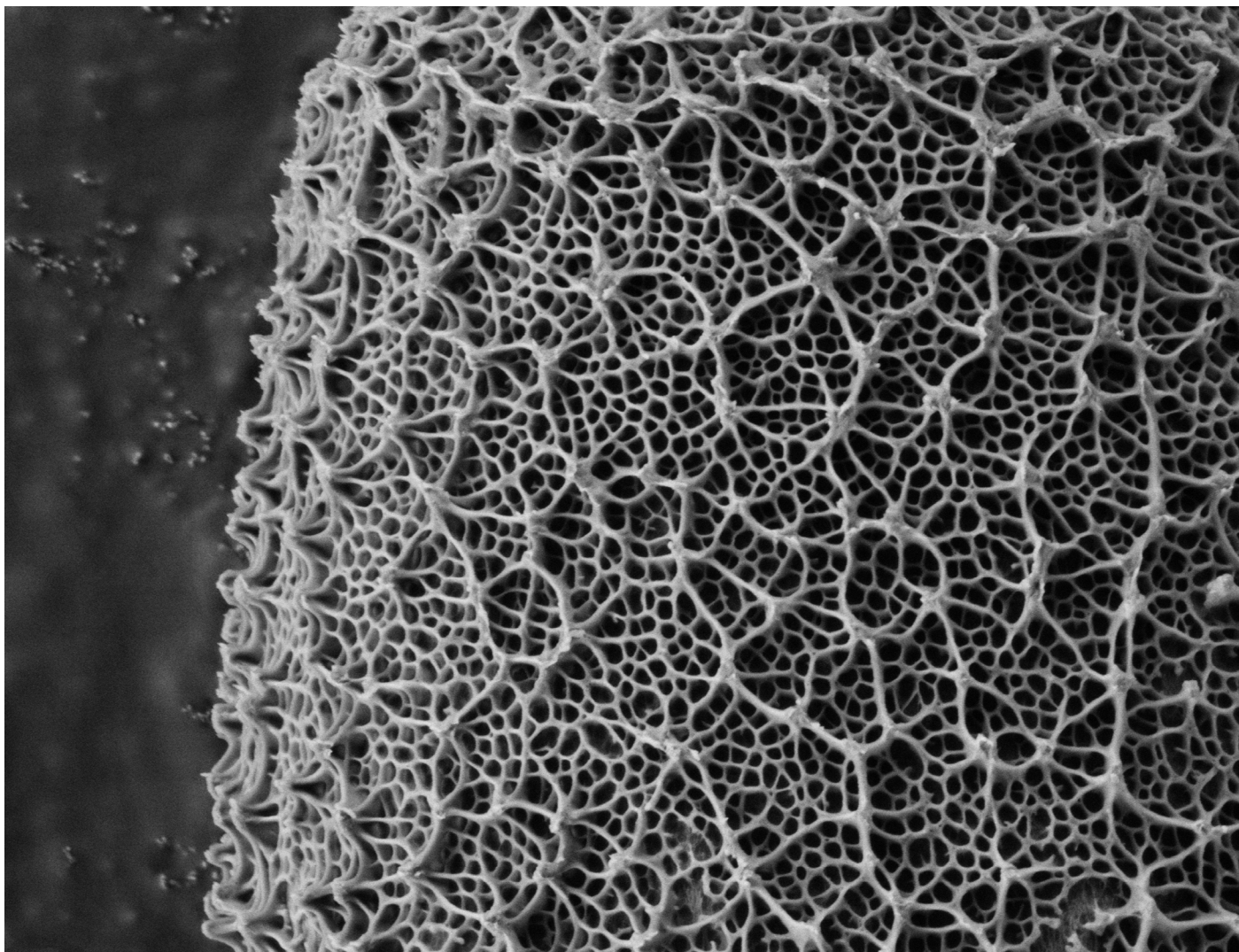




Software Manual

SmartSEM[®] V05.07

Operating software for
Scanning Electron Microscopes



We make it visible.

Software Manual

SmartSEM[®] V05.07

Operating software for Scanning Electron
Microscopes



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Software Manual SmartSEM® V05.07

Operating software for Scanning Electron Microscopes

Original instructions

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1. Introduction

1.1. For your safety

Read the instructions in this software manual carefully. Keep the software manual nearby the scanning electron microscope (SEM) or field emission scanning electron microscope (FESEM) and hand it over to future owners of the instrument.

1.1.1. Intended use

The SmartSEM[®] software is intended for the operation of ZEISS SEMs/FESEMs such as SUPRA[™], ULTRA, and Cross Beam[®] series.

The SmartSEM[®] software has to be run exclusively on a personal computer delivered by ZEISS. Any other applications are not allowed.

1.2. About this manual

This software manual is designed for operators who have been trained to operate the SEM/FESEM by an authorised expert. It is assumed that the operator is familiar with Windows[®] based programs.

Operators of the SEM/FESEM must not deviate from the instructions provided in this manual.

This software manual contains the following chapters:

- **1. Introduction**
Includes general safety information and typographical conventions.
- **2. Description**
Describes system requirements, software elements, and operating principles of SmartSEM[®].
- **3. First steps**
Summarises briefly how to open the SmartSEM[®] user interface, to navigate and to obtain the first image.
- **4. Operation**
Provides details on software-based operation sequences including user management.
- **5. Troubleshooting**
Helps to quickly solve possible problems during operation.
- **6. Summary of software functions**
Lists menus and submenus, assignments of toolbar and annotation bar icons as well as short-cuts.
- **7. Glossary**
Alphabetical list and explanation of important technical terms used in this manual.
- **8. Abbreviations**
- **9. Index**

1.2.1. Safety instructions in this manual

The safety instructions in this manual follow a system of risk levels, that are defined as follows:



CAUTION

This safety symbol and signal word indicates a potentially hazardous situation. Disregarding this warning MAY result in minor or moderate injury.

CAUTION

This signal word used without a safety symbol indicates a potentially hazardous situation. Disregarding this warning MAY result in property damage.

Moreover, you will find the following type of hints:



IMPORTANT

This symbol and signal word draws your attention to important and useful information.

