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
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.

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.

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

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.

- 2 triangular silicon nitride cantilevers with 0.08 N/m and 0.32 N/m on each 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 what you need for your AFM research. The XNC12 probes are now available for sale through all our distribution channels.

* See specifications on page 15
The New HQ Line & Test Structures

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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: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 4 - lever
Cantilever material ...................... n-type silicon
Tip shape ................................ pyramidal
Tip height .................................. 12 - 18 µm
Series: XSC11

HQ:NSC/CSC Tipless 3 - lever
Cantilever material ...................... n-type silicon
Tip shape ................................ pyramidal
Tip height ................................ .. 12 - 18 µm
Series: NSC 35, NSC 36, CSC 37, CSC 38 Tipless

XNC12 4 - 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

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**: ± 5 µm
- **Tip material**: silicon

### Back side coating:
- AI BS
- Al BS
- Cr-Au BS

### Coatings
- **Coating 1**: No Al, Al BS, Cr-Au BS
- **Coating 2**: No Al, Al BS, Cr-Au BS, Al BS, Cr-Au BS

### Series
- **Series A**: lever A
- **Series B**: lever B
- **Series C**: lever C

### Specifications:

<table>
<thead>
<tr>
<th>Cantilever Series</th>
<th>Available Coatings</th>
<th>Length ± 5 µm</th>
<th>Width ± 3 µm</th>
<th>Thickness ± 0.5 µm</th>
<th>Resonance Frequency (kHz) (Range)</th>
<th>Force Constant (N/m) (Range)</th>
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<td>42 - 17 - 90</td>
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* Please refer to our price list for available package sizes.

**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 these 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.)

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**PART NUMBER**

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<th>series</th>
<th>quantity*</th>
<th>coating</th>
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**Hi’Res-C**

High Resolution silicon probes

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 < 20 nm). On larger images, the resolution is similar to that of General Purpose probes.

**Series HARD**

Hardened DLC coated silicon probes

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

**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.

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**Hi’Res-C**

SEM image of the Hi’Res-C spike

100 nm

**Series HARD**

SEM image of the HARD tip

100 nm

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**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.

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**Hi’Res-C**

**High Resolution**

**SEM image of the Hi’Res-C**

**Hi’Res-C14**

**Hi’Res-C15**

**Hi’Res-C18**

**Hi’Res-C19**

**Hi’Res-C**

**Hi’Res-C14**

**Hi’Res-C15**

**Hi’Res-C18**

**Hi’Res-C19**

**Cantilever Series**

**Length**

**Width**

**Thickness**

**Resonance Frequency**

**Force Constant**

---

**Hi’Res-C14**

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**Available Coatings**

- Cr-Au

**Length**  ± 5 µm

**Width**  ± 3 µm

**Thickness**  ± 0.5 µm

**Resonance Frequency**  kHz

**Force Constant**  N/m

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**Hi’Res-C14**

**Hi’Res-C15**

**Hi’Res-C18**

**Hi’Res-C19**

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**Series HARD**

**Hardened DLC coated silicon probes**

**Cantilever Series**

**Length**

**Width**

**Thickness**

**Resonance Frequency**

**Force Constant**

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**HQ:NSC10**

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**HQ:NSC11**

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| 125    | 3.0   | 4.0       | 325                 | 110          ![](https://aiuto.com)
**Pt and Cr-Au Coated**

**Conductive Noncontact (NSc), Contact (cSc) and 4 - Lever (xSc) silicon probes**

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.

