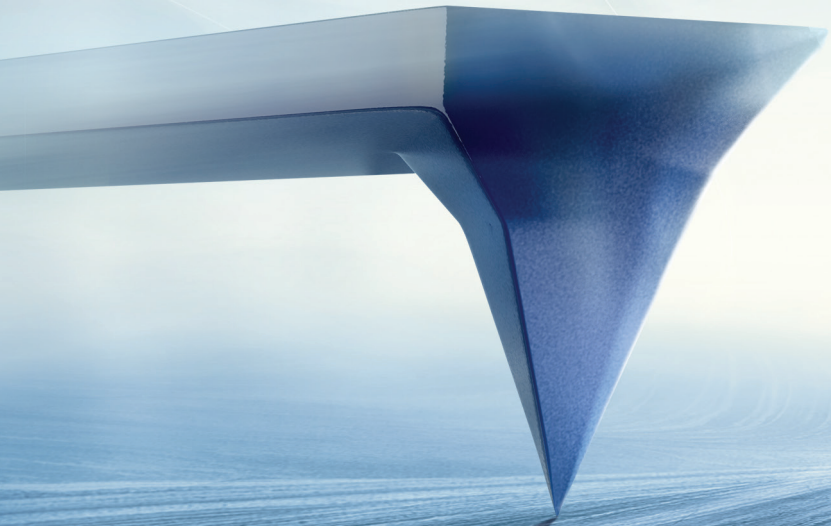
SPM PROBES & TEST STRUCTURES

MikroMasch® product catalogue



MikroMasch® HQ SPM Tips

- Tip sharpness better than 10 nm
- High Q-factor and smooth resonance curves
- Ideal reflectivity from the backside of the cantilever
- Alignment grooves for all single cantilever probes

MikroMasch®
SPM Probes & Test Structures

www.spmtips.com

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MikroMasch® Distributor

Silicon Nitride Probes

NEW

We are happy to announce the introduction of MikroMasch Silicon Nitride XNC12 series* of AFM probes. These probes are intended for contact mode measurements on biological and other soft matter specimen. The main features of the back side gold coated XNC12/Cr-Au BS and the overall gold coated XNC12/Cr-Au models are as follows:

- 2 triangular silicon nitride cantilevers with 0.08 N/ m and 0.32 N/m on one side of the holder chip
- Square pyramid silicon nitride tips with typical radii 10 nm (uncoated) and 30 nm (gold coated)
- Chip size 3.4 * 1.6 * 0.5 mm

We always listen to our customers and make sure to provide you with want you need for your AFM research. The XNC12 probes are now available for sale through all our distribution channels.

** See specifications on page 15*

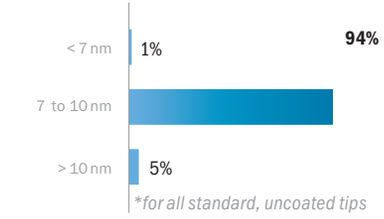
HQ Probes

The HQ Line (High Quality Line) is MikroMasch well-established state-of-the-art manufacturing and quality control technology. HQ probes are distinguished by their high quality and repeatability of characteristics. In particular, the probes have very consistent tip shape and radius, cantilever stiffness and resonance frequency, and laser reflectivity even for uncoated cantilevers.

RADIUS OF CURVATURE

The radius of curvature measures the sharpness of a particular probe. Typically, the sharper the curvature radius the more fragile a silicon tip is. Conversely, a larger curvature radius provides greater durability, but reduces the benefits of a sharper tip.

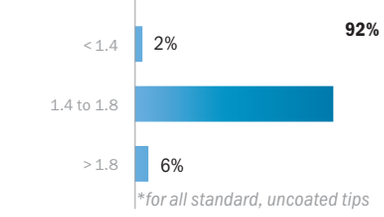
Achieving a consistent balance delivers reliable and accurate results. 94% of HQ probes have a radius of curvature between 7 and 10 nm.



TIP SHAPE FACTOR

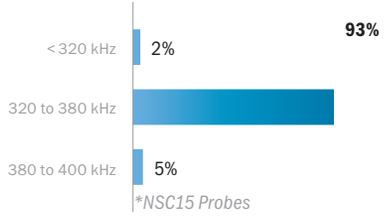
A higher value indicates a higher aspect ratio probe. A tighter range of values indicates a more consistent tip shape.

Results of the tip shape factor tests show consistent and close grouping of data. Known tip shape insures accuracy of results. 92% of HQ probes have an aspect ratio between 1.4 and 1.8.



RESONANCE FREQUENCY

Probes are designed to maintain a tight range of resonance frequencies. Reliability in cantilever specifications ensures dependable measurement results.

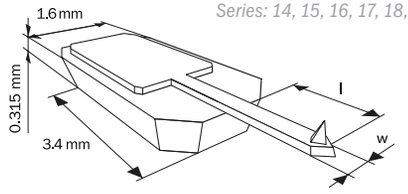


HQ AFM Probes & Test Structures

HQ:NSC/CSC 1 - lever

Cantilever material . . . . . n-type silicon
Tip shape . . . . . .pyramidal
Tip height . . . . . 12 - 18 µm
Alignment grooves on the back side of the chip

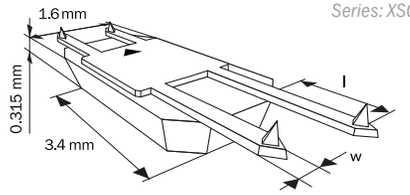
Series: 14, 15, 16, 17, 18, 19



HQ:XSC 4 - lever

Cantilever material . . . . . n-type silicon
Tip shape . . . . . .pyramidal
Tip height . . . . . 12 - 18 µm

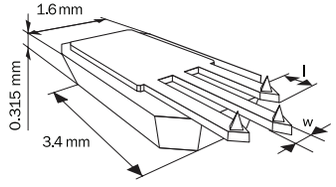
Series: XSC11



HQ:NSC/CSC 3 - lever

Cantilever material . . . . . n-type silicon
Tip shape . . . . . .pyramidal
Tip height . . . . . 12 - 18 µm

