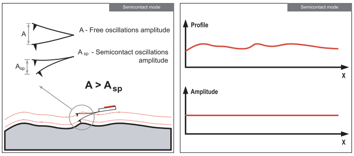
Two-pass (Many-Pass) AFM Techniques

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.



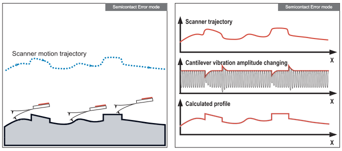
Semicontact AFM Mode (Intermittent Mode)

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



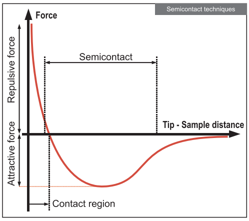
Semicontact Error AFM Mode

Semicontact AFM imaging technique based on a feedback «error» signal: where 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.



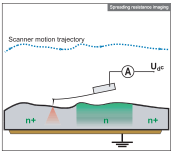
Semicontact Techniques

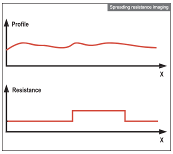
AFM techniques with the oscillating tip contacting ("touching") the surface periodically in the extreme points of its trajectory.



Spreading Resistance Imaging

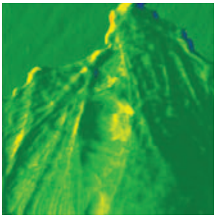
DC Contact AFM technique where bias voltage is applied to the conducting tip; resulting current through the sample is measured.





Scan Gallery and Probe Selection Guide

Topography imaging

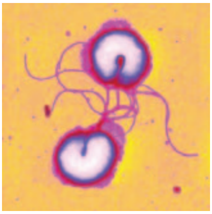


Porcine Kidney Cell
Contact Error Mode

Scan Size: 27×27 µm
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 37℃. Sample courtesy of Prof. Tang Ming-Jer, Department of Physiology.
National Cheng Kung University Medical College, Tainan, Taiwan (ROC).

Glass-Matrix of High-Temperature Coating
Semicontact Mode

Scan Size: 2×2 µm
Gas-proof coating for the protection of carbon materials at extreme applications at temperatures above 1400℃. 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.

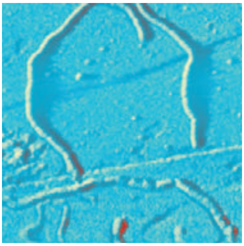


Helicobacter Pylori
Semicontact Mode

Scan Size: 7.2×7.2 µm
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.

DNA
Non-Contact Mode

Scan Size: 220×220 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.

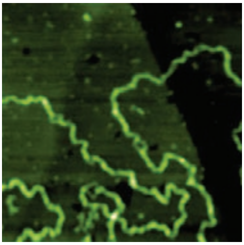


Topography

Contact mode	CSG01, CSG10, CSG30
Non-contact mode Semi-contact mode	NSG01, NSG10, NSG03, NSG30, VIT_P

High Resolution Topography Imaging

Plasmid DNA
Semicontact Mode



Scan Size: 0.25×0.25 µm
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.

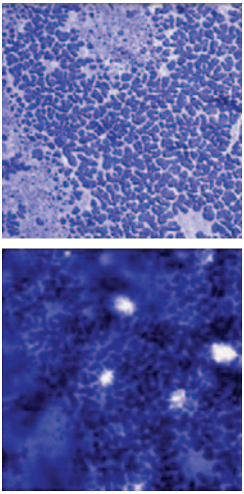
High Resolution	
Contact mode	CSG01, CSG10, CSC05
Non-contact mode Semi-contact mode	NSG01_DLC, NSG10_DLC, NSC05, NSG01, NSG10, NSG03, NSG30, VIT_P

Elastic Properties

Phase Imaging:

Polyphenylenevinylene
Phase Imaging Mode

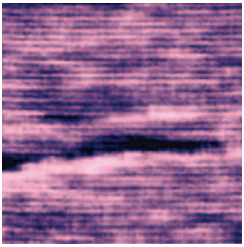
Scan Size: 3×3 µm
Mixture of two different types of PPV (see m. Ringed PPV molecules). Initially PPV blend film was deposited on another polymer and then removed by floating. Resulted structure is explained by dewetting (structure on topography) and demixing (pronounced phase contrast) on the interface between layer of two PPVs and substrate.