1.2.2. Typographical conventions

For the description of software, the following typographical conventions are used:

Typography	Meaning
Push <ENTER>.	Push the ENTER key on the keyboard.
Type <key1, key2>	Type key 1 first, then type key 2 on the keyboard.
Type <Ctrl + Alt + Del>.	Simultaneously type CTRL key, ALT key and DEL key on the keyboard.
Click the High voltage icon. Select Aperture size from the drop down list.	Icons, buttons, and menus are printed in bold.
Select Aperture size <i>30 μm</i> from the drop-down list. Set FIB Fil V Target to <i>zero</i> .	Values to be selected are printed in italics.

Text	Meaning
Click...	Press the left mouse button.
Right-click...	Press the right mouse button.
Double-click....	Press the left mouse button twice.

1.2.3. Definition of terms

The following terms are used in this software manual:

SEM	Scanning electron microscope, referred to as SEM.
FESEM	Field emission scanning electron microscope, referred to as FESEM.
ZEISS service representative	Specially trained service expert, either ZEISS staff or authorised service partner of ZEISS.
Operator	A trained person, who is assigned to operate the SEM/FESEM.
SmartSEM® Administrator	Program for user management

2. Description

2.1. System requirements

2.1.1. Operating system

SmartSEM® V05.07 requires the operating system Windows® 7 Ultimate 32 bit.



IMPORTANT

The screenshots shown in this software manual are partly taken from SmartSEM® V05.05 that runs on Windows® XP.

These screenshots are only used for parts of the user interface which can still be operated in exactly the same way as in SmartSEM® V05.05.

CAUTION

The integrated personal computer delivered with the SEM/FESEM should mainly be used to control the SEM/FESEM and to archive images, because the installation of additional software programs might cause problems.

Before installing additional software programs contact your local ZEISS service representative for his/her recommendation.

2.1.2. Dongles

To operate the software, a SmartSEM® dongle has to be installed.

For using the optional drift correction licence (DRIFT-CORR), an additional dongle (called MIL dongle) is required.



IMPORTANT

If a dongle is lost, contact your local ZEISS service representative to order one.

Microscope type and serial number have to be mentioned in the order.

2.2. Installation

The SmartSEM® software is pre-installed on your SEM/FESEM by the factory.

For possible updates or upgrades or licence installations contact your local ZEISS service representative for more information.

2. Description

SmartSEM[®] program suite

2.3. SmartSEM[®] program suite

The fundamental part of the SmartSEM[®] program suite is the EM server, which implements the internal communication between control software and microscope hardware.

Besides EM Server, the SmartSEM[®] program suite includes several programs and utilities.

	Program/Utility	Function	Remarks
Select Start/Programs/...			
...SmartSEM	ChamberScope	Allows to show the chamberscope image and the detector image at the same time	Option, requires particular hardware.
	FTP Image Archiving	For transferring data via FTP	Requires REMARCH licence
	OptiProbe Calibration	Calibration of OptiProbe after cathode replacement or realigning of the electron optical column	
	ReadMe	Important information on the current installed version	
	RemCon32	Serial interface for remote operation via RS232 (e.g. for EDX)	Requires REMCON licence.
	SampleHolderGallery	Module to inspect the dimensions of all possible sample holders as well as setting the dimensions of the custom sample holders	
	SEM Drift Correction	Compensates for the drift of the specimen by using a reference image and by controlling the beam shift	Requires DRIFT-CORR licence.
	Slideshow speed setting	Adjustment of slideshow speed	
	SmartSEM Administrator	User management and instrument configuration	
	SmartSEM User Interface	Graphical user interface of SmartSEM [®]	
	SmartSEM User Accounting	Allows recording of important information during individual working sessions	
	Release Notes	Overview on all SmartSEM [®] versions including new developments and specific details	

Table 2.1: Overview of the SmartSEM[®] program suite

	Program/Utility	Function	Remarks
...SmartSEM Service	Calibration Wizard	Service activities	For ZEISS service representatives only
	Gun Monitor	Utility for monitoring important parameters of the SEM/FESEM.	Refer to section 4.3.8.
	GUN Service	Service activities	For ZEISS service representatives only
	Piezo Configurator	Service activities	For ZEISS service representatives only
	Service Centre	Provides an overview of the state of the SEM/FESEM	
	Smart Stage Mapping	Service activities	For ZEISS service representatives only
	Stage Administrator	Service activities	For ZEISS service representatives only
	Upgrade Scangen Firmware	Service activities	For ZEISS service representatives only
	Upgrade Server Database	Service activities	For ZEISS service representatives only
	SmartBackup Tool	Utility for backing up configuration and calibration data.	Refer to section 4.12.
	Merlin Alignment Wizard	Service activities	For ZEISS service representatives only
	Merlin Database Wizard	Service activities	For ZEISS service representatives only

	Program/Utility	Function	Remarks
Select Start/Programs/...			
...SmartStitch (if installed)	Online Help	Instructions how to use the applica- tion.	Requires the licence Smart- Stitch.
	SmartStitch Image Stitch- ing Application	Opens the SmartStitch user interface.	
	Uninstall SmartStitch	Removes the application from the PC.	
	User Documentation	Instructions how to use the applica- tion.	

2. Description
SmartSEM[®] program suite

	Program/Utility	Function	Remarks
Select Start/Programs/...			
...Smart3D (if installed)	Smart3D	Opens the Smart3D user interface.	Requires particular soft- and hardware.
	Smart3D Help	Instructions how to use the application.	
	Uninstall Smart3D	Removes the application from the PC.	

2.4. Available licences

Software licences are used to enable specific functionality in the SmartSEM® software. Some licences are provided as standard with a specific model of SEM/FESEM, others are purchased as options. When the SEM/FESEM is delivered, the standard and the additionally purchased licences are already installed.