### Available Coatings

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<th>Width w, 5 µm</th>
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<th>Force Constant N/m (typical)</th>
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<td>HQ: CSC17</td>
<td>/Cr-Au, /Pt</td>
<td>450</td>
<td>50</td>
<td>2.0</td>
<td>13</td>
<td>0.18</td>
</tr>
<tr>
<td>HQ: NSC18</td>
<td>/Cr-Au, /Pt</td>
<td>225</td>
<td>27.5</td>
<td>3.0</td>
<td>75</td>
<td>2.8</td>
</tr>
<tr>
<td>HQ: NSC19**</td>
<td>/Cr-Au</td>
<td>125</td>
<td>22.5</td>
<td>1.0</td>
<td>65</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**HQ: NSC15**

<table>
<thead>
<tr>
<th>Lever</th>
<th>/Cr-Au, /Pt</th>
<th>Length l, 5 µm</th>
<th>Width w, 5 µm</th>
<th>Thickness ± 0.5 µm</th>
<th>Resonance Frequency 1 Hz (typical)</th>
<th>Force Constant N/m (typical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>110</td>
<td>35</td>
<td>2.0</td>
<td>205</td>
<td>8.9</td>
<td>2.7</td>
</tr>
<tr>
<td>B</td>
<td>90</td>
<td>35</td>
<td>2.0</td>
<td>300</td>
<td>185 - 430</td>
<td>4.8</td>
</tr>
<tr>
<td>C</td>
<td>130</td>
<td>35</td>
<td>2.0</td>
<td>150</td>
<td>95 - 205</td>
<td>4.8</td>
</tr>
</tbody>
</table>

**HQ: NSC36**

<table>
<thead>
<tr>
<th>Lever</th>
<th>/Cr-Au, /Pt</th>
<th>Length l, 5 µm</th>
<th>Width w, 5 µm</th>
<th>Thickness ± 0.5 µm</th>
<th>Resonance Frequency 1 Hz (typical)</th>
<th>Force Constant N/m (typical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>110</td>
<td>32.5</td>
<td>1.0</td>
<td>90</td>
<td>30 - 160</td>
<td>1.0</td>
</tr>
<tr>
<td>B</td>
<td>90</td>
<td>32.5</td>
<td>1.0</td>
<td>130</td>
<td>45 - 240</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>130</td>
<td>32.5</td>
<td>1.0</td>
<td>65</td>
<td>25 - 115</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**HQ: CSC17**

<table>
<thead>
<tr>
<th>Lever</th>
<th>/Cr-Au, /Pt</th>
<th>Length l, 5 µm</th>
<th>Width w, 5 µm</th>
<th>Thickness ± 0.5 µm</th>
<th>Resonance Frequency 1 Hz (typical)</th>
<th>Force Constant N/m (typical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>35</td>
<td>2.0</td>
<td>40</td>
<td>30 - 55</td>
<td>0.8</td>
</tr>
<tr>
<td>B</td>
<td>350</td>
<td>35</td>
<td>2.0</td>
<td>20</td>
<td>15 - 30</td>
<td>0.3</td>
</tr>
<tr>
<td>C</td>
<td>300</td>
<td>35</td>
<td>2.0</td>
<td>30</td>
<td>20 - 40</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**HQ: CSC38**

<table>
<thead>
<tr>
<th>Lever</th>
<th>/Cr-Au, /Pt</th>
<th>Length l, 5 µm</th>
<th>Width w, 5 µm</th>
<th>Thickness ± 0.5 µm</th>
<th>Resonance Frequency 1 Hz (typical)</th>
<th>Force Constant N/m (typical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>32.5</td>
<td>1.0</td>
<td>20</td>
<td>8 - 32</td>
<td>0.09</td>
</tr>
<tr>
<td>B</td>
<td>350</td>
<td>32.5</td>
<td>1.0</td>
<td>10</td>
<td>5 - 17</td>
<td>0.03</td>
</tr>
<tr>
<td>C</td>
<td>300</td>
<td>32.5</td>
<td>1.0</td>
<td>14</td>
<td>6 - 23</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**HQ: NSC11**

<table>
<thead>
<tr>
<th>Lever</th>
<th>/Pt</th>
<th>Length l, 5 µm</th>
<th>Width w, 5 µm</th>
<th>Thickness ± 0.5 µm</th>
<th>Resonance Frequency 1 Hz (typical)</th>
<th>Force Constant N/m (typical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>500</td>
<td>39</td>
<td>2.7</td>
<td>15</td>
<td>12 - 18</td>
<td>0.2</td>
</tr>
<tr>
<td>B</td>
<td>210</td>
<td>39</td>
<td>2.7</td>
<td>80</td>
<td>60 - 100</td>
<td>2.7</td>
</tr>
<tr>
<td>C</td>
<td>150</td>
<td>30</td>
<td>2.7</td>
<td>155</td>
<td>115 - 200</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>100</td>
<td>50</td>
<td>2.7</td>
<td>350</td>
<td>250 - 465</td>
<td>42</td>
</tr>
</tbody>
</table>