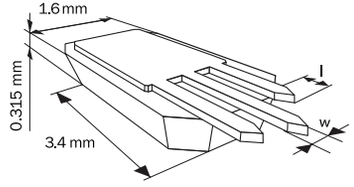
Series: NSC 35, NSC 36, CSC 37, CSC 38



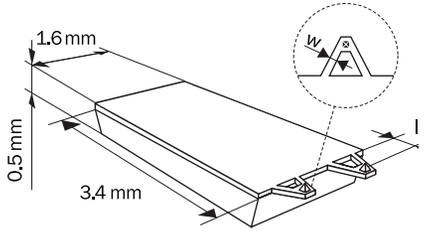
HQ: NSC/CSC Tipless 3 - lever

Cantilever material . . . . . n-type silicon

Series:NSC 35, NSC 36, CSC 37, CSC 38 Tipless



XNC12 2 - lever

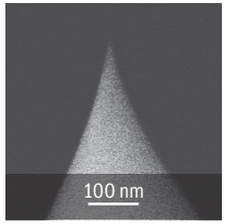


Cantilever material . . . . . silicon nitride
Tip shape . . . . . .pyramidal
Tip height . . . . . 3.5 µm

Series: XNC 12

HQ: NSC, CSC & XSC

Noncontact (NSC), Contact (CSC) and 4 - Lever (XSC) silicon probes



SEM image of the regular silicon tip

Pyramidal silicon etched probes* are characterized by high tip sharpness and narrow resonance peaks, making them very suitable for topography imaging in dynamic AFM modes and compositional mapping. These probes are available in a wide range of resonance frequencies and spring constants.

Tip properties:
Tip radius . . . . . **~ 8 nm**
Tip material . . . . . silicon

Back side coating:
Al BS . . . . . Al 30 nm
no Al . . . . . none
Cr-Au BS . . Au 30 nm on Cr 20 nm sublayer

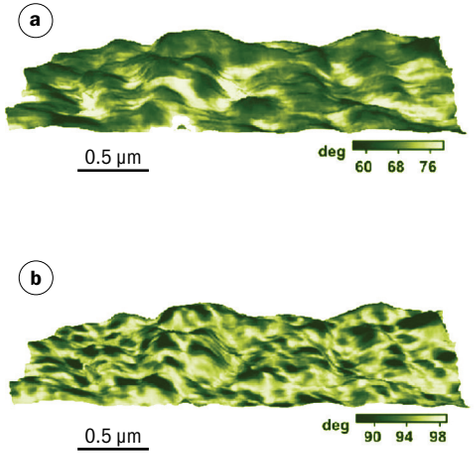
Cantilever Series	Available Coatings	Length l, ±5 µm	Width w, ±3 µm	Thickness ±0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:NSC14	/No Al, /Al BS, /Cr-Au BS	125	25	2.1	**160**	110 - 220	**5.0**	1.8 - 13
HQ:NSC15	/No Al, /Al BS, /Cr-Au BS	125	30	4.0	**325**	265 - 410	**40**	20 - 80
HQ:NSC16	/No Al, /Al BS, /Cr-Au BS	225	37.5	7.0	**190**	170 - 210	**45**	30 - 70
HQ:CSC17	/No Al, /Al BS, /Cr-Au BS	450	50	2.0	**13**	10 - 17	**0.18**	0.06 - 0.40
HQ:NSC18	/No Al, /Al BS, /Cr-Au BS	225	27.5	3.0	**75**	60 - 90	**2.8**	1.2 - 5.5
HQ:NSC19**	/No Al, /Al BS	125	22.5	1.0	**65**	25 - 120	**0.5**	0.05 - 2.3
HQ:NSC35								
lever A	/No Al, /Al BS, /Cr-Au BS	110	35	2.0	**205**	130 - 290	**8.9**	2.7 - 24
lever B		90	35	2.0	**300**	185 - 430	**16**	4.8 - 44
lever C		130	35	2.0	**150**	95 - 205	**5.4**	1.7 - 14
HQ:NSC36								
lever A	/No Al, /Al BS, /Cr-Au BS	110	32.5	1.0	**90**	30 - 160	**1.0**	0.1 - 4.6
lever B		90	32.5	1.0	**130**	45 - 240	**2**	0.2 - 9
lever C		130	32.5	1.0	**65**	25 - 115	**0.6**	0.06 - 2.7
HQ:CSC37								
lever A	/No Al, /Al BS	250	35	2.0	**40**	30 - 55	**0.8**	0.3 - 2
lever B		350	35	2.0	**20**	15 - 30	**0.3**	0.1 - 0.6
lever C		300	35	2.0	**30**	20 - 40	**0.4**	0.1 - 1
HQ:CSC38								
lever A	/No Al, /Al BS	250	32.5	1.0	**20**	8 - 32	**0.09**	0.01 - 0.36
lever B		350	32.5	1.0	**10**	5 - 17	**0.03**	0.003 - 0.13
lever C		300	32.5	1.0	**14**	6 - 23	**0.05**	0.005 - 0.21
HQ:XSC11								
lever A	/No Al, /Al BS	500	30	2.7	**15**	12 - 18	**0.2**	0.1 - 0.4
lever B		210	30	2.7	**80**	60 - 100	**2.7**	1.1 - 5.6
lever C		150	30	2.7	**155**	115 - 200	**7**	3 - 16
lever D		100	50	2.7	**350**	250 - 465	**42**	17 - 90

***ScanAsyst® compatible - ScanAsyst® is a trade mark of Bruker Corp.*

** See specifications on page 5*

APPLICATION

Phase imaging is among the AFM techniques that can be used to determine nanoscale differences in the properties of a heterogeneous system or of samples with inherent heterogeneity. Phase contrast is dependent on interactions between the tip and the sample, but those interactions are in turn partially dependent on the scan parameters and whether the image is being taken in an attractive or repulsive mode. O'Dea and Burrato used phase imaging to map the proton-conducting domains of a Nafion membrane. They found that the specific interaction forces between the tip and the sample significantly affected the resolution of the proton conducting domains. Imaging in a repulsive regime resulted in an overestimation of the area of the domains and an underestimation in the number of domains. Imaging in an attractive regime resulted in the most accurate phase imaging of the aqueous and fluorocarbon domains of the membrane. When the feedback loop was not optimized or the cantilever was driven above resonance, the phase corresponded with changes in topography rather than changes in the composition of the sample.



In figures (a) and (b) the phase data from repulsive and attractive regimes, respectively, have been overlaid on the corresponding topography image. Features of the phase contrast in the repulsive regime correspond to some features in the topography, while the phase contrast in the attractive regime is independent of the topography. Images were taken with the NSC15/Al BS (now upgraded to HQ:NSC15/Al BS).

(O'Dea, J.R. and Burrato, S.K.; J. Phys. Chem. B 2011, 115, 1014-1020.)