Licence	Sales code	Part no.	Explanation
-	IA	-	Allows image analysis operations
-	QUAD	-	Enables quad mode on MERLIN®.
-	HIGH_KV	-	License introduced for SUPRA 25 to allow 30 kV operation
16 Bit TIFF	TIFF16	348224-6052	Enables to save TIFF images with a grey value depth / grey level depth of 16 bit.
3DBSD	3DBSD	351434-6116	Licence for 3DSM
Adjustable Reduced Raster	REDUCED	350076-0372	Allows using a scan window with variable size and position, especially recommended for the adjustment of parameters such as focus or stigmator.
Advanced Measurement	MEASA	348224-6011	Further measuring possibilities such as measuring of rectangles, inserting horizontal/vertical measuring lines.
Analytical I/F Particle Scan Application	PARTICLE	348224-6032	Specific software for automatic particle analysis. Requires particular hardware.
API (Application Programming Interface)	STDAPI	348224-6036	Allows SmartSEM® to be controlled via external programs. For example 3D EDS software uses this functionality
AUTO_CAL	AUTO_CAL	348224-6085	AUTO_CAL
Automated Image Acquisition	AUTO_IMG_ACQ	351434-6206-000	Enables the Automated Imaging dialog that allows automated imaging.
AVI Capture	AVI	348224-6056	Enables capture of image sequences and storage in an AVI file.
Cell Counting Software	CELL-COUNTING	348224-6078	Allows counting of cell arrays. Requires particular hardware.
Centre Feature/Stage Map	CENTRE	348224-6005	Enables the point centring (Centre Point) and feature centring (Centre Feature) functions. Enables the function "stage overview map" (Stage Map).
Colour Mode	COLOUR-MODE	348224-6074	Enables functionality that converts the signal from different signal sources in real time and displays it live in false colours without losing important information.
Compucentric Stage Software	COMPU	348224-6030	Compucentric software enabling tilt/rotation-eucentric control and horizontal alignment of a non-eucentric stage.

Table 2.2: Available software licences

2. Description

Available licences

Licence	Sales code	Part no.	Explanation
Customer Calibration Privilege	CUSTOMER_C ALIB_PRIV	351434-6133	Allows the user to change service calibration parameters.
Cut & Paste	CLIP	350076-0370	Enables the user to copy and insert SEM images to and from the buffer store.
Defect Review	DEFECT- REVIEW	351434-6024	Defect Review is used to find defects on a wafer or a mask based on the results from KLA Tencor results file. The defect review dialog allows the user to open a wafer defect file (.rff/.001) and view the defect list (with associated images) and file header details. Requires: Licence STAGEREG 348224-6029 Useful: Licence CENTRE 348224-6005
Depth Mode	DEPTH_MODE	348224-6084	Enables higher depth of field at lower resolution. Different levels of relief-like specimens with height variations can be in focus at the same time.
Drift Corrected Frame Averaging / Integration	DRIFT_ CORRECTED_ AVG	351434-6205-000	Enables drift compensated frame integration and averaging. Refer to section 4.4.6. for a detailed description of these noise reduction methods.
Drift Correction	DRIFT- CORR	348224-6058	Image analysis software to compensate for image drift by beam shift control. Requires additional hardware.
Dual Channel	DUAL- CHANNEL	348224-6062	Enables the display of two different detector signals in different SmartSEM® windows.
Dual Image	DUAL IMAGE	348224-6047	Dual image - Win 2k uniplinth only.
Dual Magnification	DUALMAG	348224-6003	Enables a user defined area on the left hand half of a split screen display to be zoomed from 1x to 10x. Images from different detectors can be displayed at the different magnifications.
Dynamic Focus	DYNFOCUS	350076-0364	Enables a dynamic adaptation of the focus to tilted specimen surfaces during beam passage.
Extended Voltage Range	EXVOLTS	348224-6042	Acceleration voltage range maximum is set to 40 kV (without this licence only max. 20 kV can be set).
Field Mode	FIELD_MODE	350700-0743	Ability to select field mode (wide field of view) on EVO systems
Fisheye	FISHEYE	348224-6080	Enables fisheye image of sample holder and interior of the specimen chamber.
FTP Remote Archiving	REMARCH	348224-6038	Enables to send files to a FTP server or network printer.
Graticule	GRATICULE	350076-0379	Allows display of a grid on the screen with a line distance between 50 and 512.
High Current Mode	HIGH- CURRENT	348224-6048	Special control of the electron optics to increase the specimen current. Not available for SUPRA™ 25.

Table 2.2: Available software licences

Licence	Sales code	Part no.	Explanation
Image Maths	IMMATH	348224-6013	Allows mathematic manipulation of the content of the image memory, e.g. by using Kernel functions, by adding or subtracting images or by detecting grey levels.
Image stitching licence	IMAGESTITCH	351434-6113	SmartStitch, standalone application for producing tiled images or montages from a set of individual over-palling images captured via SmartSEM®.
Input Gamma	GAMMALUT	348224-6009	Release of the Input LUT function to individually adjust the characteristic input line of a detector.
Input Signal Invert	INVERT	350076-0367	Enables to invert of the signal using Input-LUT.
Knights Camelot Integration	KNIGHTS CAMELOT	351434-6043	Knights Camelot software is a CAD navigation tool for locating specific features on a semiconductor die. It works by registering the sample with the design of the die to allow the CAD image and SEM images to be synchronised to the same field of view. It is also possible to overlay the image with parts of the design.
Large Beamshift	LARGE-BEAM-SHIFT	348224-6072	Allows working with an expanded beam shift (+/- 100 µm in X and Y). Requires particular hardware.
Low Voltage Working	LOWVOLTS	348224- 6041	Acceleration voltage range minimum is set to 0.1 kV (without this licence only 0.5 kV can be set).
OptiProbe	OPTIPROBE	348224-6079	Allows automatic setting of the probe current. Requires particular hardware.
Piezo Integration	PIEZO-INTEGRATION	348224-6075	Allows the integration of a Piezo stage.
Pivot Point Calibration	PIVOT_POINT_CAL	354734-6108	Allows user to use software that does a very precise mag calibration for forensic work.
Plasma Cleaning	PLASMA	351434-6177	Enables software control of the Plasma Cleaner.
Remote SEM	REMOTEMEM	348224-6057	Remote operation of the microscope is possible using the Windows XP Remote Desktop Connection feature.
RS232 Remote Control	REMCON	348224-6014	Allows remote operation and interrogation of the SEM/ FESEM by serial communication using RS 232.
Sample Type Selection	SAMPLE_TYPE_SELECT	351434-6215-000	Enables the Sample Type Selection menu. This functionality allows you to obtain an image from any specimen quickly, i.e. a reference image, without putting any effort in selecting the operating parameters (vacuum mode, accelerating voltage probe current and detector). The quality of the initial image can subsequently be improved, if necessary, by modifying the imaging parameters.
Scan Rate Expansion	SCANEXP	350076-0358	Makes fifteen different scan speeds available (without this licence only three are available).
Scan Rotation	SCANROT	350076-0359	Allows electronic rotation of the image by changing the scan direction.