Force Modulation:

AlGaN/GaN Superlattice Cross-Section
Force Modulation Mode

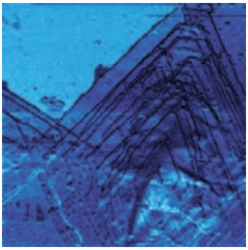
Scan Size: 500×500 nm
AFM image of AlGaN/GaN superlattice with 74 Angstroms pitch made in local elasticity (force modulation) mode. Image courtesy of A. Ankudinov and M. Dunaevsky (group of A. Titkov), Ioffe Physico-Technical Institute, St. Petersburg, Russia.



AFAM:

Crystals of Polyethylene
AFAM

Scan Size: 5.6×5.6 µm
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, NT-MDT.



Lateral Force Microscopy:

Pseudomonas Bacteria
Lateral Force Imaging

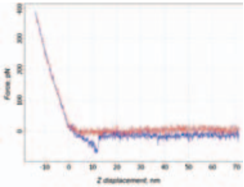
Scan Size: 2.3×2.3×0.1 µm
LFM image of pseudomonas bacteria obtained in air.
Image courtesy of M. N. Savvateev.

Elastic properties

Phase imaging AFAM	NSG01 NSG10 NSG03 NSG30 VIT_P
Force Modulation Lateral force Microscopy	FMG01 CSG01 CSG10

Spectroscopy

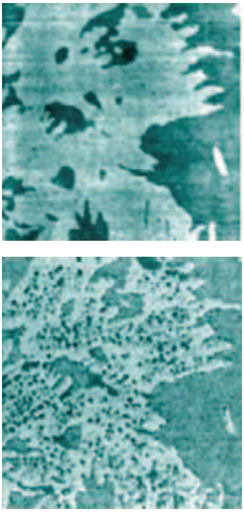
Force Distance Curves:



Force Curve
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.

Adhesion Force Imaging:



Name: Two-component LB-film
Adhesion Force Imaging

Scan size: 1,5 x 1,5 µm
Topography (left) and adhesion force distribution (right) for two-component LB-film.

Spectroscopy	
Force Distance Curves	CSG01 CSG10 FMG01 NSG01 NSG03
Adhesion Force Imaging	CSG01 CSG10

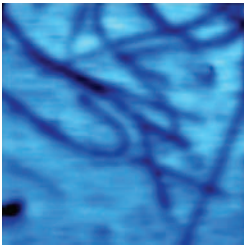
Electrical Properties

Many-Pass Techniques

Electric Force Microscopy:

Carbon nanotubes
EFM

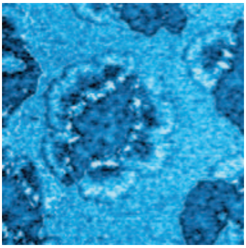
Scan size: 1,7×1,7 µm.
Electric force microscopy image of carbon nanotubes.



Kelvin Probe Microscopy:

Photo-Sensitive Polymer on PCBM film
Kelvin Probe Microscopy

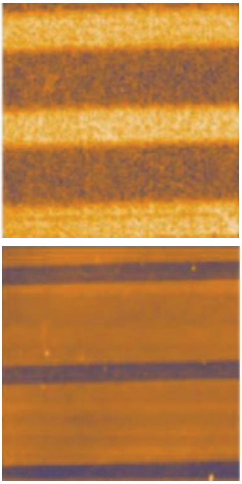
Scan Size: 8×8 µm
Topography (left) and SKM image (right) of film cast from solution of photo-sensitive polymer film and PCBM. Image courtesy of Evgeny Kuznetsov. The sample was kindly given by Dr. Igor Sokolik, Konarka Technologies Inc.



Scanning Capacitance Microscopy:

Test Grating with Different Doping Stripes
Scanning Capacitance Microscopy

Scan Size: 10.8×10.7 nm
Test grating on the silicon wafer with concentration Nn=1015 cm^{-3}, step 3 μm, height 0.1 μm from SiO$_2$. Ion implantation by boron with E=30 keV and dose 150 mkCoulomb/cm^2, then pressing during 60 minutes under temperature T=1000 °C and finally SiO$_2$ 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:

Test Structure
Contact Scanning Capacitance Microscopy

Scan Size: 18×28 μm
Test structure on the base of SiO$_2$ stripes height 0.1μm grating on the silicon wafer. Ion implantation by boron with E=100 keV, annealing and SiO$_2$ layer etching was employed.On the resulting structure following images were obtained:

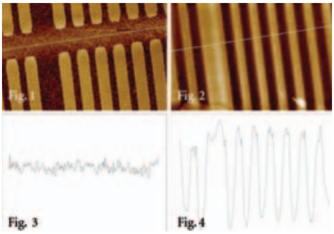
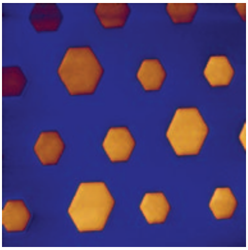


Fig. 1 - Topography of test structure (contact mode AFM),
Fig. 2. - Profile of test structure,
Fig. 3. - Contact SCM image of the same area,
Fig. 4. - Profile of Contact SCM image.