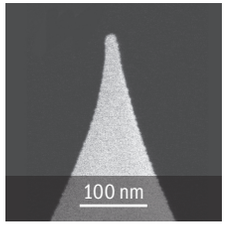
PART NUMBER HQ: * SC * / * - *

N, C, X	type
11, 14, 15, 16, 17, 18, 19, 35, 36, 37, 38	series
15, 50, 100, 200, 400	quantity*
/No Al, /Al BS, /Cr-Au BS	coating

** Please refer to our price list for available package sizes.*

Pt and Cr-Au Coated

Conductive Noncontact (NSC), Contact (CSC) and 4 - Lever (XSC) silicon probes



SEM image of the conducting silicon tip

Pyramidal silicon etched probes* with conductive platinum or gold coatings are suitable for a wide range of electrical applications of AFM. Gold and platinum coatings are inert, which makes these probes applicable for many experiments in biology and chemistry.

Pt coated resulting tip radius . . . . **< 30 nm**
Pt overall coating. . . . . 30 nm

Cr-Au coated resulting tip radius **< 35 nm**
Au overall coating . . . . . 30 nm
Cr overall sublayer . . . . . 20 nm

Cantilever Series	Available Coatings	Length l, ± 5 µm	Width w, ± 3 µm	Thickness ± 0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:NSC14	/Cr-Au, /Pt	125	25	2.1	**160**	110 - 220	**5.0**	1.8 - 13
HQ:NSC15	/Cr-Au, /Pt	125	30	4.0	**325**	265 - 410	**40**	20 - 80
HQ:NSC16	/Cr-Au, /Pt	225	37.5	7.0	**190**	170 - 210	**45**	30 - 70
HQ:CSC17	/Cr-Au, /Pt	450	50	2.0	**13**	10 - 17	**0.18**	0.06 - 0.40
HQ:NSC18	/Cr-Au, /Pt	225	27.5	3.0	**75**	60 - 90	**2.8**	1.2 - 5.5
HQ:NSC19**	/Cr-Au	125	22.5	1.0	**65**	25 - 120	**0.5**	0.05 - 2.3
HQ:NSC35								
lever A		110	35	2.0	**205**	130 - 290	**8.9**	2.7 - 24
lever B	/Cr-Au, /Pt	90	35	2.0	**300**	185 - 430	**16**	4.8 - 44
lever C		130	35	2.0	**150**	95 - 205	**5.4**	1.7 - 14
HQ:NSC36								
lever A		110	32.5	1.0	**90**	30 - 160	**1.0**	0.1 - 4.6
lever B	/Cr-Au, /Pt	90	32.5	1.0	**130**	45 - 240	**2**	0.2 - 9
lever C		130	32.5	1.0	**65**	25 - 115	**0.6**	0.06 - 2.7
HQ:CSC37								
lever A		250	35	2.0	**40**	30 - 55	**0.8**	0.3 - 2
lever B	/Cr-Au, /Pt	350	35	2.0	**20**	15 - 30	**0.3**	0.1 - 0.6
lever C		300	35	2.0	**30**	20 - 40	**0.4**	0.1 - 1
HQ:CSC38								
lever A		250	32.5	1.0	**20**	8 - 32	**0.09**	0.01 - 0.36
lever B	/Cr-Au	350	32.5	1.0	**10**	5 - 17	**0.03**	0.003 - 0.13
lever C		300	32.5	1.0	**14**	6 - 23	**0.05**	0.005 - 0.21
HQ:XSC11								
lever A		500	30	2.7	**15**	12 - 18	**0.2**	0.1 - 0.4
lever B	/Pt	210	30	2.7	**80**	60 - 100	**2.7**	1.1 - 5.6
lever C		150	30	2.7	**155**	115 - 200	**7**	3 - 16
lever D		100	50	2.7	**350**	250 - 465	**42**	17 - 90

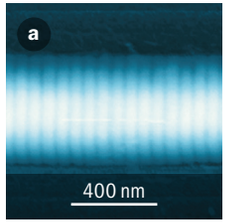
***ScanAsyst® compatible - ScanAsyst® is a trade mark of Bruker Corp.*

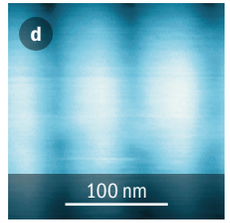
** See specifications on page 5*

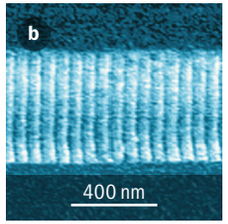
APPLICATION

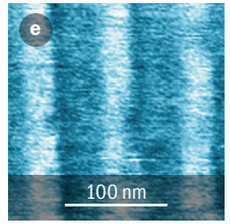
AFM is capable of mapping different electric properties of materials to topography images. These data can be used for analysis of the structure and composition of heterogeneous samples as well as for quantitative characterization of individual grains or defects on the surface. Electric properties of a sample can be mapped using probes with conducting coatings, when AC or DC bias is applied between the tip and the sample. Contact mode or two-pass operation techniques can be used for this purpose.

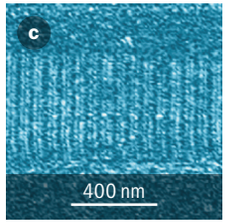
Although traditional piezoelectric and ferroelectric materials are often the samples studied using piezoresponse force microscopy, Minary-Jolandan and Yu showed that the electromechanical properties of collagen fibrils can also be investigated with PFM. They found via high resolution PFM with a Pt coated CSC17 probe (now upgraded to HQ:CSC17/Pt) that collagen fibrils have piezoelectrically heterogeneous gap and overlap regions. The gap regions exhibit little to no piezoelectricity, while the overlap regions show piezoelectricity. Images (a) and (d) show the topography of the collagen fibril, while (b) and (e) show the PFM amplitude. (c) and (f) are the 2ω signal measured to rule out any electrostatic interference with the PFM signal. The Pt only coating on the CSC17 probe (now upgraded to HQ:CSC17/Pt) allowed for the resolution of features ~30 nm. (Minary-Jolandan, M. and Yu, M.-F.; ACS Nano 2009, 3, 1859-1863.)

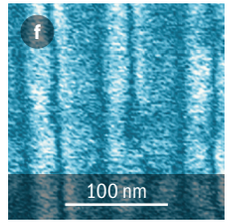












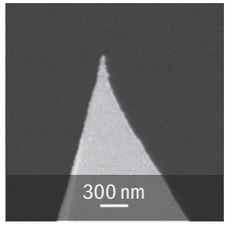
PART NUMBER

HQ: * SC * / * - *

N, C, X	type
11, 14, 15, 16, 17, 18, 19, 35, 36, 37, 38	series
15, 50, 100	quantity
/Cr-Au, /Pt	coating

DPER

High Resolution Conductive silicon probes



SEM image of the DPER silicon tip

DPER probes* are made by depositing a thin platinum coating on silicon tips. While the thickness of the coating on a flat cantilever surface is about 15 nm, there is only a 10 nm increase in the tip dimensions compared to bare silicon probes. These probes are recommended for electrical applications requiring higher resolution.

