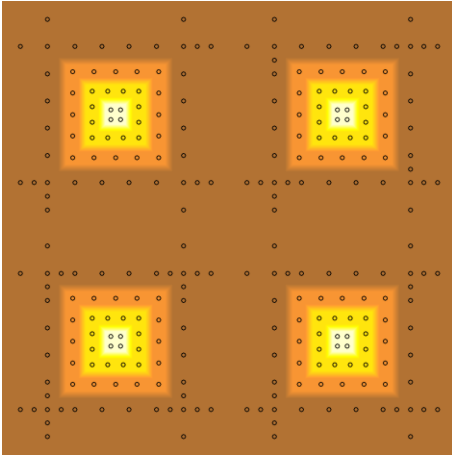


3D calibration standards SPM



M2C 3D SPM calibration technology provides **improved measurement accuracy** and has the following advantages:

- **One Step:** Simultaneous lateral and vertical calibration is provided in one measurement step
- **One Model:** For the first time, determination of coupling between vertical and lateral axes is possible
- **One Click:** Calibration is extremely efficient and accurate due to advanced image processing methods
- **One Reference:** Universal application with one reference structure is possible (SPM, CLSM, SEM or other)

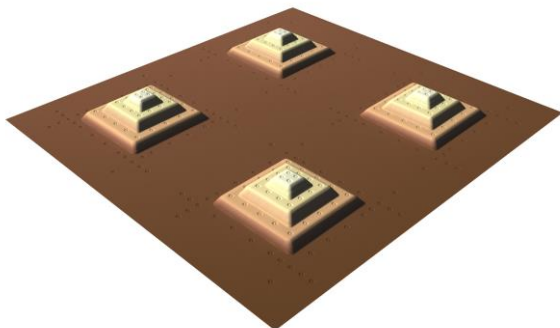
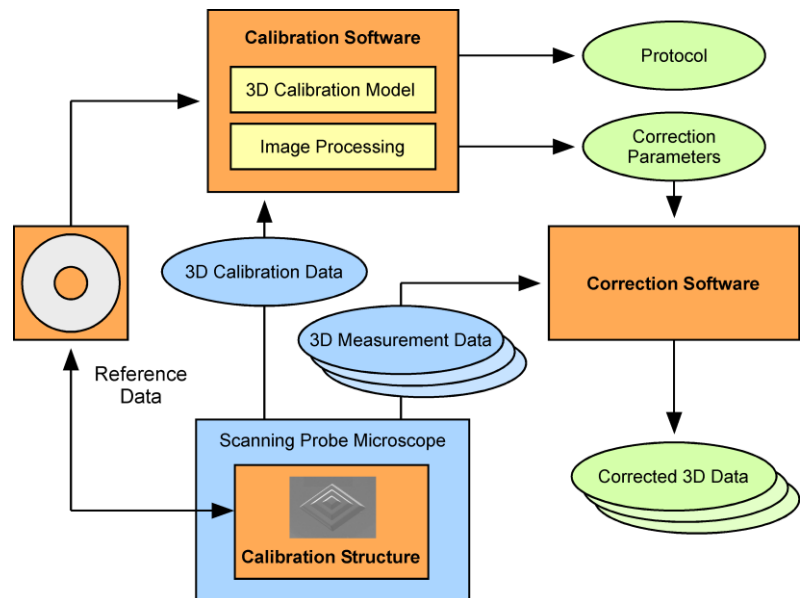
M2C 3D SPM calibration structures are available for several scan areas, from 20 μm x 20 μm and up to 80 μm x 80 μm . The complete structure with four pyramidal elements (full area) or a single pyramidal element (quarter area) may be used for the automated calibration process.

How does it work?

M2C customers obtain a 3D calibration structure, the M2C 3D calibration software *microCal*, and a reference data set that represents the 3D coordinates of the reference marks on the structure's surface.

The calibration structure is then measured with the customer's microscope. The measured 3D data are imported into the M2C software package, automatically analysed and compared to the reference data.

The resulting geometric parameters (scale, shear) characterize the accuracy of the used device and may be used for the correction of all further measurements performed by the customer's microscope.