**Coatings**

- Pt coated resulting tip radius . . . < 30 nm
- Au coated resulting tip radius < 35 nm

**Applications**

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 **/ /** series

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Type</th>
<th>Coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>11, 14, 15, 16, 17, 18, 19, 35, 36, 37, 38</td>
<td>N, C, X</td>
<td>/Pt</td>
</tr>
</tbody>
</table>

* See specifications on page 5
**CONDUCTIVE**

**DPE**

**Low Noise Conductive silicon probes**

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.

**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

---

**DPER**

**High Resolution Conductive silicon probes**

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.

**Application**

Topography (a) and in-plane piezoelectric force response (b) images of an approximately 80 nm thick BiFeO₃ film grown on a LaAlO₃ 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

---

* See specifications on page 5
**Co-Cr Coated**

Magnetic Noncontact (NSC) silicon probes

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

**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.

---

**Silicon Nitride Probes**

Probes of the 12 series have 2 silicon nitride cantilevers and tips on each 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
- Cr-Au . . . . . . . . . . . . . . . . . . 70 nm, Au on Cr

**Back side coating:**

- Cr-Au BS . . . . . . . . . . . . . . . . . . 70 nm, Au on Cr
- Cr-Au . . . . . . . . . . . . . . . . . . 70 nm, Au on Cr

**Co-Cr coated tip radius . . . . . . . < 10 nm**
- Co tip side coating . . . . . . . . . . . 60 nm
- Cr tip side coating . . . . . . . . . . . 20 nm

**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 - *
- XNC12 / * - *

**PART NUMBER**

- 18.36 / series
- 15.50 / quantity

---

**PART NUMBER**

- XNC12 / * - *
- 10, 35, 70 / quantity
- Cr-Au, /Cr-Au BS / coating
Mix and Match enables you to create a custom MikroMasch® AFM probes box with quantities of 100, 150, 200, 250, 300, 350 or 400 pcs. inside where you can mix different MikroMasch® AFM probe types in units of 50 pcs.

The more units of 50 AFM probes you order, the higher your discount will be from the 50 probes list prices of each variety ordered:

You Can Create Your Own MikroMasch® Box Using the Form on Our Website. We Will Ship Your Personal Mix and Match Box Within 10 Business Days.

Mix and Match enables you to create a custom MikroMasch® AFM probes box with quantities of 100, 150, 200, 250, 300, 350 or 400 pcs. inside where you can mix different MikroMasch® AFM probe types in units of 50 pcs.

The more units of 50 AFM probes you order, the higher your discount will be from the 50 probes list prices of each variety ordered:

10% 15% 20% 25% 30% 35% 40%

You Can Create Your Own MikroMasch® Box Using the Form on Our Website. We Will Ship Your Personal Mix and Match Box Within 10 Business Days.

Mix and Match enables you to create a custom MikroMasch® AFM probes box with quantities of 100, 150, 200, 250, 300, 350 or 400 pcs. inside where you can mix different MikroMasch® AFM probe types in units of 50 pcs.