Table 2.2: Available software licences

2. Description

Available licences

Licence	Sales code	Part no.	Explanation
Signal Mixing	SIGMIX	350076-0350	Allows continued mixing of two detector signals in the range between 0 and 100%.
SmartBrowse	SMART-BROWSE	351434-6144	The additional software SmartBrowse allows the user to sort images by various parameters, such as stage position or detector used.
Smart Stage Mapping	SMART-STAGE-MAPPING	348224-6081	Calibration routine that optimises the stage accuracy.
SmartImage Enhancement	SMARTIMAGE	348224-6077	Enables the SmartImage image processing dialog (noise reduction and contrast enhancement).
SmartSEM Report Generator	REPORT_GENERATOR	351434-6092	Enables an Office 2007 add in ribbon that imports CZTIFF images and can read the tags so users can create reports. The CZTIFF images can be created by previous software versions.
Split	SPLIT	350076-0360	Split screen
Spot Mode	SPOT	350076-0383	Spot positioning of the electron beam on a given spot of the specimen.
Stage Coordinate store and recall	STAGECO	348224-6006	Allows saving stage coordinates together with the magnification and the working distances. The stage can automatically be driven to these positions.
Stage Fine Step	FINESTEP	348224-6050	Allows more precise movement of the stage.
Stage Navigator	NAVIGATOR	351434-6109	Allows installation of the StageNavigator.
Stage Registration	STAGEREG	348224-6029	Defines user specific coordinate systems for the specimen stage.
Stage Registration	REGISTER	-	Stage registration (allowing users to define specimen coordinate systems for navigation).
Stage Scan	STAGESCAN	348224-6007	Allows analysis of a sample range in the form of a series of exactly defined regularly dispersed image fields.
Stage Survey Mode	SURVEY	348224-6040	Magnifications and working distances for two different working modes can be started automatically.
Static Stereo	STATIC-STEREO	348224-6076	-
Tilt Compensation	TILTCOMP	350076-0362	Allows correction of perspective foreshortening occurring when scanning tilted specimens.
User Accounting	ACCOUNT	348224-6031	Automatic registration of special parameters during a working session to enable the instrument administrator to trace who worked on the SEM/FESEM. For each user, the number of saved TIFF images, output photos and prints is saved.

Table 2.2: Available software licences

Licence	Sales code	Part no.	Explanation
User Align	USERALIGN	351434-6022	The user align function keeps track of which alignment values each user has utilised for different operating conditions. When these conditions are next used, the previous alignment values will be reloaded. The operation of user align requires no extra involvement of the user, once the function has been enabled on the SEM conditions page of the user preferences dialog.

Table 2.2: Available software licences

2.5. Principle of operation

The SEM/FESEM is operated by the SmartSEM[®] software: All commands, settings and functions necessary for the handling of the SEM/FESEM are controlled by the SmartSEM[®] software using keyboard and/or mouse.

The motorised stage can be operated by the dual joystick or by the software.

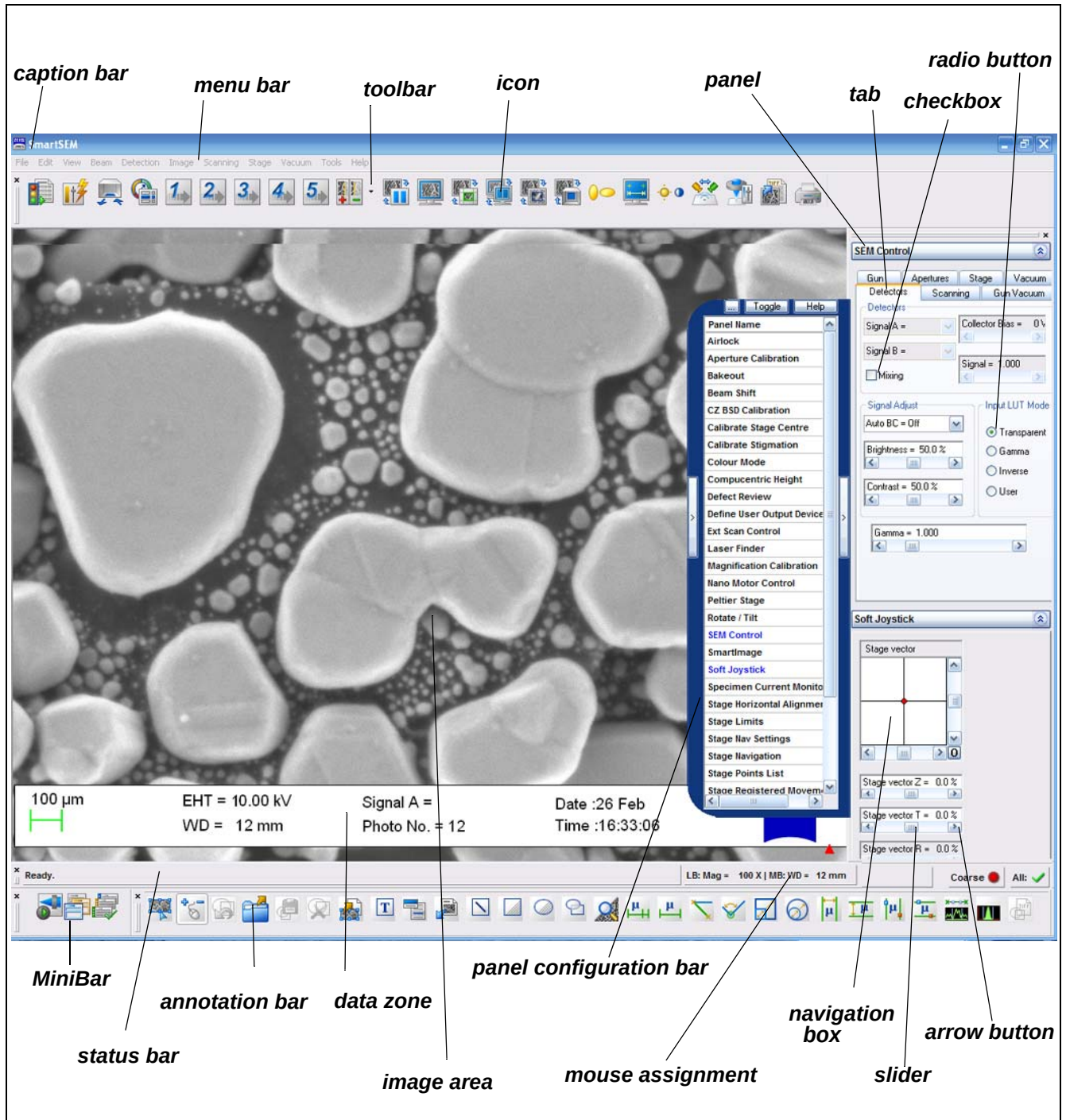
In most cases, the SmartSEM[®] user interface offers more than one possibility to run a function. For instance, to switch on the EHT you can use

- the menu bar or
- the status bar or
- the MiniBar or
- the **Gun** tab in the **SEM Controls** panel.

