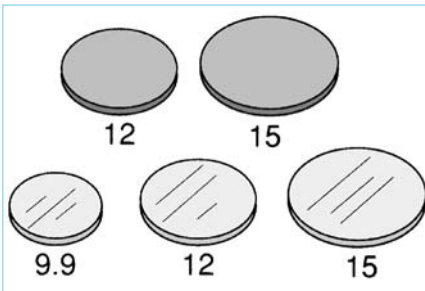


# 21 - SPM accessories

## Specimen discs



### Metal discs

High quality magnetic stainless steel (alloy 430) discs for mounting AFM specimens are available. They have smooth edges and consistently flat surfaces. The AFM discs are 22 gauge which is a thickness of 0.68 to 0.83 mm.

**F7001** SPM specimen discs, 12 mm dia. Pack of 50

**F7003** SPM specimen discs, 15 mm dia. Pack of 50

### Mica mounting discs and glass coverslips

**F7013** Mica discs, 9.9 mm dia, 0.22 - 0.27 mm thick. Pack of 10

**F7019** Mica discs, 14 mm dia, 0.1 mm thick. Pack of 10

**F7011** Round glass coverslips, 12 mm dia, 0.13 - 0.17 mm thick. Box of 100

**F7012** Round glass coverslips, 15 mm dia, 0.13 - 0.17 mm thick. Box of 100

## Dispenser for discs



This dispenser provides a practical way to store and dispense SPM discs. The plastic tubes in which the discs are packaged may be inserted into the dispenser and, with a turn of the cylinder, a disc is released ready to be picked up using a disc gripper. The dispenser can accept either 12 or 15 mm discs.

**F7009** Disc dispenser

## Disc gripper



This disc gripper has been specially designed with rubber coated tips for picking up discs from a flat surface.

**F7005** Gripper for 12 mm discs

**F7006** Gripper for 15 mm discs

## Agar storage boxes for metal AFM/SPM discs



These 75 x 120 x 32 mm storage boxes are available with magnetic strips to hold metal SPM discs. The boxes are available with two strips of 20 mm width for 15 mm diameter discs, or with three strips of 12 mm width to hold 12 mm diameter discs.

**G3047** Storage box for 15 mm dia discs

**G3048** Storage box for 12 mm dia discs

## Disc carrier and pick-up tool

These disc carriers provide practical dust-free storage for 12 and 15 mm SPM discs. Discs are placed face down into a stepped cavity, which prevents damage to the specimen. The sliding cover secures the disc in position.

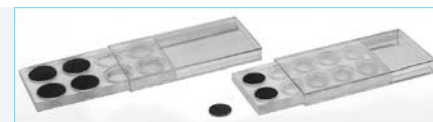
**F7007** Disc carrier for ten 12 mm discs

**F7008** Disc carrier for eight 15 mm discs

### Magnetic pick-up tool

This convenient magnetic tool is useful for picking up and manoeuvring SPM discs without damage to mounted specimens.

**F7010** Magnetic pick-up tool



## Highly ordered pyrolytic graphite (HOPG)

HOPG is widely used as a substrate for specimens to be examined in scanning probe microscopy. It is also used as a calibration specimen and cleaves almost like mica because of its layered structure. Unlike mica, HOPG is non-polar and, for samples where elemental analysis is required, it provides a carbon-only background. It consists of highly ordered planes of carbon atoms in (002) orientation and the quality of these parallel planes is defined by the mosaic spread angle.

The standard grade of HOPG has a mosaic angle of  $3.5^\circ \pm 1.5^\circ$ , while substrates with more highly ordered planes, with mosaic angles of  $0.8^\circ \pm 0.2^\circ$  and  $0.4^\circ \pm 0.1^\circ$ , are also available.