Pt coated resulting tip radius . . . . **< 20 nm**
Pt overall coating. . . . . 15 nm

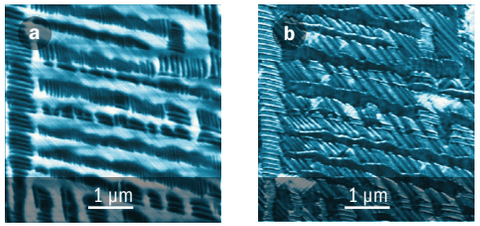
Cantilever Series	Length l, ± 5 µm	Width w, ± 3 µm	Thickness ± 0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:DPER-XSC11							
lever A	500	30	2.7	**15**	12 - 18	**0.2**	0.1 - 0.4
lever B	210	30	2.7	**80**	60 - 100	**2.7**	1.1 - 5.6
lever C	150	30	2.7	**155**	115 - 200	**7**	3 - 16
lever D	100	50	2.7	**350**	250 - 465	**42**	17 - 90

** See specifications on page 5*

APPLICATION

Topography (a) and in-plane piezoelectric force response (b) images of an approximately 80 nm thick $BiFeO_3$ film grown on a $LaAlO_3$ substrate taken with a DPER18 probe (now replaced by HQ:DPE-XSC11).

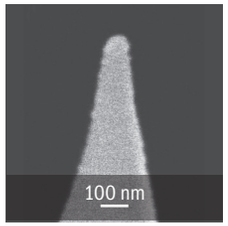
Image courtesy of Zuhuang Chen, Nanyang Technological University.



PART NUMBER **HQ: DPER - XSC11 - *** 15, 50, 100 quantity

DPE

Low Noise Conductive silicon probes



SEM image of the DPE silicon tip

The DPE probes* feature silicon tips and a special structure of conductive layers, which provides a more stable electrical signal and less noise. However, some reduction in resolution for topography images is possible when using DPE probes due to the increased tip radius.

Pt coated resulting tip radius . . . . **< 40 nm**
Pt overall coating. . . . . 50 nm

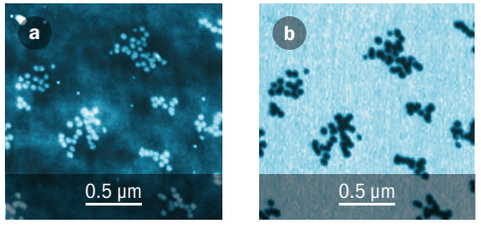
Cantilever Series	Length l, ± 5 µm	Width w, ± 3 µm	Thickness ± 0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:DPE-XSC11							
lever A	500	30	2.7	**15**	12 - 18	**0.2**	0.1 - 0.4
lever B	210	30	2.7	**80**	60 - 100	**2.7**	1.1 - 5.6
lever C	150	30	2.7	**155**	115 - 200	**7**	3 - 16
lever D	100	50	2.7	**350**	250 - 465	**42**	17 - 90

** See specifications on page 5*

APPLICATION

DPE probe topography (a) and surface potential (b) images of a fluoroalkane ($F_{12}H_{20}$) on a Silicon substrate.

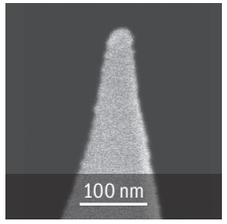
Image was taken using single-pass KFM with an Agilent 5500 by S. Magonov.



PART NUMBER **HQ: DPE - XSC11 - *** 15, 50, 100 quantity

Co-Cr Coated

Magnetic Noncontact (NSC) silicon probes



SEM image of the magnetic silicon tip

Two HQ:NSC probe* models are available with a special coating for Magnetic Force Microscopy. The coating consists of a 60 nm cobalt layer on the tip side and is protected from oxidation with a 20 nm chromium film. The cantilever parameters are optimized for stable measurements of topography and magnetic properties.

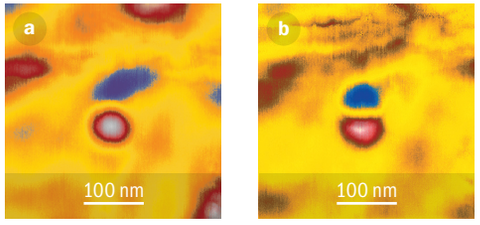
Co-Cr coated tip radius . . . . . **< 60 nm**
Co tip side coating. . . . . 60 nm
Cr tip side coating . . . . . 20 nm
Back side Al coating . . . . . 30 nm
Coercivity . . . . . 300–400 Oe

Cantilever Series	Available Coatings	Length l, ± 5 µm	Width w, ± 3 µm	Thickness ± 0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:NSC18	/Co-Cr/Al BS	225	27.5	3.0	**75**	60 - 90	**2.8**	1.2 - 5.5
HQ:NSC36								
lever A	/Co-Cr/Al BS	110	32.5	1.0	**90**	30 - 160	**1.0**	0.1 - 4.6
lever B		90	32.5	1.0	**130**	45 - 240	**2**	0.2 - 9
lever C		130	32.5	1.0	**65**	25 - 115	**0.6**	0.06 - 2.7

** See specifications on page 5*

APPLICATION

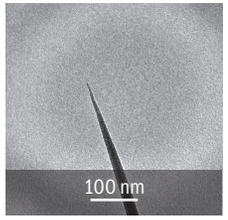
Topography (a) and magnetic (b) images of a Co mono domain particle obtained in Lift Mode using a NSC36 series cantilever with Co-Cr coating (now upgraded to HQ:NSC36/Co-Cr/Al BS). Image courtesy of Prof. V. Shevyakov, MIET.



PART NUMBER	HQ: NSC * / Co-Cr / Al BS - *	18,36	series
		15, 50	quantity

Hi'Res-C

High Resolution silicon probes



SEM image of the Hi'Res-C spike

The Hi'Res-C probes* suffer less contamination than silicon probes and are capable of obtaining many high-resolution scans, although they do require special care in use. Due to the small tip curvature radius, the tip-sample attraction force is minimized.

Advantages of Hi'Res-C are noticeable when scanning small areas (< 250 nm) and flat samples (R_a < 20 nm). On larger images, the resolution is similar to that of General Purpose probes.

Spike radius . . . . . **< 1 nm**
Spike height . . . . . .100 - 200 nm
Spike material . . . . . .diamond-like

Overall coating:
Au overall coating . . . . . .30 nm
Cr overall sublayer . . . . . .20 nm
The coating does not cover the spike!