This allows the user to operate the SmartSEM[®] software according to his/her individual preferences.

2.6. SmartSEM® user interface

The SmartSEM® software is operated via a graphical user interface that can be used intuitively.



2. Description

SmartSEM[®] user interface

Menu bar	When left-clicking on a menu, the pull-down menu shows the different submenus.
User toolbar	Most icons in the toolbar are assigned twice. The different functions and parameters can be activated by pressing the left or the middle mouse button. When moving the cursor across the icon, tool tips show the different assignments.
MiniBar	The MiniBar provides quick access to recently used dialogs and to the recipe management.
Status bar	The status bar shows the active mouse assignment: • Left: left mouse button • Mid: middle mouse button Moreover, it shows the Coarse/Fine toggle button and allows access to a pop-up menu for quick control of important SEM parameters.
Annotation bar	The annotation bar allows putting additional information on the SEM image. Text, SEM parameter data, and even bitmaps (like logos etc.) can easily be added to the image. Moreover, it provides several measurement functions.
Data zone	The data zone contains important information on the recording parameters of the current image. Each user can design the data zone as desired and store it together with the image.
Panel Configuration Bar	The panel configuration bar allows accessing to several functions which are listed alphabetically.

Moreover, the following symbols may be displayed in the user interface:

Anchor symbol The anchor symbol is displayed when using functions that divide the image area into different zones, e.g. the functions Split, Windowing, or Dual Magnification.

Image modifications are applied only to the zone marked with the green anchor symbol.



The red *and* green anchor symbol indicates that image modifications are applied to both zones simultaneously.



Red dot	A red dot displayed in the lower right corner of the image area indicates that the image has been frozen.	
Blue dot	A blue dot displayed in the lower right corner of the image area indicates that the image has been saved.	
Red triangle	A red triangle displayed in the lower right corner of the image area indicates that the image has been saved by using the Image Capture mode.	

2.7. User access levels

SmartSEM[®] distinguishes three user access levels. The user access level defines which parameters are displayed for selection purposes (e.g. in the status window selection, annotation parameter selection).

- **Novice**
Displays only those items assigned as novice category. These include most frequently used parameters.
- **Expert**
Displays items assigned as novice and expert category. These include parameters useful for advanced operators.
- **Service/Full**
Displays all items, also including infrequently uses items and calibrations.

The user profile is the collection of privileges and settings associated with the username.

2. Description

User access levels

3. First steps

At a glance

This chapter contains information about:

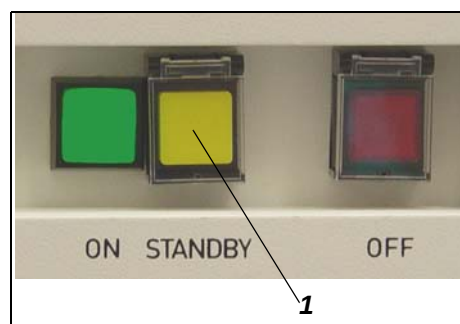
- Switching on the SEM/FESEM
- Starting the SmartSEM[®] user interface
- Finding your way in the SmartSEM[®] software
- Obtaining the first image
- Using the help functions
- Closing the SmartSEM[®] software

3.1. Switching on the SEM/FESEM

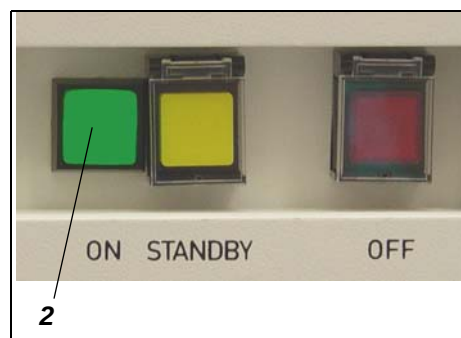
If the SEM/FESEM is in OFF mode:

- a Lift the protective lid of the yellow **STANDBY** button (**1**) that is located at the front of the plinth.
- b Press the yellow **STANDBY** button (**1**).

Now, the SEM/FESEM is in STANDBY mode.



- 1 To switch on the SEM/FESEM, press the green **ON** button (**2**) that is located at the front of the plinth.



3. First steps

Starting the SmartSEM[®] user interface

3.2. Starting the SmartSEM[®] user interface

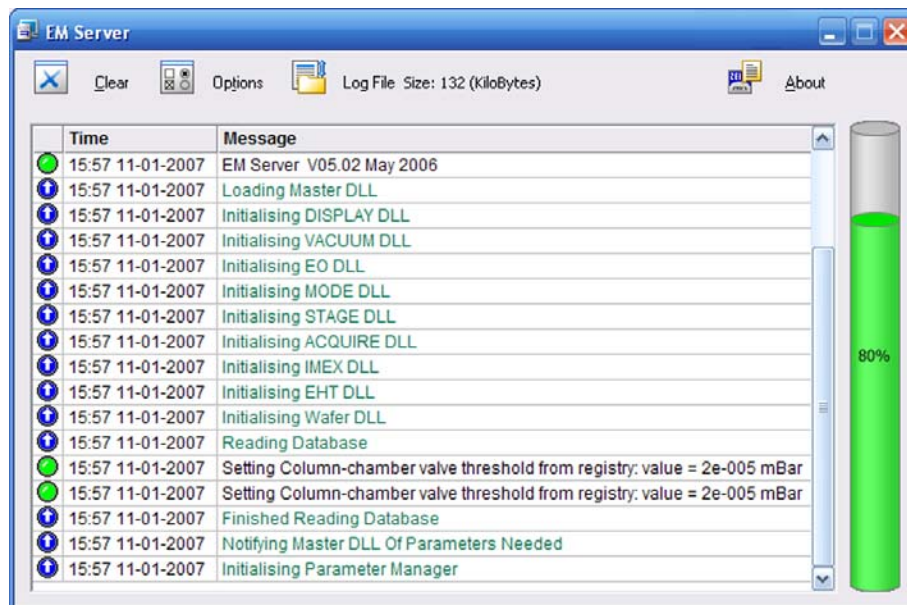
Prerequisites:

- The SEM/FESEM is switched on.
- The Windows[®] operating system has been loaded.