**G3389** HOPG mosaic spread  $3.5^\circ \pm 1.5^\circ$ , 10 x 10 x 2 mm

**G3389-1212** HOPG mosaic spread  $3.5^\circ \pm 1.5^\circ$ , 12 x 12 x 2 mm

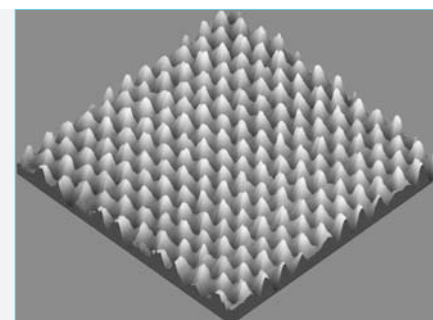
**G3389-1717** HOPG mosaic spread  $3.5^\circ \pm 1.5^\circ$ , 17 x 17 x 2 mm

**G3046-55** HOPG mosaic spread  $0.8^\circ \pm 0.2^\circ$ , 5 x 5 x 1 mm

**G3046-1010** HOPG mosaic spread  $0.8^\circ \pm 0.2^\circ$ , 10 x 10 x 1 mm

**G3045-55** HOPG mosaic spread  $0.4^\circ \pm 0.1^\circ$ , 5 x 5 x 1 mm

**G3045-1010** HOPG mosaic spread  $0.4^\circ \pm 0.1^\circ$ , 10 x 10 x 1 mm



Other sizes are available on request.

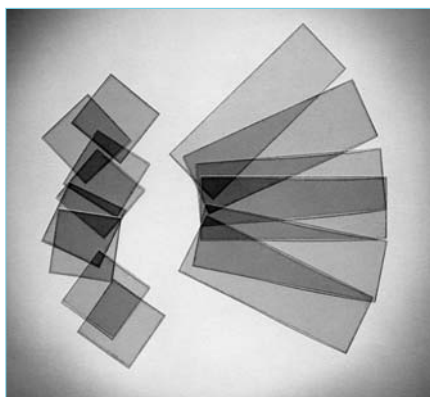
## Diamond knives for AFM

High quality diamond knives are useful for surface sections of all kinds of biological and industrial specimens for AFM investigation.

For further details of diamond knives, please refer to section 14.



## Mica



Freshly cleaved ruby muscovite mica surfaces are extremely even and flat. They are also quite transparent and free from scratches and contamination. Cleaved mica is traditionally used in electron microscopy for the production of carbon support films, cell growing and thin film coating research. Ruby muscovite mica surfaces are also suitable as substrates for high resolution atomic force microscopy studies of DNA and DNA-protein complexes.

The mica cleaving process involves insertion of a sharp edge or point into an edge or corner of the mica sheet and gently separating the natural layers of the mica. A thin double edged razor blade is extremely good for this purpose.

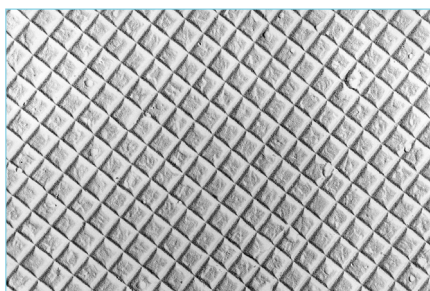
The freshly exposed cleaved surface should be used immediately to utilise the clean and even surface. The starting thickness of the mica sheets varies between 0.10 and 0.25 mm. The minimum thickness is dependant on the skill of the person doing the cleaving.

Ruby muscovite is a hard material with excellent cleaving properties. It has a minimal tendency to cracking and splits more easily into thin films along natural cleavage planes.

- G250-3** Mica 11 x 11 mm, 0.15 mm thick. Pack of 20
- G250-2** Mica 25 x 25 mm, 0.15 mm thick. Pack of 20
- G250-1** Mica 75 x 25 mm, 0.15 mm thick. Pack of 20
- G250-4** Mica 100 x 20 mm, 0.15 mm thick. Pack of 20
- G250-5** Mica 150 x 150 mm, 0.15 mm thick. Pack of 3
- G250-6** Mica 9.9 mm dia, 0.1 mm thick, ultra-clean. Pack of 10
- G250-7** Mica 20 x 20 mm, 0.25 mm thick, ultra-clean. Pack of 10

Other sizes are available on request.