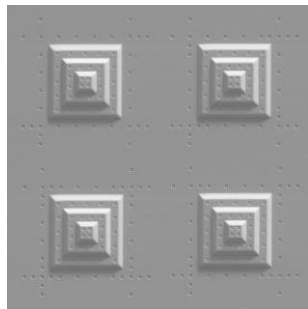
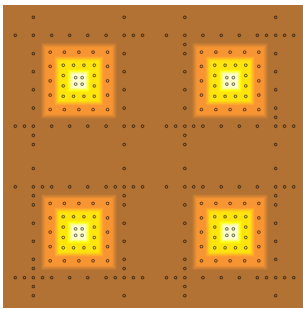
SPM calibration structure MMC-80. 3D view of SPM measurement data set with emphasized height values.

M2C calibration technology for Scanning Probe Microscopy is compliant with VDI/VDE Guideline 2656 "Determination of geometrical quantities by using of Scanning Probe Microscopes – Calibration of measurement systems"

M2C also provides general services in measurement technology as well as in specific software development in the field of spatial data analysis, image processing and co-ordinate measurements. We are experts in FIB prototyping and in programming automated FIB patterning processes. Besides SPM calibration samples, M2C also offer other structure variants (i.e. with spheres for SEM calibration) and customized layouts upon request.

3D calibration standards SPM

Name	Structure		Pyramidal Elements				Reference Marks		
	Scanning Area	Max. Height	Number	Size	Steps	Step Height	Diameter	Line Width	Depth
	[μm^2]	[μm]		[μm]		[μm]	[nm]	[nm]	[nm]
MMC-20	20 x 20	0,6	4	5	2	0,3	400	80	75
MMC-40	40 x 40	1,8	4	10	3	0,6	600	100	120
MMC-80	80 x 80	3,0	4	20	3	1,0	800	150	150



MMC-80, structure layout

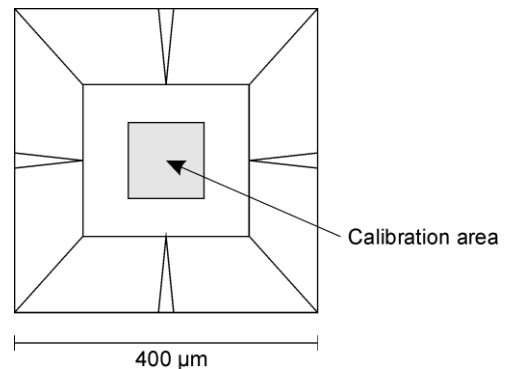
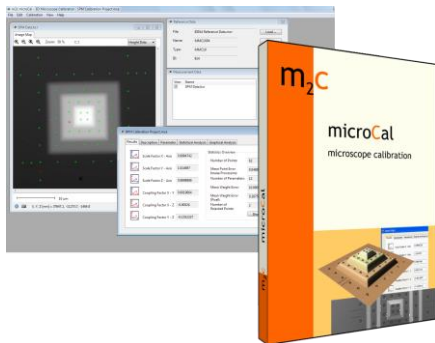
MMC-80, SEM image

Please note: This table contains only nominal values. The real dimensions differ from these nominal values. As a special feature, M2C calibration structures have reference marks with calibrated co-ordinates. For calibration, the reference marks have to be used. To provide a traceable calibration, reference measurements are performed by the German metrological institute PTB upon request.

Each calibration structure can be used for the calibration of at least two scan areas (whole structure and single pyramid). For different tasks, m2c also provides other calibration structures and customized layouts upon request.

M2C calibration software *microCal* is recommended for a successful 3D calibration. It is developed especially for use with M2C 3D calibration structures.

microCal allows an easy and automated calibration of your microscope. It determines 6 linear calibration parameters: three scale factors for the co-ordinate axes, and three coupling factors for the coupling between all co-ordinate axes (orthogonal deviation). In addition, it provides tools for 3D data manipulation, especially for 3D data correction based on the calibration results.



MMC calibration structures are fabricated in a combination of FIB (Focused Ion Beam) deposition and FIB milling. They consist of a composite of carbon and platinum, structured on a 6 mm x 6 mm Silicon chip. This silicon chip is conductive and fixed on a 12 mm x 12 mm aluminium plate. For easier handling, a finder grid points to the calibration area.

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