Image courtesy of V. Polyakov, NT-MDT, Moscow, Russia.

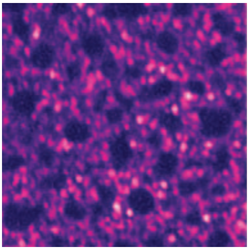
AcContact Piezoresponse Force Microscopy:



Lithiumniobate
Piezoresponse Force Microscopy

Scan Size: 62×62 μm
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:



Distribution of Current on the Surface of Two Semiconducting Polymer Blend.
Spreading Resistance Imaging

Scan Size: 2.7×2.7 μm
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
Capacitance Microscopy

Contact Scanning AcContact Piezoresponse Force Microscopy Spreading Resistance Imaging	CSG01 CSG10 FMG01	with Au/ Pt/ TiN

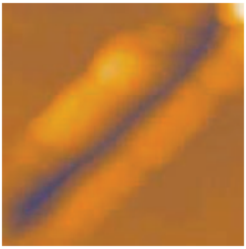
Surface Modulation

AFM Oxidation Lithography

Thin Ti Film
AFM Oxidation Lithography

Scan Size: 2×2 µm
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 W_2C covering, at relative humidity of 70 %. Image courtesy of Smirnov V.A., Taganrog Technological Institute Of Southern Federal University

AFM Lithography – Scratching



Al Surface
AFM Scratching Lithography

Scan Size: 1.6×1.6 µm
Scratched with 100 nN/m cantilever polished Al surface.

AFM Lithography – Dynamic Plowing

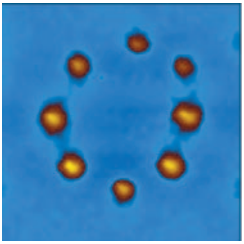
AFM Resonant Mode Lithography
AFM Lithography - Dynamic Plowing

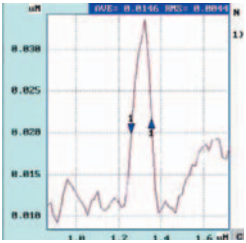
Scan Size: 1.2×2.3 µm
Resonance AFM modification of polycyanoacrylate film on silicon.
Word "Science" in Chineese.

AFM Lithography – Dynamic Plowing

SNOM Lithography

Scan Size: 16×16 µm
SNOM lithography on the positive photoresist.
Resolution 100 nm.
Images courtesy of Igor Dushkin.





Surface Modulation

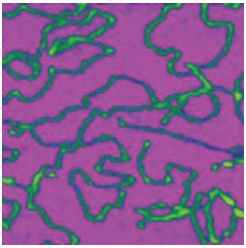
AFM Oxidation Lithography AFM Lithography – Scratching AFM Lithography – Dynamic Plowing	DCP11 DCP20 NSG01 NSG10 NSG30 VIT_P	with Pt/TiN
SNOM Lithography	SNOM probes	

Optical Properties

Shear Force Microscopy

DNA Shear-Force Image
Shear Force Microscopy

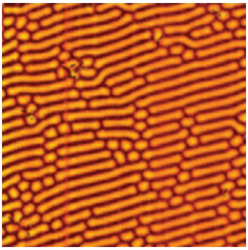
Scan Size: 1.3×1.3 nm
DNA plasmid pGem7zf+ (Promega) 3000 b. p. linearized with the SmaI endonuclease deposited on freshly cleaved mica. DNA01 test sample was measured by SOLVER P47H using the Shear Force head. Humidity - 1-10 %.



Force Modulation:

Ferrite-Garnet Film
Transmission Mode

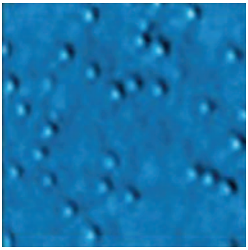
Scan Size: 105×105 µm
Magneto-optical image (transmission mode) of ferrite-garnet film.
Images courtesy of Igor Dushkin, NT-MDT.