- 1 Double-click the SmartSEM shortcut.

Alternatively, select **Start/Programs/Smart-SEM/SmartSEM User Interface**.

The **EM Server** opens, loading various drivers. The function of the EM Server is to implement the internal communication between the SmartSEM[®] software and hardware of the SEM/FESEM.

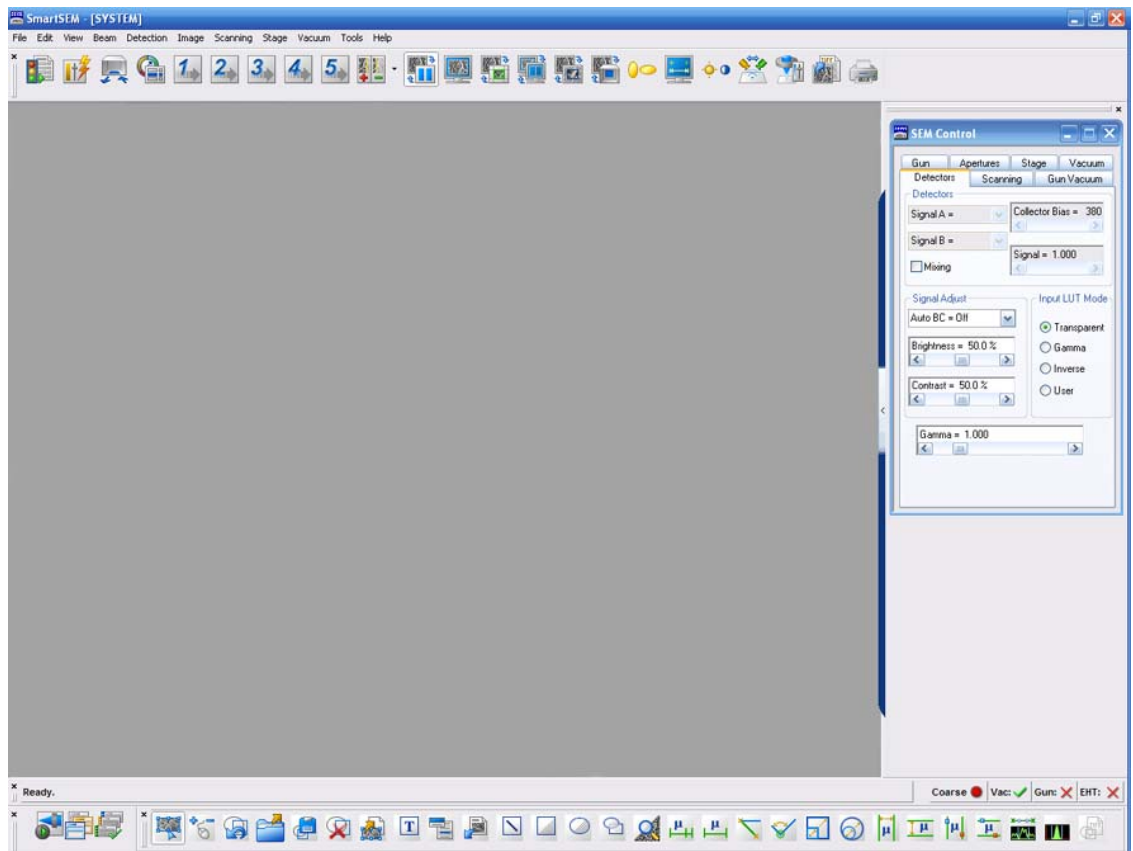


The **EM Server Log On** dialog appears.

- 2 Enter your username and password.
- 3 Confirm by clicking on **OK**.



The SmartSEM[®] user interface opens.



The **EM Server** is minimised to a small element (icon) on the right side of the Windows[®] task bar.

The SmartSEM[®] software is ready to operate the SEM/FESEM.

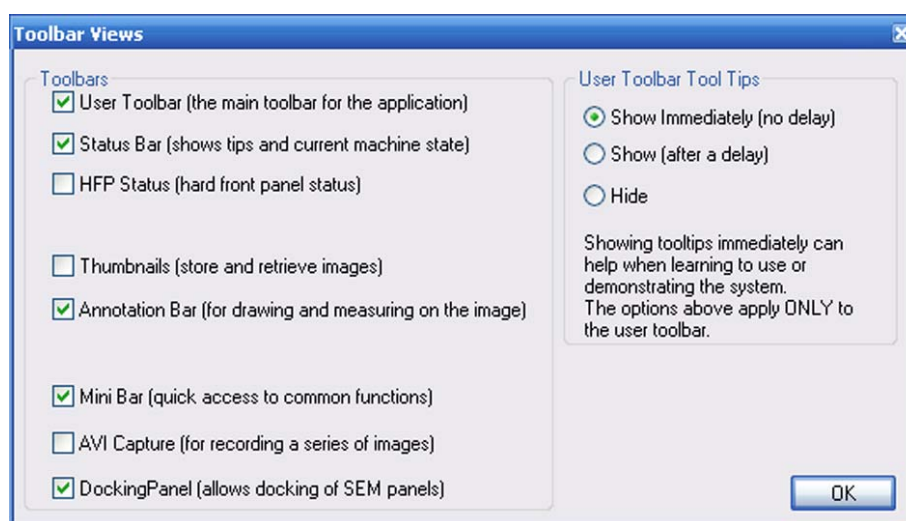
3.3. Finding your way in the user interface

3.3.1. Showing or hiding toolbars

Several toolbars such as user toolbar, status bar, and annotation bar are available for easy access to the SmartSEM[®] functions.