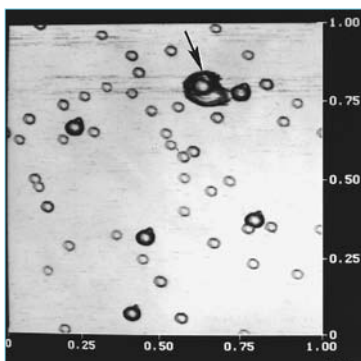
## Crossed grating replica



This crossed-line grating replica has 2160 lines/mm, and can be used for X, Y axis calibration.

- F7016** Crossed grating replica on 12 mm disc
- F7017** Crossed grating replica, unmounted

## Gold calibration kit



Gold colloids of known size provide a reliable means of characterising tip geometry and calibrating the Z-axis to piezoelectric response. The incompressible, monodisperse and spherical nature of the colloids can also be used to characterise the vertical dimension of co-adsorbed biomolecules. The standard kit has colloids of 5, 15 and 30 nm diameter, eight numbered mica-coated 15 mm discs, a disc carrier and a magnetic pick-up tool. The extended kit contains additional colloids of 10 and 20 nm diameter.

- F7020** Standard gold calibration kit
- F7018** Extended gold calibration kit

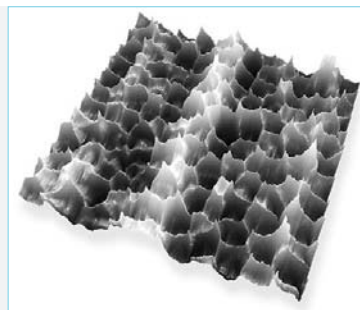
## Silicon calibration gratings

A range of ultra-sharp silicon gratings for calibration and distortion checking of scanning probe microscopes is available. Gratings with different profiles have been manufactured using microfabrication techniques.

Individual gratings can also be supplied as sets; see page 378.

### Porous aluminium tip characterisation structure

This thin film porous aluminium test structure consists of hexagonal hollow cells. The film is 500 µm thick with 40 nm pore depth, and has an active area of 3 x 3 mm. The thickness of the partitions between the pores is about 5 nm. The radius of the spikes formed at the intersections of the partitions is approximately 2 nm, which is extremely useful for characterisation of AFM tip shape. In order not to damage the spikes of the grating, scanning should be performed in tapping mode because hard cantilevers in contact mode may break off the spikes.



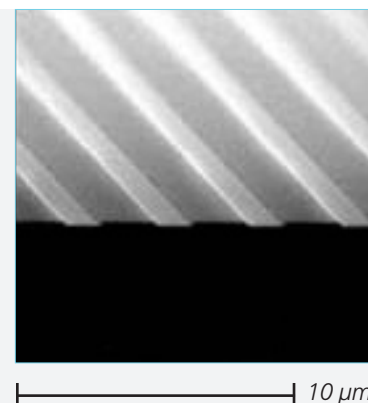
Cat. no.	Grating type	Pore depth, nm	Pitch*, nm	Accuracy, nm
<b>F7030</b>	PA01	40	100	± 10

\* Value for information only, not for vertical calibration purposes

### Grating type TGZ

The calibration gratings from the TGZ series are 1-D arrays of rectangular SiO<sub>2</sub> steps on a silicon wafer. The structure is coated with Si<sub>3</sub>N<sub>4</sub> to protect the silicon from oxidation. The step height value is calibrated over the whole active area.

Gratings are available with nominal heights ranging between 20 nm and 1.5 µm, with an active area of 3 x 3 mm on chips of 5 x 5 x 0.45 mm. The 1.5 µm grating has a pitch of 10 µm, while the others have a pitch of 3.0 µm.