Cantilever Series	Available Coatings	Length l, ± 5 µm	Width w, ± 3 µm	Thickness ± 0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
Hi'Res-C14	/Cr-Au	125	25	2.1	**160**	110 - 220	**5.0**	1.8 - 13
Hi'Res-C15	/Cr-Au	125	30	4.0	**325**	265 - 410	**40**	20 - 80
Hi'Res-C18	/Cr-Au	225	27.5	3.0	**75**	60 - 90	**2.8**	1.2 - 5.5
Hi'Res-C19**	/Cr-Au	125	22.5	1.0	**65**	25 - 120	**0.5**	0.05 - 2.3

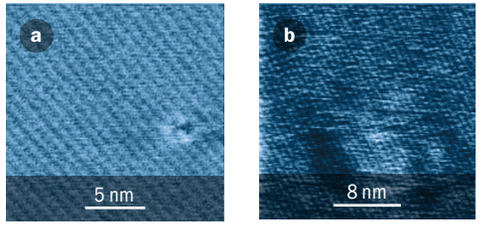
** See specifications on page 5*

***ScanAsyst® compatible - ScanAsyst® is a trade mark of Bruker Corp.*

APPLICATION

The advantages of the Hi'Res-C probes are noticeable on scans less than 250 nm in size. The tip radius of 1 nm allows high resolution imaging of nanometer-sized objects like single molecules, ultrathin films, and porous materials in air.

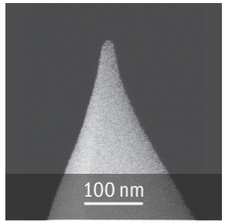
(a) Height image of polydiacetylene crystal obtained with Dimension 5000 SPM microscope and Hi'Res-C probe. Scan size 15 nm. A single defect in the molecular lattice of PDA crystal is visible. (b) Height image of PDA crystal obtained with Agilent 5500 SPM microscope and Hi'Res-C14 probe. Scan size 23 nm. Molecular lattice of PDA is observed only.
Images courtesy of Dr. S. Magonov, Agilent Technologies.



PART NUMBER	Hi'Res - C * / Cr-Au - *	14, 15, 19	series
		5	quantity

Series HARD

Hardened DLC coated silicon probes



SEM image of the HARD tip

The HARD series silicon etched probe* tips have pyramidal shape. The probes are coated with a hard DLC film. The Back side of the cantilevers is coated with the 30 nm aluminium reflective film.

Typical tip radius . . . . . **< 20 nm**
Tip side coating. . . . . DLC 20 nm
Back side coating . . . . . Al 30 nm

Cantilever Series	Available Coatings	Length l, ±5 µm	Width w, ±3 µm	Thickness ±0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:NSC14	/Hard/Al BS	125	25	2.1	**160**	110 - 220	**5.0**	1.8 - 13
HQ:NSC15	/Hard/Al BS	125	30	4.0	**325**	265 - 410	**40**	20 - 80
HQ:NSC16	/Hard/Al BS	225	37.5	7.0	**190**	170 - 210	**45**	30 - 70
HQ:CSC17	/Hard/Al BS	450	50	2.0	**13**	10 - 17	**0.18**	0.06 - 0.40
HQ:NSC18	/Hard/Al BS	225	27.5	27.5	**75**	60 - 90	**2.8**	1.2 - 5.50
HQ:NSC35								
lever A	/Hard/Al BS	110	35	2.0	**205**	130 - 290	**8.9**	2.7 - 24
lever B		90	35	2.0	**300**	185 - 430	**16**	4.8 - 44
lever C		130	35	2.0	**150**	95 - 205	**5.4**	1.7 - 14
HQ:NSC36								
lever A	/Hard/Al BS	110	32.5	1.0	**90**	30 - 160	**1.0**	0.1 - 4.6
lever B		90	32.5	1.0	**130**	45 - 240	**2**	0.2 - 9
lever C		130	32.5	1.0	**65**	25 - 115	**0.6**	0.06 - 2.7
HQ:XSC11								
lever A	/Hard/Al BS	500	30	2.7	**15**	12 - 18	**0.2**	0.1 - 0.4
lever B		210	30	2.7	**80**	60 - 100	**2.7**	1.1 - 5.6
lever C		150	30	2.7	**155**	115 - 200	**7**	3 - 16
lever D		100	50	2.7	**350**	250 - 465	**42**	17 - 90

** See specifications on page 5*

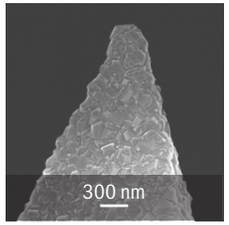
APPLICATION

The wear-resistant diamond-like carbon (DLC) coating increases tip durability and lifetime. DLC coated probes are useful for scanning large areas and very hard materials.

PART NUMBER	HQ: * SC * / Hard / Al BS - *		
		N, X, C	type
		15, 50	quantity
		11, 14, 15, 16, 17, 18, 35, 36	series

DMD-XSC11

Conductive diamond coated silicon probes



SEM image of the Diamond silicon tip

The DMD series silicon etched tips have real polycrystalline diamond tip side coating for unsurpassed long scanning ability. The doping of the coating ensures good electrical conductivity.

Typical tip radius . . . . . **100-250 nm**
Tip side coating. . . . . Diamond
Back side coating . . . . . Al 30 nm

Cantilever Series	Length l, ±5 µm	Width w, ±3 µm	Thickness ±0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:DMD-XSC11							
lever A	500	30	2.7	**18**	15 - 22	**0.5**	0.25 - 1
lever B	210	30	2.7	**110**	90 - 130	**6.5**	3.5 - 10
lever C	150	30	2.7	**210**	170 - 250	**18**	10 - 30
lever D	100	50	2.7	**450**	350 - 575	**95**	55 - 175

** See specifications on page 5*

APPLICATION

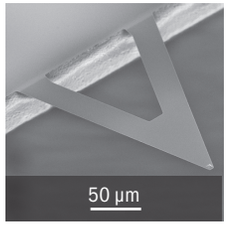
The HQ:DMD-XSC11 features 4 different cantilevers with tips that are both extremely durable and electically conductive. This makes the probe very versatile with a large range of applications:

- Surface modification and nanomechanics: nanoscratching, nanolithography, nanoindentation, force-distance spectroscopy, etc.
- Electrical characterization: demanding electrical measurements in contact mode such as Tunnelling current AFM and Conductive AFM, as well as dynamic mode measurements such as KPFM, EFM, etc.
- Long series of tapping, soft tapping, force modulation or contact mode measurements where extreme tip shape stability is required.