- 1 Select **View/Toolbars**.
Alternatively, type <Ctrl+B>.

The **Toolbar Views** panel is shown.



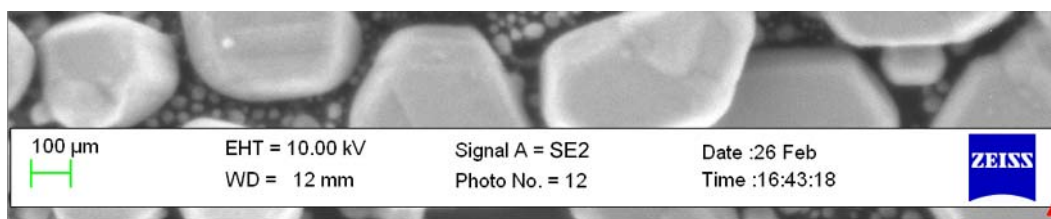
- 2 If you wish to show a toolbar, tick the respective checkbox.
- 3 To change the tooltip features of the user toolbar, select the respective radio button on the right hand side of the panel.
- 4 Confirm by clicking on **OK**.

3.3.2. Showing or hiding the data zone

The data zone is a special group of annotation objects which are used to display current parameters. You can also include a μ -marker to show the base magnification.

- 1 Select **View/Data Zone/Show Data Zone** from the menu.
A tick is shown to indicate that the function is activated.

Alternatively, type **<Ctrl+D>** to toggle the data zone.



3.3.3. Showing a full screen image

To take advantage of the full monitor size to display the microscopic image, show a full screen image.

- 1 Select **View/Toggle Full Screen Image** from the menu.
Alternatively, type **<Shift + F3>**.

To undo the function, type **<Shift + F3>**.

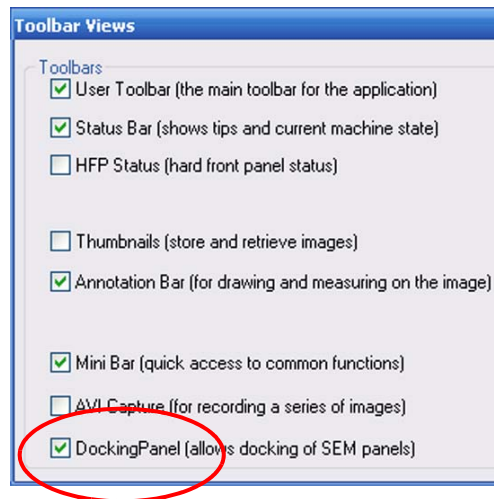
3. First steps

Finding your way in the user interface

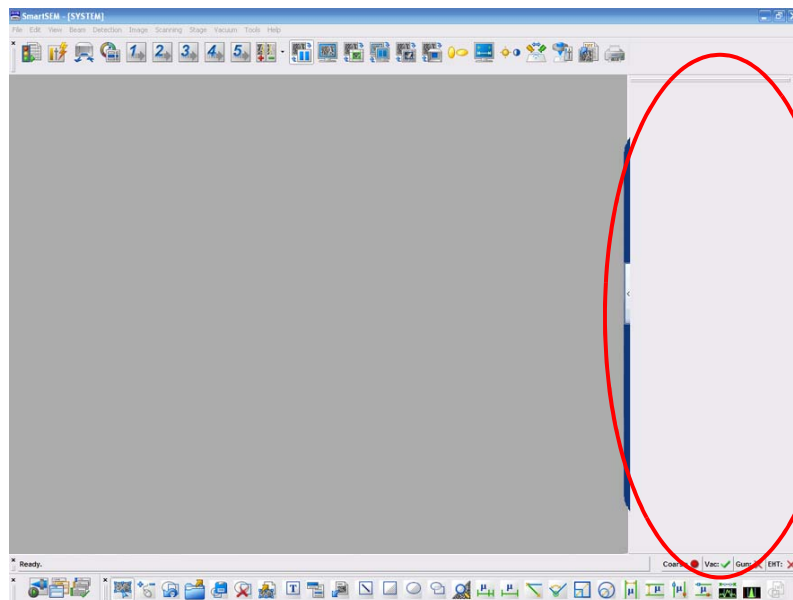
3.3.4. Docking panels

It is possible to dock various panels onto the main window. The purpose of the docking panel is to keep the area of the image completely clear, as the docking panel is outside the main window.

- 1 To show the docking panel select **View/Toolbars** from the menu.
- 2 Tick the **Docking Panel** checkbox.



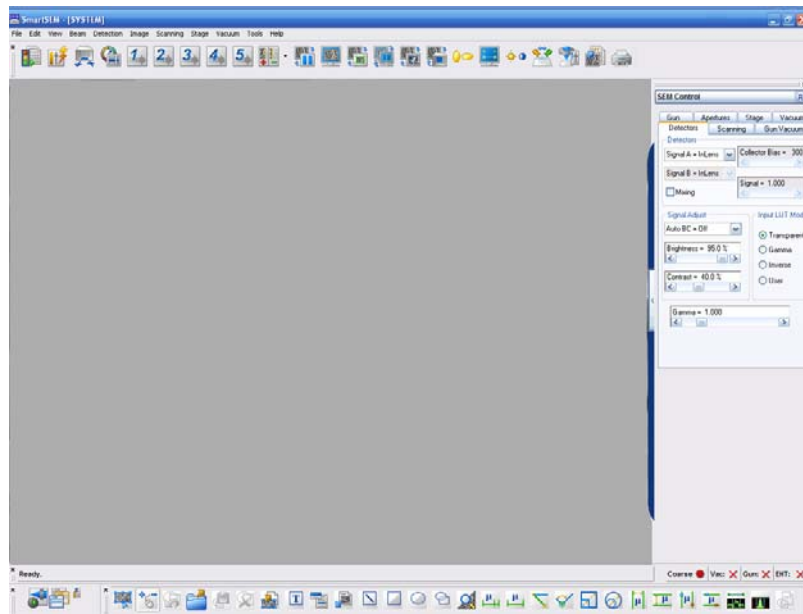
The docking panel is shown on the right hand side of the image area.



- 3 To move the docking panel to the left hand side, pick up the panel by clicking on the title bar and drag it to the other side of image area.