Cat. no.	Grating type	Step height	Range, nm	Accuracy
<b>F7021</b>	TGZ01	20 nm	18 - 26	± 1 nm
<b>F7022</b>	TGZ02	100 nm	94 - 106	± 1.5 nm
<b>F7023</b>	TGZ03	500 nm	490 - 520	± 1 %
<b>F7031</b>	TGZ04	1 µm	900 - 1100	± 1 %
<b>F7032</b>	TGZ11	1.5 µm	1350 - 1650	± 1 %

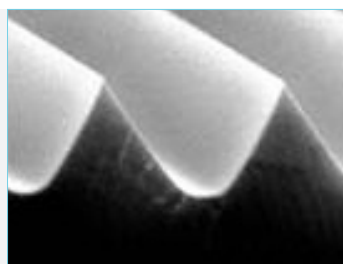
NIST traceable gratings of types TGZ01, TGZ02 and TGZ03, which have been individually controlled and certified with an AFM calibrated using NIST certified reference standards, are also available.

**F7021C** NIST traceable grating TGZ01

**F7022C** NIST traceable grating TGZ02

**F7023C** NIST traceable grating TGZ03

### Grating type TGG



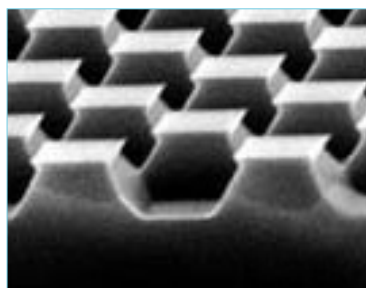
1.0 μm

The TGG01 silicon calibration grating is a 1-D array of triangular steps having precise linear and angular dimensions defined by the crystallography of silicon ((111) plane) and maintained with high accuracy. The edges of the triangular steps have curvature radii less than 10 nm. This type of calibration grating can be used for lateral calibration, non-linearity detection, assessment of angular distortion and determining the radius of curvature of cantilever tips. The silicon grating has an active area of 3 x 3 mm on chips of 5 x 5 x 0.45 mm.

Cat. no.	Grating type	Step height*, μm	Pitch, μm	Accuracy, nm
F7024	TGG01	1.8	3.0	± 5

\* Step height for information only, not for vertical calibration purposes

### Grating type TGX



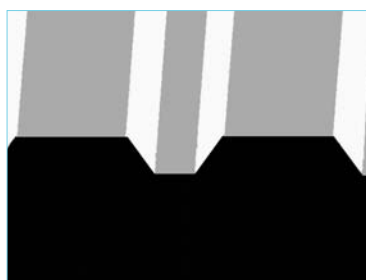
1.0 μm

The TGX series silicon calibration grating is a chequerboard-like array of square pillars with sharp undercut edges formed by the (110) crystallographic planes of silicon. The typical radius of the edges is less than 5 nm. TGX calibration gratings are intended for lateral calibration of SPM scanners, and can be used as test structures for the detection and correction of lateral non-linearity, hysteresis, and creep and cross-coupling effects. It can also be used for the determination of the tip aspect ratio. The grating has an active area of 2 x 2 mm on chips of 5 x 5 x 0.45 mm.

Cat. no.	Grating type	Step height*, μm	Pitch, μm	Accuracy
F7026	TGX01	1.8	3.0	± 8 nm
F7033	TGX11	1.8	10.0	± 0.25 %

\* Step height for information only, not for vertical calibration purposes

### Grating type TGF



10 μm

The TGF11 silicon calibration grating is a 1-D array of trapezoidal steps with a 10 μm pitch and height of approximately 1.75 μm. The lateral faces of the steps have an inclination angle with respect to the horizontal plane of precisely  $\arctan \sqrt{2}$  (54° 74'). This angle is defined by the crystallography of silicon and is maintained with high accuracy. The grating has an active area of 3 x 3 mm on chips of 5 x 5 x 0.45 mm.

This grating can be used for the assessment of scanner non-linearity in the vertical direction. Direct calibration of the lateral force can be obtained by analysing the contact response measured on the flat and sloped facet. 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.