Reflection Mode

Quantum Dots
SNOM

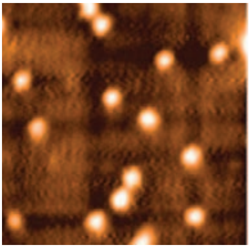
Scan Size: 7×7 µm
Shear Force (topography) (a) and reflection (b) images of In-Ga quantum dots made with the use of He-Cd 442 nm laser.
Images courtesy of Igor Dushkin, NT-MDT.

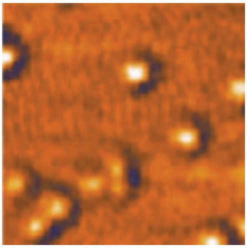


Lumenscence Mode

Latex Spheres
Lumenscence

Upper picture - latex spheres images obtained in Shear Force mode, lower picture - latex spheres image obtained in Luminescence mode.





Optical properties

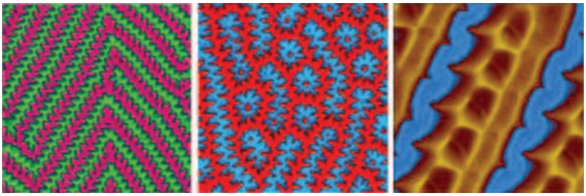
- Shear Force Microscopy
- Transmission Mode
- Reflection Mode
- Lumenscence Mode

MF001
MF002
MF003
MF004
MF005

Shear Force Microscopy

Magnetic Domains of Yttrium Iron Garnet
AC MFM

Scan Size: 60×60 µm
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.

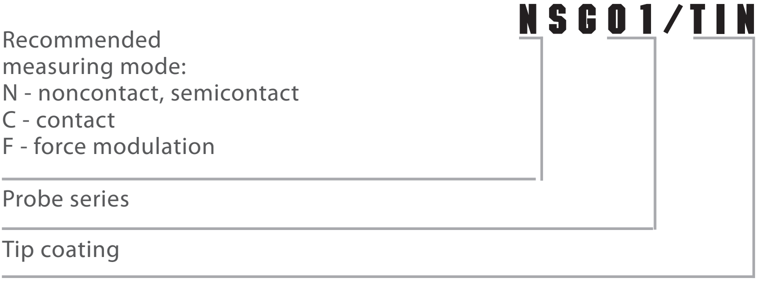


Magnetic properties

AC MFM	NSG01/Co
DC MFM	FMG01/Co

Table of available probes

Probe series name:



Recommended
measuring mode:
N - noncontact, semicontact
C - contact
F - force modulation

Probe series

Tip coating

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
CSG30	Rect	0.6	48
CSC05	Rect	0.11	22
NSG01	Rect	5.1	150
NSG10	Rect	11.8	240
NSG30	Rect	40	320
NSG03	Rect	1.74	90
VIT_P	Rect	50	300
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	VIT_P	FMG01	CSG10	CSG01	CSG30
Uncoated	NSG10	NSG01	NSG30	NSG03	VIT_P	FMG01	CSG10	CSG01	CSG30
PtIr coated	NSG10/Pt	NSG01/Pt	NSG30/Pt	NSG03/Pt	VIT_P/Pt	FMG01/Pt	CSG10/Pt	CSG01/Pt	CSG30/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 and VIT_P 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
Non-contact\ Semicontact	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,	1-5	50-100	TiN, PtIr	NC, Au
	Scanning Kelvin (SCM, SKM)				
	Magnetic Force (MFM)	1-5	50-100	CoCr	NC, Au
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
Noncontact	Adhesion Force	0.1-2	10-40	NC	NC, Au
	Topography	5-50	100-400	NC	NC, Au
	Phase Imaging	5-5	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					•				•
CGS10/Au						•			
CSG30	•	•	•	•		•	•	•	
CSG30/Pt					•				
CSC05	•					•			
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	•			•						•	•
CSG30	•										
CSG30/Pt						•	•				
VIT_P	•										