PART NUMBER	HQ: DMD - XSC11 - *		
		5, 15, 50	quantity

Silicon Nitride Probes

Silicon Nitride Probes



SEM image of a XNC12 Cantilever

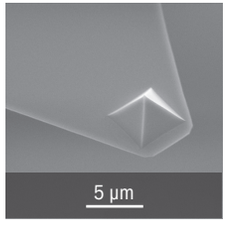
Probes of the 12 series have 2 silicon nitride cantilevers and tips on one side of the glass holder chip. They are used for soft contact mode applications.

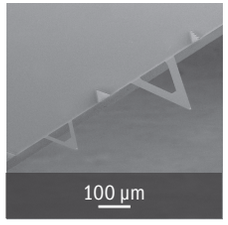
Tip side coating:
Cr-Au BS . . . . . none
Cr-Au . . . . . 35 nm, Au on Cr

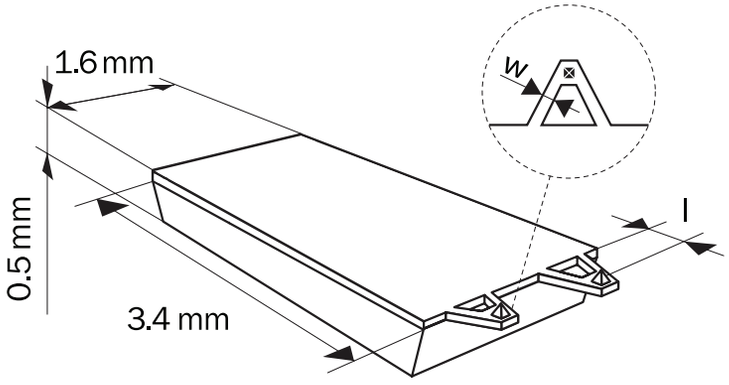
Back side coating:
Cr-Au BS . . . . . 70 nm, Au on Cr
Cr-Au . . . . . 70 nm, Au on Cr

Cr-Au BS uncoated tip radius . . . . . ~ 10 nm
Cr-Au coated tip radius . . . . . ~ 30 nm

Cantilever Series	Available Coatings	Length l, ± 10 µm	Width w, ± 5 µm	Thickness ±0.075 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
XNC12								
lever A	Cr-Au / Cr-Au BS	200	28	0.5	**17**	-	**0.08**	-
lever B		100	13.5	0.5	**67**	-	**0.32**	-



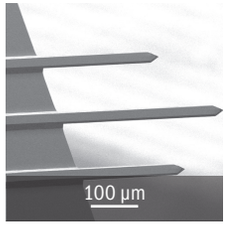




PART NUMBER	XNC12 / * - *		
		10, 35, 70	quantity
		/Cr-Au, /Cr-Au BS	coating

Tipless Cantilevers

Tipless Noncontact (NSC) and Contact (CSC) three-lever silicon probes



SEM image of a tipless silicon cantilever

Probes of the Tipless Series feature 3 tipless cantilevers* with different spring constants and resonance frequencies on one side of the chip. This series replaces the former 12 Series.

Back side coating:
Al BS. . . . . Al 30 nm
no Al . . . . . no

Cr-Au coated
Au overall coating . . . . . 30 nm
Cr overall sublayer. . . . . 20 nm

Cantilever Series	Available Coatings	Length l, ± 5 µm	Width w, ± 3 µm	Thickness ±0.5 µm	Resonance Frequency kHz (typical)	Resonance Frequency kHz (range)	Force Constant N/m (typical)	Force Constant N/m (range)
HQ:NSC35/Tipless								
lever A	/No Al, /Al BS, /Cr-Au	110	35	2.0	**205**	130 - 290	**8.9**	2.7 - 24
lever B		90	35	2.0	**300**	185 - 430	**16**	4.8 - 44
lever C		130	35	2.0	**150**	95 - 205	**5.4**	1.7 - 14
HQ:NSC36/Tipless								
lever A	/No Al, /Al BS, /Cr-Au	110	32.5	1.0	**90**	30 - 160	**1.0**	0.1 - 4.6
lever B		90	32.5	1.0	**130**	45 - 240	**2**	0.2 - 9
lever C		130	32.5	1.0	**65**	25 - 115	**0.6**	0.06 - 2.7
HQ:CSC37/Tipless								
lever A	/No Al, /Al BS, /Cr-Au	250	35	2.0	**40**	30 - 55	**0.8**	0.3 - 2
lever B		350	35	2.0	**20**	15 - 30	**0.3**	0.1 - 0.6
lever C		300	35	2.0	**30**	20 - 40	**0.4**	0.1 - 1
HQ:CSC38/Tipless								
lever A	/No Al, /Al BS, /Cr-Au	250	32.5	1.0	**20**	8 - 32	**0.09**	0.01 - 0.36
lever B		350	32.5	1.0	**10**	5 - 17	**0.03**	0.003 - 0.13
lever C		300	32.5	1.0	**14**	6 - 23	**0.05**	0.005 - 0.21

** See specifications on page 5*

APPLICATION

Tipless cantilevers can be used for measurements of material properties and interactions. Different objects such as glass spheres or polystyrene particles can also be mounted on tipless cantilevers to make them applicable for AFM-like experiments.

PART NUMBER	HQ: * SC * / Tipless / * - *		
		N, C	type
		35, 36, 37, 38	series
		15, 50, 100, 200, 400	quantity*
		/No Al, /Al BS, /Cr-Au	coating

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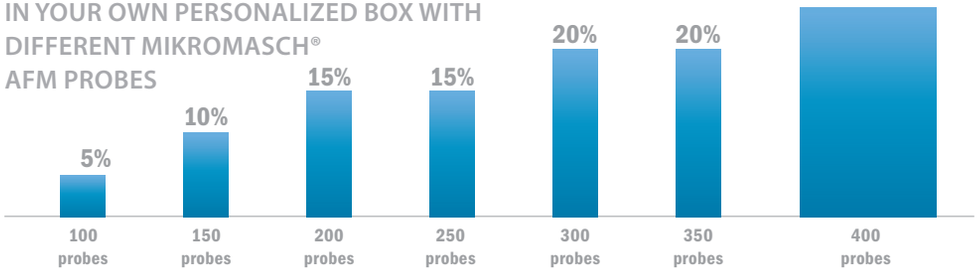

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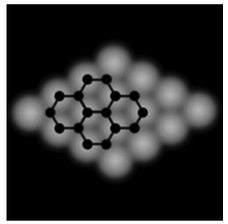
HOPG



Typical STM image of HOPG with superimposed graphene structure

Highly ordered pyrolytic graphite (HOPG) is a lamellar material and consists of stacked planes. Carbon atoms within a single plane interact more strongly than with those in adjacent planes. Each atom within a plane has three nearest neighbors, resulting in a honeycomb-like structure. This two-dimensional single-atom thick plane is called graphene.

