

[1] Gratings for calibration of the scanners

Room 702:

DI 10 μm pitch, squares, 200 nm deep (nominal, not intended for z calibration) 2 gratings P/N 498-000-026
278 nm (Martin Dienwiebel) reference for fine calibration. Al lines on glass. Height $\sim 30\text{nm}$.

10:th floor (Claudiu)

DI 10 μm pitch squares, 200 nm deep (nominal?)

Room 706:

MI ~ 2160 lines/mm > pitch 463nm, Waffle pattern. height $\sim 31\text{nm}$

[2] Calibration crystals

2.1 Layered crystals

MoTe_2 , a layered crystal of the family of transition metal dichalcogenides (Wilson and Yoffe, 1969), was employed to calibrate the piezo scanner of the AFM. It was prepared by chemical vapor transport (CVT), with chlorine or bromine as carrier gases in a temperature of 100°C across the quartz ampoule (Jungblut *et al.*, 1992), and was a kind gift.

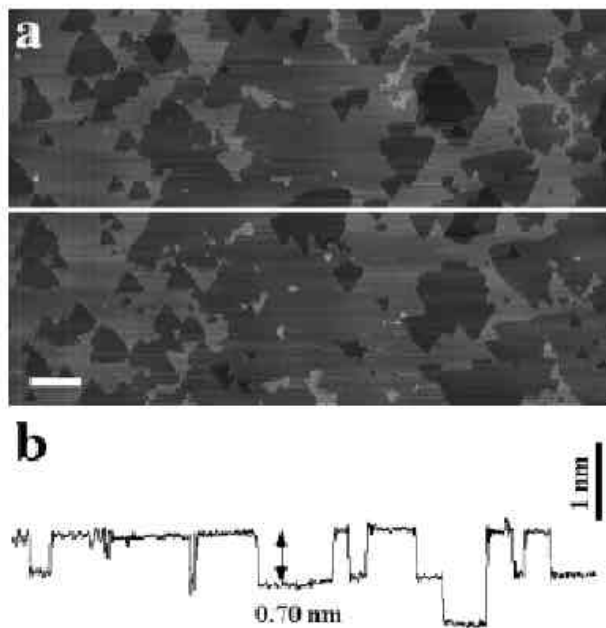


Fig. 1. Vertical calibration of the piezo scanner using defects of the layered crystal MoTe_2 . a) Height image of the etched surface, scale bar = 500 nm. The crystal layers are visible, while the triangular defects can be directly related to the trigonal prismatic elements that assemble the layers. b) Height profile along the line indicated in a). The height differences were multiples of a single crystal layer thickness including the van der Waals gap ($c = 0.698\text{ nm}$).

References:

- 1 **The height of biomolecules measured with the atomic force microscope depends on electrostatic interactions** Biophysical Journal 1997, 73:1633-1644
Daniel J. Müller and Andreas Engel

Can be found at: <http://www.mih.unibas.ch/>

[3] E-mails from SPMers

3.1 Jim Flach

Wij hebben niet zulke kristallen.

Wel hebben wel geetste oppervlakken, met verschillende hoogtestappen. Het grit met de laagste stap is 18nm. Dit is op zich laag genoeg, omdat in dat gebied de piezo zich erg lineair gedraagt, alleen de breedte van de stap is erg lang: 3micron pitch, wat zoiets betekent als 1.5micron laag en 1.5 micron hoog gedeelte. Dan gaat de hysteresis wel meespelen.

Als je hem wilt hebben: model STR3-180P, \$1750,=

Jim Flach

3.2 Massimo Antognozzi

To calibrate our piezotubes in the range of 20 nm (in the z direction) we use the Tobacco Mosaic Virus (TMV). The sample works well and it is quite simple to prepare. TMV has a cylindrical shape 300nm long and 18 nm diameter. A reference for the preparation is:

Zenhausen, F., et al., Scanning Force Microscopy and Cryoelectron Microscopy of Tobacco Mosaic-Virus as a Test Specimen. Ultramicroscopy, 1992. 42: p. 1168-1172.

Please, let me know if you need more information.

Regards,

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3.3 Dr. Alexander Bittner MSc

Cleave a sheet of mica, immerse it for several hours in a few ml of 40% HF (take *utmost* care in handling this corrosive and highly toxic liquid!), rinse with water, and you will have steps of 1.0 nm height, arranged more or less randomly; terrace widths are in the 100 nm range.

Alexander

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http://www.mpi-stuttgart.mpg.de/kern/Res_act/solid_liquid/solid_liquid.html

3.4 Dr. Holger Schönherr

we have been using a set of three vertical calibration standards (TGZ 01- 03) with step heights between 25 and 515 nm (Silicon-MDT, Moscow, Russia). I think this company is now called micromasch (check out <http://www.siliconmdt.com/>).

The linear regression analysis you can do with data obtained on this set yields accurate results for heights down to the nm range. For nm scale you could think about Au(111) - we compared results and came up with very good agreement.

More important may be that you calibrate with a sample of correct height: see Snetivy, D.; Vancso, G. J. Langmuir 1993, 9, 2253-2254.

Hope this helps.

Holger

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<http://mtp.ct.utwente.nl/projectdescriptions/holger/index.htm>

[4] Calibration grids

4.1 TGZ Series of Gratings for Vertical Calibration

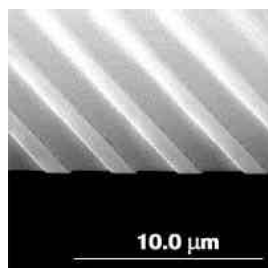
http://www.spmtips.com/products/grat_soft/tgz.htm

Description

Calibration gratings of the TGZ series are 1-D arrays of rectangular SiO₂ steps on a Si wafer. The structure is coated by Si₃N₄ to prevent Si from oxidation. The step height value is calibrated over the whole active area.

Actual step height, shown in the individual specifications, may slightly differ from the nominal value. Step height accuracy is a standard deviation calculated over the whole active area. It shows deviation from the actual (not nominal) step height value.

The TGZ01, TGZ02, and TGZ03 gratings are also contained in the TGS01 and TGS02 sets. NIST traceable TGZ01, TGZ02, and TGZ03 gratings are available in TGS01C and TGS02C sets only.



Part number	Step height	Pitch*
TGZ01	20 ± 1.0 nm	3.0 μm
TGZ02	100 ± 1.5 nm	3.0 μm
TGZ03	500 ± 1%	3.0 μm
TGZ04	1000 ± 1%	3.0 μm
TGZ11	1500 ± 1%	10.0 μm

Active area	3 x 3 mm (all models)
Chip dimensions	5 x 5 x 0.45 mm (all models)

Application Notes

TGZ calibration gratings are intended for vertical calibration of SPM scanners. Using several calibration gratings with different nominal step height you can compensate for vertical non-linearity.

For accurate quantification of images of calibration grating of TGZ series, we recommend you to use Scanning Probe Image Processor (SPIP) designed by Image Metrology, the Calibration option.

NIST certification and calibration

There are TGZ01, TGZ02, and TGZ03 NIST traceable gratings, which are individually controlled and certified. The height of the steps is measured with an AFM calibrated using the Step Height Reference Standards. The reference standards are three samples of ULTRASHARP gratings that were measured and certified by NIST (NIST Reports 821/261141-99 and 821/265166-01). Measurement and calibration techniques are based on NIST modified ISO step height determination algorithm (ISO5436).