Products by groups

High Resolution «Golden» silicon AFM probes

Product	Description	Page
CSG01/15	15 chips for contact mode CSG01 series, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	11
CSG01/50	50 chips for contact mode CSG01 series, resonant frequency 4-17 kHz, force constant 0.003-0.13N/m.	11
CSG01/Au/15	15 chips of Contact AFM probes CSG01 series with Au conductive coating, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	15
CSG01/Au/50	50 chips of Contact AFM probes CSG01 series with Au conductive coating, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	15
CSG01/Pt/15	15 chips of Contact AFM probes CSG01 series with Pt conductive coating, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	15
CSG01/Pt/50	50 chips of Contact AFM probes CSG01 series with Pt conductive coating, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	15
CSG01/TiN/15	15 chips of Contact AFM probes CSG01 series with TiN conductive coating, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	15
CSG01/TiN/50	50 chips of Contact AFM probes CSG01 series with TiN conductive coating, resonant frequency 4-17 kHz, force constant 0.003-0.13 N/m.	15
CSG10/15	15 chips for contact mode CSG10 series, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	12
CSG10/50	50 chips for contact mode CSG10 series, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	12
CSG10/Au/15	15 chips of Contact AFM probes CSG10 series with Au conductive coating, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	15
CSG10/Au/50	15 chips of Contact AFM probes CSG10 series with Au conductive coating, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	15
CSG10/Pt/15	15 chips of Contact AFM probes CSG10 series with Pt conductive coating, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	15
CSG10/Pt/50	50 chips of Contact AFM probes CSG10 series with Pt conductive coating, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	15
CSG10/TiN/15	15 chips of Contact AFM probes CSG10 series with TiN conductive coating, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	15
CSG10/TiN/50	50 chips of Contact AFM probes CSG10 series with TiN conductive coating, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	15
CSG30/15	15 chips of Contact AFM probes CSG30 series, resonant frequency 26-76 kHz, force constant 0.13-2 N/m.	13
CSG30/50	50 chips of Contact AFM probes CSG30 series, resonant frequency 26-76 kHz, force constant 0.13-2 N/m.	13

CSG30/Pt/15	15 chips of Contact AFM probes CSG30 series with Pt conductive coating, resonant frequency 26-76 kHz, force constant 0.13-2 N/m.	15
CSG30/Pt/50	50 chips of Contact AFM probes CSG30 series with Pt conductive coating, resonant frequency 26-76 kHz, force constant 0.13-2 N/m.	15
NSG01/15	15 chips for noncontact/semicontact modes NSG01 series, resonant frequency 87-230 kHz, force constant 1.45-15.1N/m.	6
NSG01/50	50 chips for noncontact/semicontact modes NSG01 series, resonant frequency 87-230 kHz, force constant 1.45-15.1N/m.	6
NSG01/Au/15	15 chips of Noncontact AFM probes NSG01 series with Au conductive coating, resonant frequency 87-230 kHz, force constant 1.45-15.1N/m.	15
NSG01/Au/50	50 chips of Noncontact AFM probes NSG01 series with Au conductive coating, resonant frequency 87-230 kHz, force constant 1.45-15.1N/m.	15
NSG01/Co/15	15 chips of Noncontact AFM probes NSG01 series with CoCr magnetic coating, resonant frequency 87-230 kHz, force constant 1.45-15.1N/m.	16
NSG01/Co/50	50 chips of Noncontact AFM probes NSG01 series with CoCr magnetic coating, resonant frequency 87-230 kHz, force constant 1.45-15.1 N/m.	16
NSG01/Pt/15	15 chips of Noncontact AFM probes NSG01 series with Pt conductive coating, resonant frequency 87-230 kHz, force constant 1.45-15.1 N/m.	15
NSG01/Pt/50	50 chips of Noncontact AFM probes NSG01 series with Pt conductive coating, resonant frequency 87-230 kHz, force constant 1.45-15.1 N/m.	15
NSG01/TiN/15	15 chips of Noncontact AFM probes NSG01 series with TiN conductive coating, resonant frequency 87-230 kHz, force constant 1.45-15.1 N/m.	15
NSG01/TiN/50	50 chips of Noncontact AFM probes NSG01 series with TiN conductive coating, resonant frequency 87-230 kHz, force constant 1.45-15.1 N/m.	15
NSG03/15	15 chips for noncontact/semicontact modes NSG03 series, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m.	7
NSG03/50	50 chips for noncontact/semicontact modes NSG03 series, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m.	7
NS603/Au/15	15 chips of Noncontact AFM probes NSG03 series with Au conductive coating, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m	15
NS603/Au/50	15 chips of Noncontact AFM probes NSG03 series with Au conductive coating, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m	15
NSG03/Pt/15	15 chips of Noncontact AFM probes NSG03 series with Pt conductive coating, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m.	15
NSG03/Pt/50	50 chips of Noncontact AFM probes NSG03 series with Pt conductive coating, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m.	15
NSG03/TiN/15	15 chips of Noncontact AFM probes NSG03 series with TiN conductive coating, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m.	15
NSG03/TiN/50	50 chips of Noncontact AFM probes NSG03 series with TiN conductive coating, resonant frequency 47-150 kHz, force constant 0.35-5.1 N/m.	15
NSG10/15	15 chips for noncontact/semicontact modes NSG10 series, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	8
NSG10/50	50 chips for noncontact/semicontact modes NSG10 series, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	8
NSG10/Au/15	15 chips of Noncontact AFM probes NSG10 series with Au conductive coating, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	15
NSG10/Au/50	50 chips of Noncontact AFM probes NSG10 series with Au conductive coating, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	15
NSG10/Pt/15	15 chips of Noncontact AFM probes NSG10 series with Pt conductive coating, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	15
NSG10/Pt/50	50 chips of Noncontact AFM probes NSG10 series with Pt conductive coating, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	15
NSG10/TiN/15	15 chips of Noncontact AFM probes NSG10 series with TiN conductive coating, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	15