Part number:

HOPG/ZYA/DS/1-1	10 x 10 x 1 mm, 1 chip
HOPG/ZYA/DS/2-1	10 x 10 x 2 mm, 1 chip
HOPG/ZYB/DS/1-1	10 x 10 x 1 mm, 1 chip
NEW HOPG/ZYB/DS/2-1	10 x 10 x 2 mm, 1 chip
HOPG/ZYH/DS/1-1	10 x 10 x 1 mm, 1 chip
HOPG/ZYH/DS/2-1	10 x 10 x 2 mm, 1 chip
HOPG/ZYH/DS/1-5	10 x 10 x 1 mm, 5 chips
HOPG/ZYH/DS/2-5	10 x 10 x 2 mm, 5 chips

Density	2.266 g/cm^3

Thermal conductivities:

thermal conductivity parallel (002)	1700 ± 100 W/(m·K)
thermal conductivity perpendicular (002)	8 ± 1 W/(m·K)
electrical conductivity parallel (002)	2.1 ± 0.1 x 10^6 [(Ω·m)$^{-1}$]
electrical conductivity perpendicular (002)	5 x 10^2 [(Ω·m)$^{-1}$]

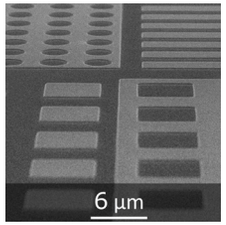
There are several grades of double sided HOPG with thickness 1 mm or more:

	ZYA Grades ▼	ZYB Grades ▼	ZYH Grades ▼
Mosaic spread	0.4° ± 0.1°	0.8° ± 0.2°	3.5° ± 1.5°

APPLICATION

HOPG terminated with a graphene layer can serve as an ideal atomically flat surface to be used as a substrate or standard for SPM investigations. This is also an easily “cleavable” material with a smooth surface, which is vital for SPM measurements that require a uniform, flat and clean substrate.

TGXYZ Series



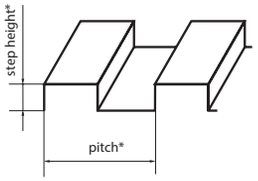
SEM image of a TGXYZ02 grating

Calibration gratings from the TGXYZ series are arrays of different structures comprising rectangular silicon dioxide steps on a silicon wafer. The small square in the center with dimensions 500 µm by 500 µm includes circular pillars and holes, as well as lines in the X- and Y-direction with a pitch of 5 µm. The large square with dimensions 1 mm by 1 mm contains square pillars and holes with a pitch of 10 µm.

Active area . . . . . 1 x 1 mm
Chip dimensions . . . . . .5 x 5 x 0.3 mm

Part number	Step height*	Height accuracy	Pitch	Pitch accuracy
▼	▼	▼	▼	▼
TGXYZ01	20 nm	5%	5 and 10 µm	0.1 µm
TGXYZ02	100 nm	3%	5 and 10 µm	0 .1 µm
TGXYZ03	500 nm	3%	5 and 10 µm	0.1 µm

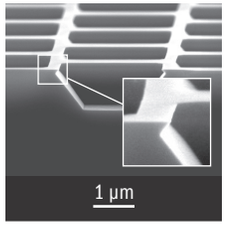
*The dimensions marked * are given for reference only. The actual step height, shown on the label of the individual grating box may differ slightly from the nominal value.*



APPLICATION

The TGXYZ calibration gratings are intended for vertical and lateral calibration of SPM scanners. The vertical non-linearity can be compensated for by using several calibration gratings with different nominal step heights.

TGX Series



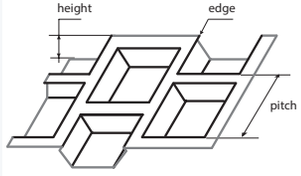
SEM image of a TGX01 grating

The silicon calibration grating TGX is an array of square holes with sharp undercut edges formed by anisotropic etching along the (111) crystallographic planes of silicon. The typical radius of the edges is less than 5 nm.

Part number . . . . . **TGX**

Active area . . . . . 1 x 1 mm
Chip dimensions . . . . . .5 x 5 x 0.3 mm
Edge radii . . . . . < 5 nm
Pitch . . . . . 3 µm
Pitch accuracy . . . . . 0.1 µm
Step height* . . . . . 1 µm

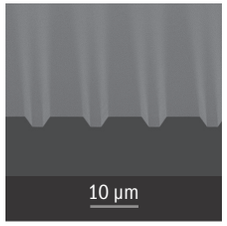
*The dimensions marked * are given for reference only.*



TGX calibration gratings are intended for determination of the tip aspect ratio and for lateral calibration of SPM scanners. The gratings can also be used for detection of lateral non-linearity, hysteresis, creep, and cross-coupling effects.

Please note: The TGXYZ, TGX, TGF11, and PA Series Calibration Gratings are available either mounted on a round metal plate with Ø12mm or unmounted. For ordering information visit www.spmtips.com

TGF11 Series



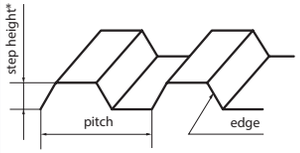
SEM image of a TGF11 grating

The TGF calibration gratings feature one-dimensional arrays of trapezoidal steps etched into a silicon substrate. The sidewalls of the structures are very smooth and planar surfaces with well-defined orientation formed by the (111) crystallographic planes in monocrystalline silicon. The sidewalls and the horizontal top surfaces form an angle of 54.74°.

Part number **TGF11**

Active area . . . . . 3 x 3 mm
Chip dimensions . . . . . .5 x 5 x 0.3 mm
Pitch . . . . . 10 µm
Pitch accuracy . . . . . 0.1 µm
Step height* . . . . . 1.75 µm

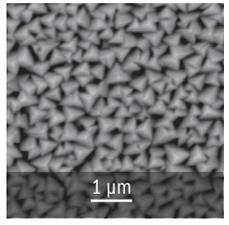
The step height value is given for information only, not for vertical calibration purposes.



APPLICATION

TGF11 grating can be used for the assessment of scanner nonlinearity in the vertical direction. Direct calibration of the lateral force can be obtained by analyzing the contact response measured on the flat and sloped facets. This can be done for the calibration of conventional Si probes or cantilevers with an attached colloidal particle with any radius of curvature up to 2 µm.