Cat. no.	Grating type	Step height, μm*	Pitch, μm	Accuracy	Edge angle
F7027	TGF11	1.75	10.0	± 0.25 %	54° 74'

\* Step height for information only, not for vertical calibration purposes

## Calibration grating sets TGS

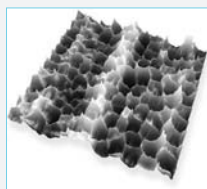
Sets of calibration gratings and test structures are available to suit different requirements.

Set **F7034** is for vertical calibration only, and the **F7034C** calibrated set is traceable to NIST.

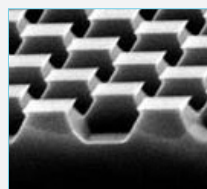
Set **F7036** is for tip characterisation and lateral calibration only.

Set **F7035** is the most comprehensive set of gratings and test structures, combining **F7034** and **F7036** to allow lateral calibration, vertical calibration and tip characterisation.

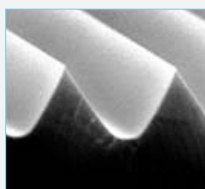
Set **F7035C** makes the vertical calibration traceable to NIST.



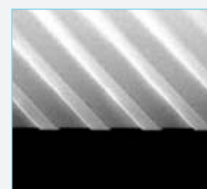
PA01, **F7030**



TGX, **F7026**



TGG, **F7024**



TGZ, **F7021/2/3**

Cat. no.	Grating type					
	PA01	TGX01	TGG01	TGZ01	TGZ02	TGZ03
<b>F7034</b>				F7021	F7022	F7023
<b>F7035</b>	F7030	F7026	F7024	F7021	F7022	F7023
<b>F7036</b>	F7030	F7026	F7024			
<b>F7034C*</b>				F7021	F7022	F7023
<b>F7035C*</b>	F7030	F7026	F7024	F7021	F7022	F7023

\* Calibration traceable to NIST

## Gold-coated substrates

PLATYPUS™ gold-coated substrates are prepared in an electron beam evaporator in a dedicated clean environment, to prevent contamination of the gold film, and using a titanium adhesion layer on plasma-cleaned surfaces. Substrates of mica, silicon, aluminosilicate glass slides and coverslips are available, with a range of thicknesses of gold film.

The gold-coated mica and aluminosilicate glass slides can be flame-annealed for atomically flat terraces and enhanced (111) orientation, that can be used in many surface science fields, including electrochemistry, biosensors and nanowetting.

**F7040** Mica 1 x 1.5", with 200 nm gold

**F7041** Mica 1 x 3", with 200 nm gold

**F7042** Silicon wafers 4" dia, with 100 nm gold. Pack of 3

**F7043** Silicon wafers 4" dia, with 100 nm gold. Pack of 12

**F7044** Aluminosilicate glass slides 1 x 3", 0.7 mm thick, with 10 nm gold. Pack of 5

**F7045** Aluminosilicate glass slides 1 x 3", 0.7 mm thick, with 50 nm gold. Pack of 5

**F7046** Aluminosilicate glass slides 1 x 3", 0.7 mm thick, with 100 nm gold. Pack of 5

**F7047** Coverslips 22 mm square, 0.13 - 0.16 mm thick, with 10 nm gold. Pack of 12

**F7048** Coverslips 22 mm square, 0.13 - 0.16 mm thick, with 50 nm gold. Pack of 12

**F7049** Coverslips 15 mm dia circular, 0.13 - 0.16 mm thick, with 10 nm gold. Pack of 24



## Arrandee™ gold-coated substrates



Arrandee gold-coated substrates use a borosilicate glass base of 0.7 mm thickness. They are suitable for easy preparation of gold terraces and by simple flame annealing 100 x 100 nm Au (111) terraces can easily be obtained.