The more units of 50 AFM probes you order, the higher your discount will be from the 50 probes list prices of each variety ordered:

You Can Create Your Own MikroMasch® Box Using the Form on Our Website. We Will Ship Your Personal Mix and Match Box Within 10 Business Days.
**TGXYZ Series**

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.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Step height*</th>
<th>Height accuracy</th>
<th>Pitch</th>
<th>Pitch accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGXYZ01</td>
<td>20 nm</td>
<td>2%</td>
<td>5 and 10 µm</td>
<td>0.1 µm</td>
</tr>
<tr>
<td>TGXYZ02</td>
<td>100 nm</td>
<td>3%</td>
<td>5 and 10 µm</td>
<td>0.1 µm</td>
</tr>
<tr>
<td>TGXYZ03</td>
<td>500 nm</td>
<td>3%</td>
<td>5 and 10 µm</td>
<td>0.1 µm</td>
</tr>
</tbody>
</table>

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**

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.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Active area</th>
<th>Chip dimensions</th>
<th>Edge radii</th>
<th>Pitch</th>
<th>Pitch accuracy</th>
<th>Step height*</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGX</td>
<td>1 x 1 mm</td>
<td>5 x 5 x 0.3 mm</td>
<td>&lt; 5 nm</td>
<td>3 µm</td>
<td>0.1 µm</td>
<td>1 µm</td>
</tr>
</tbody>
</table>

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.

**TGF11 Series**

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°.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Active area</th>
<th>Chip dimensions</th>
<th>Pitch</th>
<th>Pitch accuracy</th>
<th>Step height*</th>
<th>Edge radii</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGF11</td>
<td>3 x 3 mm</td>
<td>5 x 5 x 0.3 mm</td>
<td>10 µm</td>
<td>0.1 µm</td>
<td>1.75 µm</td>
<td>2%</td>
</tr>
</tbody>
</table>

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**

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

<table>
<thead>
<tr>
<th>Part number</th>
<th>Pyramid base</th>
<th>Pyramid height</th>
<th>Smallest edge radii</th>
<th>Active area</th>
<th>Chip dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA01</td>
<td>50 - 100 nm</td>
<td>50 - 150 nm</td>
<td>&lt; 5 nm</td>
<td>5 x 5 mm</td>
<td>5 x 5 x 0.3 mm</td>
</tr>
</tbody>
</table>

**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.
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

HOPG

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:

<table>
<thead>
<tr>
<th>Part number</th>
<th>Dimensions</th>
<th>Chip Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOPG/ZYA/DS/1-1</td>
<td>10 x 10 x 1 mm</td>
<td>1 chip</td>
</tr>
<tr>
<td>HOPG/ZYA/DS/2-1</td>
<td>10 x 10 x 2 mm</td>
<td>1 chip</td>
</tr>
<tr>
<td>HOPG/ZYB/DS/1-1</td>
<td>10 x 10 x 1 mm</td>
<td>1 chip</td>
</tr>
<tr>
<td>HOPG/ZYB/DS/2-1</td>
<td>10 x 10 x 2 mm</td>
<td>1 chip</td>
</tr>
<tr>
<td>HOPG/ZYH/DS/1-1</td>
<td>10 x 10 x 1 mm</td>
<td>1 chip</td>
</tr>
<tr>
<td>HOPG/ZYH/DS/2-1</td>
<td>10 x 10 x 2 mm</td>
<td>1 chip</td>
</tr>
<tr>
<td>HOPG/ZYH/DS/1-5</td>
<td>10 x 10 x 1 mm</td>
<td>5 chips</td>
</tr>
<tr>
<td>HOPG/ZYH/DS/2-5</td>
<td>10 x 10 x 2 mm</td>
<td>5 chips</td>
</tr>
</tbody>
</table>

Density ........................................... 2.266 g/cm³

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 10⁶ [(Ω·m)⁻¹]
- Electrical conductivity perpendicular (002) ......................... 5 x 10² [(Ω·m)⁻¹]

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

<table>
<thead>
<tr>
<th>ZYA Grades</th>
<th>ZYB Grades</th>
<th>ZYH Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosaic spread</td>
<td>0.4°± 0.1°</td>
<td>0.8°± 0.2°</td>
</tr>
</tbody>
</table>

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.