PA Series



SEM image of a PA01 structure
Scan size 1 µm

Sample for characterization of tip shape with hard sharp pyramidal nanostructures.
The structures are covered by a highly wear-resistant layer.

Part number **PA01**

Pyramid base . . . . . 50 - 100 nm
Pyramid height . . . . . 50 - 150 nm
Smallest edge radii . . . . . < 5 nm
Active area . . . . . 5 x 5 mm
Chip dimensions . . . . . 5 x 5 x 0.7 mm

APPLICATION

The exact shape of the scanning probe tip is very important for obtaining AFM images of high quality and accuracy. As new AFM tips with nanometer radii of curvature become widespread, periodic structures that have surface features of similar or greater sharpness should be used to estimate the parameters of the tip.

Please note: The TGXYZ, TGX, TGF11, and PA Series Calibration Gratings are available either mounted on a round metal plate with Ø12mm or unmounted. For ordering information visit www.spmtips.com

RECOMMENDATIONS FOR SPECIFIC APPLICATIONS

	Probe Type	Characteristics	*k*, N/m	f_o, kHz	Tip Material, Coating	R_{tip}, nm
Materials characterization	HQ:NSC18	Force modulation	~2.8	~75	Silicon, Al or no Al back side coating	~8
	HQ:NSC14	Phase imaging	~5.0	~150	Silicon, Al or no Al back side coating	~8
General topology imaging	HQ:NSC17	Contact imaging	~0.18	~13	Silicon, Al or no Al back side coating	~8
	HQ:NSC15	Intermittent/non-contact Imaging	~40	~325	Silicon, Al or no Al back side coating	~8
	HQ:NSC14	Intermittent contact imaging	~5.0	~150	Silicon, Al or no Al back side coating	~8
	HQ:NSC19	Intermittent contact imaging / ScanAsyst ® PeakForce tapping™ *	~0.5	~65	Silicon, Al or no Al back side coating	~8
Topology imaging for life science	HQ:NSC14	Intermittent contact imaging	~5.0	~150	Silicon, Al or no Al back side coating	~8
	HQ:NSC18/ Cr-Au BS	Intermittent contact imaging in fluid	~2.8	~75	Silicon, Au back side coating	~8
	HQ:NSC18/Cr-Au BS	Contact imaging in fluid	~2.8	~75	Silicon, Au back side coating	~8
	HQ:CSC17	Contact imaging	~0.18	~13	Silicon, Al or no Al back side coating	~8
	HQ:CSC38 (three lever)	Contact imaging	~0.09 ~0.03 ~0.05	~20 ~10 ~14	Silicon, Al or no Al back side coating	~8
	Hi'Res-C14/Cr-Au	High resolution Imaging	~5.0	~160	Carbon spike, Al back side coating	~1
	HQ:NSC36 (three lever)	Intermittent contact imaging	~1.0 ~2.0 ~0.6	~90 ~130 ~65	Silicon, Al or no Al back side coating	~8
	XNC12/Cr-Au BS (two lever)	Soft contact mode imaging	~0.08 ~0.32	~17 ~67	Silicon Nitride, Au back side coating	<40
	XNC12/Cr-Au (two lever)	Soft contact mode imaging	~0.08 ~0.32	~0.08 ~0.32	Cr-Au coating on both sides	<60
Probes for mechanical property measurements in life science	HQ:NSC14/Hard	Specially coated for durability	~5.0	~160	DLC tip coating, Al back side coating	<20
	HQ:NSC18	Force modulation	~2.8	~75	Silicon, Al or no Al back side coating	~8
	HQ:CSC17/Cr-Au	Chemical inertness, functionalization	~0.18	~13	Cr-Au coating on both sides	<35
Probes for high resolution imaging	Hi'Res-C14/Cr-Au	Nanometer-sized objects like single molecules, ultrathin films, and porous materials in air	~5.0	~160	Carbon spike, Cr-Au coating on both sides (spike not coated)	~1

k — Force constant; f_o — Resonance frequency

** ScanAsyst® and PeakForce Tapping™ are trademarks of Bruker Corporation*

	Probe Type	Characteristics	*k*, N/m	f_o, kHz	Tip Material, Coating	R_{tip}, nm
Electrical applicatons in vacuum	HQ:DPER/XS11, Cantilever A	High resolution	~0.2	~15	Pt coating on both sides	<20
	HQ:DPE/XSC11, Cantilever A	High sensitivity, low wear	~0.2	~15	Pt coating on both sides	<40
Electrical applications for PFM, TUNA, SCM, SSRM	HQ:DPER/XSC11, Cantilever C	High resolution	~7	~155	Pt coating on both sides	<20
	HQ:DPE/XSC11, Cantilever C	Dynamic/contact electrical mode, high sensitivity, low wear	~7	~155	Pt coating on both sides	<40
	HQ:CSC17/Cr-Au	Chemical inertness, functionalization	~0.15	~12	Cr-Au coating on both sides	<35
	HQ:NSC18/Pt	Dynamic/contact electrical mode	~2.8	~75	Pt coating on both sides	<30
	HQ:DMD-XSC11 Cantilever A	Low wear	~0.5	~18	Diamond tip coating, Al back side coating	<250
Electrical applications for EFM, SKPM, Voltage Modulation, Scanning Impedance Microscopy, SGM	HQ:DPER/XSC11, Cantilever C	High resolution	~7	~155	Pt coating on both sides	<20
	HQ:DPE/XSC11, Cantilever C	Dynamic/contact electrical mode, high sensitivity, low wear	~7	~155	Pt coating on both sides	<40
	HQ:NSC14/Pt	General stability in conductive modes	~7	~155	Pt coating on both sides	<30
	HQ: NSC14/Cr-Au	Chemical inertness, functionalization	~7	~155	Cr-Au coating on both sides	<35
	HQ:DPER/XSC11, Cantilever B	High resolution	~2.7	~80	Pt coating on both sides	<20
	HQ:DPE/XSC11, Cantilever B	High sensitivity, low wear	~2.7	~80	Pt coating on both sides	<40
	HQ:NSC18/Pt	General stability in conductive modes	~2.8	~75	Pt coating on both sides	<30
	HQ:NSC18/Cr-Au	Chemical inertness, functionalization	~2.8	~75	Cr-Au coating on both sides	<35
	HQ:DMD-XSC11 Cantilever B	Low wear	~6.5	~110	Diamond tip coating, Al back side coating	<250
Magnetic force microscopy	HQ:NSC18/Co-Cr/ Al BS	Magnetic tip coating, Al back side coating	~2.8	~75	Co-Cr tip coating, Al Back side coating	<90

k — Force constant; f_o — Resonance frequency

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