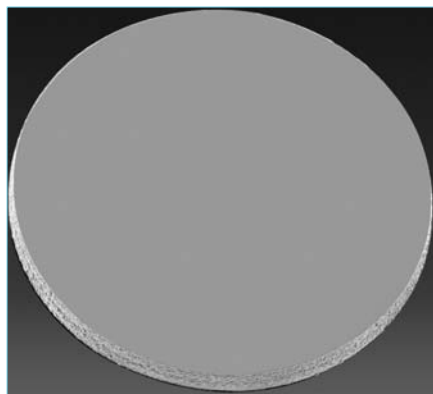
A thin layer of chromium, 1 to 4 nm, is applied to the glass surface. This layer guarantees optimum adhesion to the glass as well as to the subsequently deposited gold layer (250 nm ± 50 nm). Arrandee substrates are very useful for SPM investigations.

**F7037-25** Gold coated substrates, 11 x 11 mm. Pack of 25

**F7037** Gold coated substrates, 11 x 11 mm. Pack of 50

**F7038** Gold coated substrates, 12 x 12 mm. Pack of 50

## Silicon nitride coated discs (blanks)



These 200 µm thick 3 mm silicon support discs have a low stress, ultra-flat 50 nm layer of silicon nitride on both sides. The film is non-stoichiometric and is closer to SiN than Si<sub>3</sub>N<sub>4</sub>. The discs are perfectly round and free of debris, with a specially designed edge for ease of handling.

The discs have a mean surface roughness of 0.45 nm ± 0.2 nm. They can be used for a number of applications, including as specimen discs for AFM and also as specimen mounts for SEM and FESEM. Silicon nitride coated discs are also available with a hydrophilic surface coating which consists of a 5 nm atomic layer of hydroxylated aluminium deposited onto the membrane surface.

Supplied in packs of 10.

**G3343** Silicon nitride discs, 3 mm dia. Pack of 10

**G3343H** Silicon nitride discs with hydrophilic coating, 3 mm dia. Pack of 10

## MetroChip calibration standard



The MetroChip microscope calibration standard provides an extensive range of features for SEM, FIB, AFM, light microscopy and metrology systems calibration. It is supplied on a 20 x 20 mm chip with a thickness of 750 µm, with periodic features for enhanced calibration in the range 4 mm down to 100 nm.

The MetroChip can also be used for AFM and light microscopy and includes a number of features to check linearity, distortion and scan length.

The SEM calibration feature includes alignment marks, linear microscale, distortion measurements, paraxial calibration (image shift), resolution measurements, focus star, stigmator calibration, gratings, and concentric circles and squares. The combination of these features on one standard makes the MetroChip ideal as an all-in-one standard both for initial setup and regular calibration checks. Due to its composition, the chip exhibits minimal charging and, if cared for properly, a long sample life.

The MetroChip standard is easy to navigate and comes with dimension labels on most features. It is fully traceable to NIST certification.

**S1949** MetroChip calibration standard, certified

## Critical dimension (CD) calibration test specimens

A CD calibration test specimen is of particular interest to microscopists and test engineers using high performance SEMs for critical measurement of semiconductor line width dimensions.

The 4.8 x 4.8 mm silicon standard has a series of chequerboard patterns around its edges with a side length of 480 µm. These can be used for optimising imaging parameters and checking distortion.

The central region of the standard contains a series of five line patterns, each one clearly identified with its pitch size. Each pattern is made up of five bars and spaces of equal width. Bar pitch for the individual patterns range in size from 0.5 to 10 µm for calibrating intermediate size structures and 100 to 500 nm for smaller structures. Each standard is identified by a unique serial number.

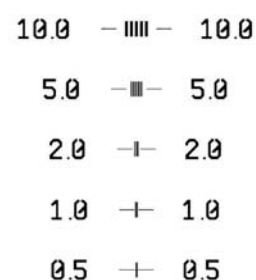
The test specimen is available as non-certified, or certified by the German Physikalisch-Technische Bundesanstalt. For certified standards, each pitch is measured and a mean value calculated from a series of five measurements. Measurements were made on a dedicated CD measuring system fitted to a FEG SEM at an accelerating voltage of 700 eV.