NSG10/TiN/50	50 chips of Noncontact AFM probes NSG10 series with TiN conductive coating, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m.	15
NSG30/15	15 chips for noncontact/semicontact modes NSG30 series, resonant frequency 240-440 kHz, force constant 22-100 N/m.	9
NSG30/50	50 chips for noncontact/semicontact modes NSG30 series, resonant frequency 240-440 kHz, force constant 22-100 N/m.	9
NSG30/Au/15	15 chips of Noncontact AFM probes NSG30 series with Au conductive coating, resonant frequency 240-440 kHz, force constant 22-100 N/m.	15
NSG30/Au/50	50 chips of Noncontact AFM probes NSG30 series with Au conductive coating, resonant frequency 240-440 kHz, force constant 22-100 N/m.	15
NSG30/Pt/15	15 chips of Noncontact AFM probes NSG30 series with Pt conductive coating, resonant frequency 240-440 kHz, force constant 22-100 N/m.	15
NSG30/Pt/50	50 chips of Noncontact AFM probes NSG30 series with Pt conductive coating, resonant frequency 240-440 kHz, force constant 22-100 N/m.	15
NSG30/TiN/15	15 chips of Noncontact AFM probes NSG30 series with TiN conductive coating, resonant frequency 240-440 kHz , force constant 22-100 N/m.	15
NSG30/TiN/50	50 chips of Noncontact AFM probes NSG30 series with TiN conductive coating, resonant frequency 240-440 kHz, force constant 22-100 N/m.	15
VIT_P/15	15 chips of Noncontact Top Visial Probes VIT_P series resonant frequency 200-400 kHz, force constant 25-95 N/m.	14
VIT_P/50	15 chips of Noncontact Top Visial Probes VIT_P series resonant frequency 200-400 kHz, force constant 25-95 N/m.	14
VIT_P/Pt/15	15 chips of Noncontact Top Visial Probes VIT_P series with Pt conductive coating, resonant frequency 200-400 kHz, force constant 25-95 N/m.	15
VIT_P/Pt/50	15 chips of Noncontact Top Visial Probes VIT_P series with Pt conductive coating, resonant frequency 200-400 kHz, force constant 25-95 N/m.	15
FMG01/15	15 chips for noncontact/semicontact modes FMG01 series, resonant frequency 50-70 kHz, force constant 1-5 N/m.	10
FMG01/50	50 chips for noncontact/semicontact modes FMG01 series, resonant frequency 50-70 kHz, force constant 1-5 N/m.	10
FMG01/Au/15	15 chips of Noncontact AFM probes FMG01 series with Au conductive coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	15
FMG01/Au/50	50 chips of Noncontact AFM probes FMG01 series with Au conductive coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	15
FMG01/Co/15	15 chips of Noncontact AFM probes FMG01 series with CoCr magnetic coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	16
FMG01/Co/50	50 chips of Noncontact AFM probes FMG01 series with CoCr magnetic coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	16
FMG01/Pt/15	15 chips of Noncontact AFM probes FMG01 series with Pt conductive coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	15
FMG01/Pt/50	50 chips of Noncontact AFM probes FMG01 series with Pt conductive coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	15
FMG01/TiN/15	15 chips of Noncontact AFM probes FMG01 series with TiN conductive coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	15
FMG01/TiN/50	50 chips of Noncontact AFM probes FMG01 series with TiN conductive coating, resonant frequency 50-70 kHz, force constant 1-5 N/m.	15

«Whisker Type» probes

Product	Description	Page
CSC05/5	5 chips «Whisker Type» probes for contact modes, resonant frequency 8-39 kHz, force constant 0.01-0.5 N/m.	30
NSC05/5	5 chips “Whisker Type” probes for noncontact/semicontact modes, resonant frequency 140-390 kHz, force constant 3.1-37.6 N/m	30