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
**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:NSC17 Contact imaging ~0.18 ~13 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: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 ~0.20 ~0.03 ~0.10 ~0.05 ~0.14 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:NSC18 (three lever) Intermittent imaging ~2.0 ~130 ~2.0 ~65 Silicon, Al or no Al Back side coating ~8

XNC12/Cr-Au BS Soft contact mode imaging ~0.08 ~0.17 ~0.32 ~0.67 Silicon Nitride, Au Back side coating ~<40

XNC12/Cr-Au (four lever) Soft contact mode imaging ~0.08 ~0.08 ~0.32 ~0.32 Cr-Au coating on both sides ~<60

**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

**Probes for mechanical property measurements in life science**

HQ:NSC14/Hand Specially coated for durability ~5.0 ~160 DLC 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

**RECOMMENDATIONS FOR SPECIFIC APPLICATIONS**

<table>
<thead>
<tr>
<th>Probe Type</th>
<th>Characteristics</th>
<th>k, N/m</th>
<th>f₀, kHz</th>
<th>Tip Material, Coating</th>
<th>R, nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>HQ:DPER/XS11</td>
<td>High resolution</td>
<td>~0.2</td>
<td>~15 Pt coating on both sides</td>
<td>~&lt;20</td>
<td></td>
</tr>
<tr>
<td>HQ:DPE/XSC11, Cantilever A</td>
<td>High sensitivity, low wear</td>
<td>~0.2</td>
<td>~15 Pt coating on both sides</td>
<td>~&lt;40</td>
<td></td>
</tr>
<tr>
<td>HQ:DPER/XSC11, Cantilever C</td>
<td>High resolution</td>
<td>~7</td>
<td>~155 Pt coating on both sides</td>
<td>~&lt;20</td>
<td></td>
</tr>
<tr>
<td>HQ:DPE/XSC11, Cantilever C</td>
<td>Dynamic/contact electrical mode, high sensitivity, low wear</td>
<td>~7</td>
<td>~155 Pt coating on both sides</td>
<td>~&lt;40</td>
<td></td>
</tr>
<tr>
<td>HQ:CSC17/Cr-Au</td>
<td>Chemical inertness, functionalization</td>
<td>~0.15</td>
<td>~&lt;40 Cr-Au coating on both sides</td>
<td>~&lt;35</td>
<td></td>
</tr>
<tr>
<td>HQ:NSC18/Pt</td>
<td>Dynamic/contact electrical mode</td>
<td>~2.8</td>
<td>~75 Pt coating on both sides</td>
<td>~&lt;30</td>
<td></td>
</tr>
<tr>
<td>HQ:NSC14/Pt</td>
<td>General stability in conductive modes</td>
<td>~7</td>
<td>~155 Pt coating on both sides</td>
<td>~&lt;30</td>
<td></td>
</tr>
<tr>
<td>HQ:NSC14/Cr-Au</td>
<td>Chemical inertness, functionalization</td>
<td>~7</td>
<td>~155 Cr-Au coating on both sides</td>
<td>~&lt;35</td>
<td></td>
</tr>
<tr>
<td>HQ:DPER/XSC11, Cantilever B</td>
<td>High resolution</td>
<td>~2.7</td>
<td>~80 Pt coating on both sides</td>
<td>~&lt;20</td>
<td></td>
</tr>
<tr>
<td>HQ:DPE/XSC11, Cantilever B</td>
<td>High sensitivity, low wear</td>
<td>~2.7</td>
<td>~80 Pt coating on both sides</td>
<td>~&lt;40</td>
<td></td>
</tr>
<tr>
<td>HQ:NSC18/Pt</td>
<td>General stability in conductive modes</td>
<td>~2.8</td>
<td>~75 Pt coating on both sides</td>
<td>~&lt;30</td>
<td></td>
</tr>
<tr>
<td>HQ:NSC18/Cr-Au</td>
<td>Chemical inertness, functionalization</td>
<td>~2.8</td>
<td>~75 Cr-Au coating on both sides</td>
<td>~&lt;35</td>
<td></td>
</tr>
<tr>
<td>HQ:NSC18/Pt</td>
<td>Magnetic coating</td>
<td>~2.8</td>
<td>~75 Co-Cr coating, Al Back side coating</td>
<td>~&lt;90</td>
<td></td>
</tr>
</tbody>
</table>

*k* — Force constant; *f*₀ — Resonance frequency

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