### 10-5-2-1-0.5 µm structure

This CD calibration test specimen comprises five line patterns, each one clearly identified by its pitch. Each pattern has five bars and spaces of equal pitch: 10, 5, 2, 1 and 0.5 µm. The central line area can be used for AFM measurements. The patterns are etched into silicon with a depth of approximately 200 µm. There is no coating on the silicon surface.

**S1995A** CD calibration specimen, 10-5-2-1-0.5 µm, non-certified

**S1997A** CD calibration specimen, 10-5-2-1-0.5 µm, certified



Each standard is identified by a unique serial number.

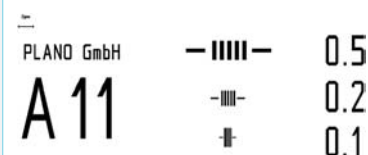
The specimen can be supplied unmounted or mounted on any of the standard range of SEM stubs. Please specify.

### 500-200-100 nm structure

This advanced CD calibration test specimen is suitable for calibrating smaller structures. It comprises three line patterns, each identified by its pitch. Each pattern has five bars and spaces of equal pitch: 500, 200 and 100 nm. The central line area can be used for AFM measurements. The patterns are etched into silicon with a depth of approximately 45 to 50 nm. There is no coating on the silicon surface.

**S1998** CD calibration specimen, 500-200-100 nm, non-certified

**S1998A** CD calibration specimen, 500-200-100 nm, certified



Each standard is identified by a unique serial number.

The specimen can be supplied unmounted or mounted on any of the standard range of SEM stubs. Please specify.

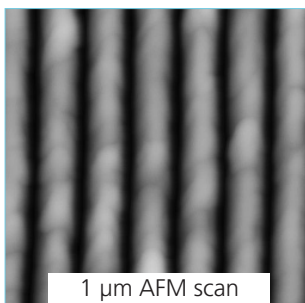


## High magnification, high resolution calibration reference and traceable standard for SEM, AFM, Auger and FIB

This precision, holographic pattern is highly accurate and stable, with moderate ridge heights that are convenient for AFM. This specimen provides excellent contrast for secondary and backscatter imaging with SEM. It provides accurate calibration for high resolution, nanometer-scale measurements. These are available with 70, 145 and 292 nm pitch.

Reference standards for AFM calibration are mounted on a 12 mm steel AFM disc, and can be used in contact, tapping and other modes with image sizes from 100 nm to 3  $\mu\text{m}$ . Standards for SEM can be supplied unmounted or mounted on an SEM stub of choice, and can be used for a wide range of accelerating voltages (1 - 20 kV) calibrating images from x25,000 to x1,000,000. The traceable, certified standards conform to the German Physikalisch-Technische Bundesanstalt, and subsequently NIST.

### High resolution AFM reference standards, certified

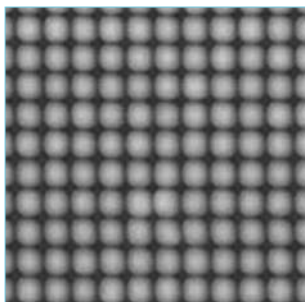


<b>F7053</b>	70 nm AFM reference standard, non-traceable, on 12 mm steel disc
<b>F7053T</b>	70 nm AFM reference standard, traceable, on 12 mm steel disc
<b>F7054</b>	145 nm AFM reference standard, non-traceable, on 12 mm steel disc
<b>F7054U</b>	145 nm AFM reference standard, non-traceable, unmounted
<b>F7055</b>	292 nm AFM reference standard, non-traceable, on 12 mm steel disc
<b>F7055T</b>	292 nm AFM reference standard, traceable, on 12 mm steel disc

1  $\mu\text{m}$  AFM scan

For details of these products, please refer to section 3, pages 63 - 65.