SNOM probes

Product	Description	Page
MF001/10	Set of 10 SNOM probes (wavelength 400-550 nm), without turning forks	38
MF002/10	Set of 10 SNOM probes (wavelength 450-600 nm), without turning forks.	38
MF003/10	Set of 10 SNOM probes (wavelength 600-770 nm), without turning forks.	38
MF004/10	Set of 10 SNOM probes (wavelength 780-970 nm), without turning forks.	38
MF005/10	Set of 10 SNOM probes (wavelength 980-1600 nm), without turning forks	38
TF001/10	Set of 10 tuning forks	39

Super Sharp DLC tips

Product	Description	Page
NSG01_DLC/10	10 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1 nm grown on the cantilever series NSG01.	33
NSG01_DLC/50	50 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1 nm grown on the cantilever series NSG01.	33
NSG10_DLC/10	10 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1 nm grown on the cantilever series NSG10.	33
NSG10_DLC/50	50 chips of Super Sharp Diamond-Like Carbon (DLC) tips with typical curvature radius 1 nm grown on the cantilever series NSG10.	33

Calibration Gratings

Product	Description	Page
SNG01	Standard test sample for Scanning Near Field Optical Microscope	40
TDG01	Diffraction grating TDG01 is intended for submicron calibration scanning probe microscopes in the X or Y direction.	46
TGG1	Test grating TGG1 is intended for AFM calibration in X or Y axis, detection of lateral and vertical scanner nonlinearity, detection of angular distortion, tip characterization.	45
TGQ1	Calibration grating TGQ1 is intended for simultaneous calibration in X, Y, and Z directions.	42
TGS1	Grating set for Z-axis AFM calibration with three different height range –20±1.5 nm, 110±2 nm, 520±3 nm.	47
TGS1F	Grating set for Z-axis AFM calibration with four different height ranges - 20±1.5 nm, 110±2 nm, 520±3 nm, 1400±10 nm.	47
TGS1_PTB	Calibration grating set TGS1 (consists of three gratings TGZ1, TGZ2, TGZ3) with PTB traceable certificate (step heights 20±1 nm, 100±1.2nm, 500±1.5 nm).	49
TGS2	Grating set for AFM lateral and vertical calibration, detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip shape.	51
TGSFull	Full set of calibration standards for inclutes 9 gratings – TGZ1, TGZ2, TGZ3, TGZ4, TGG1, TGT1, TGX1, TGQ1, TG01 for AFM lateral and vertical calibration (including submicron calibration and simultaneous calibra tion in X, Y and Z directions) , detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip shape.	52
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.	43
TGX1	Test grating TGX1 is intended for lateral calibration of AFM scanners, detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects, determination of the tip aspect ratio.	44
TGZ1	Calibration grating TGZ1 for AFM Z-axis calibration (step height 20±1 nm).	41
TGZ2	Calibration grating TGZ2 for AFM Z-axis calibration (step height 110±2 nm).	41
TGZ3	Calibration grating TGZ1 for AFM Z-axis calibration (step height 520±3 nm).	41
TGZ4	Calibration grating TGZ4 for AFM Z-axis calibration (step height 1400±10 nm).	41
TGS_Cert	Calibration grating set (includes 7 gratings – TGZ1, TGZ2, TGZ3, TGG1, TGT1, TGQ1, TDG01) with International Calibration Certificates for AFM 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.	54

Diamond Coated Conductive Probes

Product	Description	Page
DCP20/15	15 chips of Diamond Coated Conductive Probes, resonant frequency 260-630 kHz, force constant 28-91 N/m.	23
DCP20/50	50 chips of Diamond Coated Conductive Probes, resonant frequency 260-630 kHz, force constant 28-91 N/m.	23
DCP11/15	15 chips of Diamond Coated Conductive Probes, resonant frequency 190-325 kHz, 115-190kHz, force constant 5.5-22.5 N/m, 2.5-10 N/m.	22
DCP11/50	50 chips of Diamond Coated Conductive Probes, resonant frequency 190-325 kHz, 115-190kHz, force constant 5.5-22.5 N/m, 2.5-10 N/m.	22

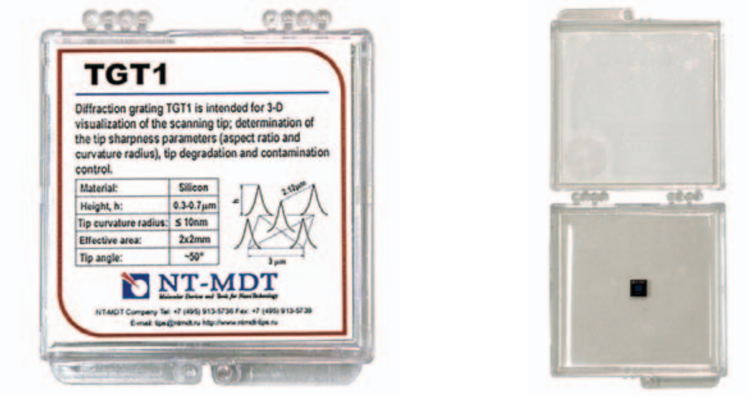
HOPG (Highly Oriented Pyrolitic Graphite)

Product	Description	Page
GRAS/1.2	HOPG ZYA Quality, piece thickness 1.2±0.2 mm, mosaic spread 0.4-0.7 degrees	56
GRAS/1.5	HOPG ZYA Quality, piece thickness 1.5±0.2 mm, mosaic spread 0.4-0.7 degrees	56
GRBS/1.2	HOPG ZYB Quality, piece thickness 1.2±0.2 mm, mosaic spread 0.8-1.2 degrees	56
GRBS/1.7	HOPG ZYB Quality, piece thickness 1.7±0.2 mm, mosaic spread 0.8-1.2 degrees	56
GRBS/2.0	HOPG ZYB Quality, piece thickness 2.0±0.2 mm, mosaic spread 0.8-1.2 degrees	56
GRHS/1.7	HOPG ZYH Quality, piece thickness 1.7±0.2 mm, mosaic spread 3.5-5.0 degrees	56
GRHS/2.0	HOPG ZYH Quality, piece thickness 2.0±0.2 mm, mosaic spread 3.5-5.0 degrees	56

Test Samples

Product	Description	Page
DNA01	Long-life, stable and indestructible biological test sample for AFM investigation in air.	58
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 0.31 nm.	59
SiC/0.75	Test sample for calibrating AFM scanner movements along the Z axis with step height 0.75 nm.	61
SiC/1.5	Test sample for calibrating AFM scanner movements along the Z axis with step height 1.5 nm.	61
PFM03	Test sample for Piezoresponce Force Microscopy	63

Packing



TGT1

Diffraction grating TGT1 is intended for 3-D visualization of the scanning tip; determination of the tip sharpness parameters (aspect ratio and curvature radius), tip degradation and contamination control.

Material:	Silicon
Height, h:	0.3-0.7µm
Tip curvature radius:	≤ 10nm
Effective area:	2x2mm
Tip angle:	~50°

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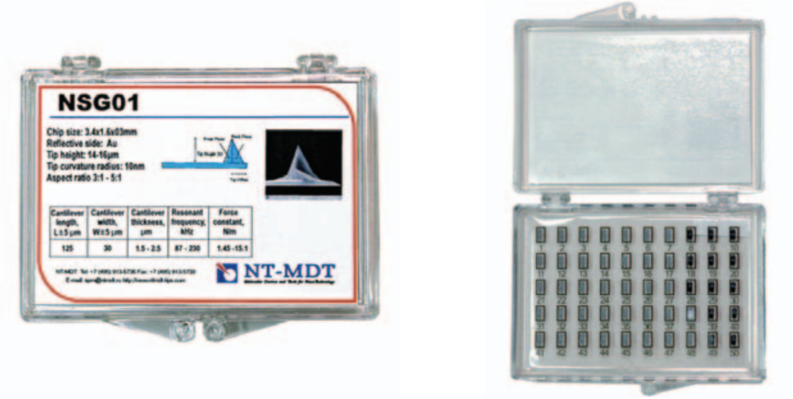
Box with TGT1 calibration grating



NSG01

Chip size: 3.4x1.6x03mm
Reflective side: Au
Tip height: 14-16µm
Tip curvature radius: 10nm
Aspect ratio 3:1 - 5:1

Cantilever length, L±5 µm	Cantilever width, W±5 µm	Cantilever thickness, µm	Resonant frequency, kHz	Force constant, N/m
125	30	1.5 - 2.5	87 - 230	1.45 -15.1

Box with 50 chips of probes NSG01 series

Wafer with probes NSG01 series

Box with MF012 SNOM probes

For notes

For notes

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AFM probes & accessories –
cantilevers, calibration gratings,
test samples, HOPG, SNOM probes etc.

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