### 2-D holographic array standards



These 2-D holographic array standards for simultaneous calibration of X and Y axes have unique characteristics that make them especially easy to use. The pitch is less than 500 nm and the pattern covers the entire die so there is no need to hunt for the scan area. The array of bumps means that the image contrast is high even when the probe tip is slightly dull. The patterns are durable and allow for high contrast scanning in contact mode so that calibration and measurements are faster. They can be used in contact, intermittent contact (TappingMode™) and other modes with image sizes from 250 nm to 10 mm.

### AFM 144 nm reference standards, certified, non-traceable, mounted on disc

**F7050** 144 nm 2-D pattern calibration standard on 12 mm steel disc

### AFM 144 nm reference standards, certified (certificate provided), traceable, mounted on disc

**F7051** 144 nm 2-D UTC pattern calibration standard on 12 mm steel disc

### AFM 300 nm reference standards, certified, non-traceable, mounted on disc

**F7052** 300 nm 2-D resolution AFM reference standard on 12 mm steel disc

For more details, please refer to section 3, pages 61 - 62.

## Geller reference standards MRS-3, MRS-4 and MRS-5

MRS-3, MRS-4 and MRS-5 are a series of standards that are available for use with all scanning probe microscopies. These standards have fine dimensional pitch patterns. The 80 nm pitch has a nominal space width of 40 nm and a pattern height of 0.1  $\mu\text{m}$  and therefore the cantilever tip must be smaller to define the pattern.

- S1990** MRS-3 reference standard, non-certified
- S1991** MRS-3XY certified standard, NPL and NIST traceable
- S1992** MRS-3XYZ certified standard, NPL and NIST traceable in X, Y with Z calibration NIST traceable
- S1993** MRS-3 reference standard, non-certified 3 mm dia

Please add suffix S for universal holder and O for optical holder for mounted specimens.

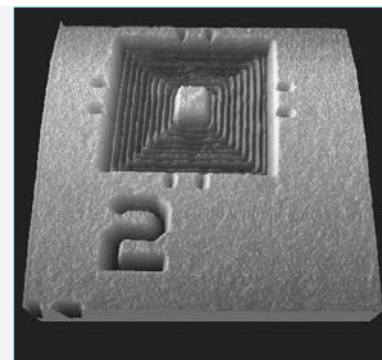
- S1810** MRS-4 reference standard, non-certified
- S1811** MRS-4XY certified standard, NPL and NIST traceable
- S1812** MRS-4XYZ certified standard, NPL and NIST traceable in X, Y with Z calibration NIST traceable
- S1813** MRS-4 reference standard, non-certified 3 mm dia

Please add suffix S for universal holder and O for optical holder for mounted specimens.

- S1814** MRS-5 reference standard, non-certified
- S1815** MRS-5XY certified standard, NPL and NIST traceable

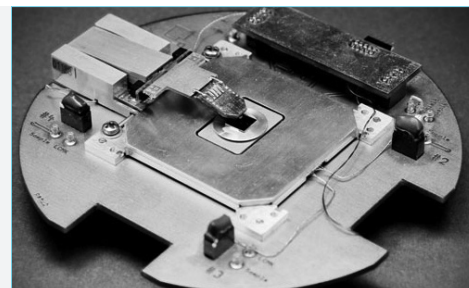
Please add suffix -S for universal holder and -O for optical holder for mounted specimens.

For more details, please refer to section 3, pages 59 - 60.



## Kleindiek SuperFlat Atomic Force Microscope

The SuperFlat Atomic Force Microscope (SF-AFM) is an addition to the range of load-lockable tools which offers a high resolution AFM solution for work inside an SEM. Based on the Shuttle platform used by the Prober Shuttle, the SF-AFM consists of a next generation nanomanipulator in combination with a super flat piezo scanner. The manipulator is used for coarse positioning of the cantilever tip. Once the area of interest has been located with the help of the SEM, and the cantilever has been brought into position, scanning is performed using the piezo scanner to which the sample is mounted. By using a compact and flexible AFM inside the SEM, information on lateral dimensions from SEM inspection can be complemented by precise topographical and force information.



For further details, please refer to section 20.