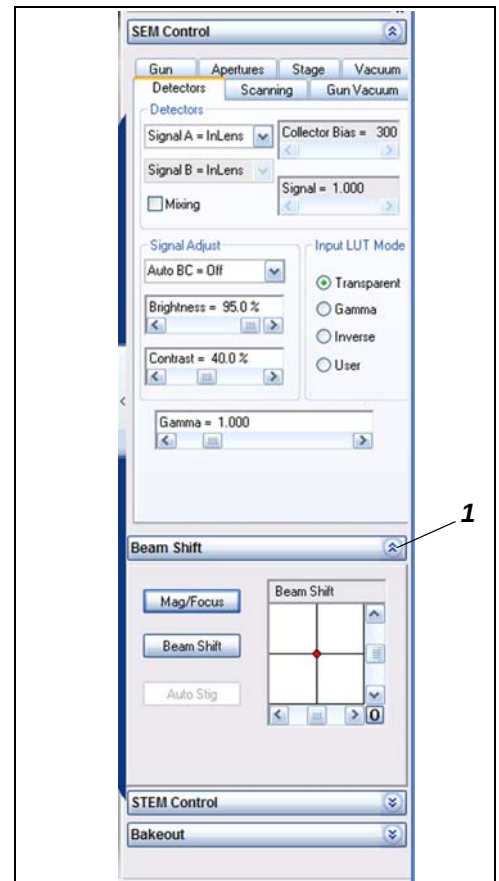
- 4 To stick a control panel to the docking panel, click the title bar of the control panel and drag it to the docking panel.

The panel becomes integrated into the docking panel.



You can stick several control panels to the docking panel.

- 5 To minimise a panel, click the **arrow** button (1) in the title bar.

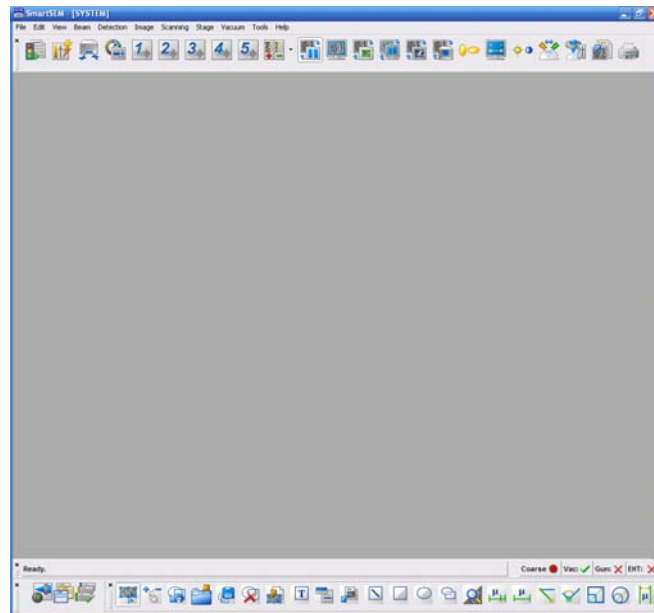


3. First steps

Finding your way in the user interface

- 6 To hide the docking panel untick the **Docking Panel** checkbox.

The docking panel is hidden.



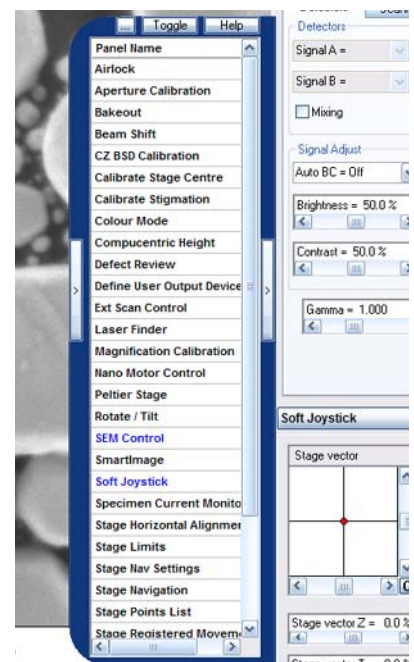
3.3.5. Opening the Panel Configuration Bar

- 1 Select **Tools/Goto Panel** from the menu.

Alternatively, click the arrow button at the side of the image area.

The **Panel Configuration Bar** opens showing an alphabetical list of functions.

- 2 To select a function, double-click it.



3.4. Obtaining the first image

The following section summarizes basic sequences to quickly obtain an image using the SE2 detector. To simplify the procedure, the method described mainly uses **SEM Controls** panel and status bar functions.

Dependent on your type of SEM/FESEM (Standard vacuum system, VP vacuum system, Cross Beam® series), the SmartSEM® user interface may differ slightly.

Prerequisite:

- SmartSEM® software has been started and is ready to control the SEM/FESEM.

Parts required	No.
Allen wrench, 1.5 mm	delivered with the SEM/FESEM
Stub	delivered with the SEM/FESEM
Tweezers for specimen	delivered with the SEM/FESEM
Specimen holder	delivered with the SEM/FESEM
If necessary: carbon tape, conductive carbon, adhesive metal tape or similar	-
Appropriate specimen (with conducting properties e.g. gold on carbon)	-
Lint-free gloves	-

At a glance

The complete sequence includes:

- Preparing the sample holder
- Loading the specimen chamber
- Locating the specimen
- Switching on the gun
- Switching on the EHT
- Generating an image
- Optimising the image
- Saving the image

3. First steps

Obtaining the first image

3.4.1. Preparing the sample holder



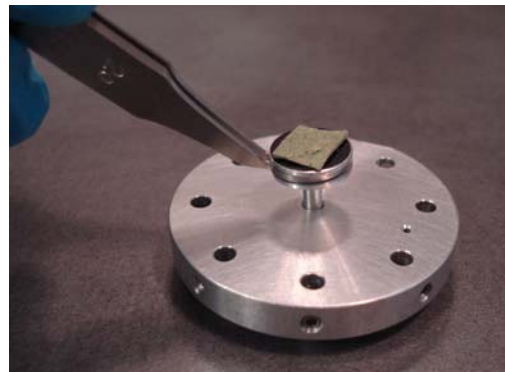
IMPORTANT

Contamination caused by fingerprints can lead to vacuum deterioration or prolonged pumping times. Always wear lint-free gloves when touching specimen, sample holder or stage.

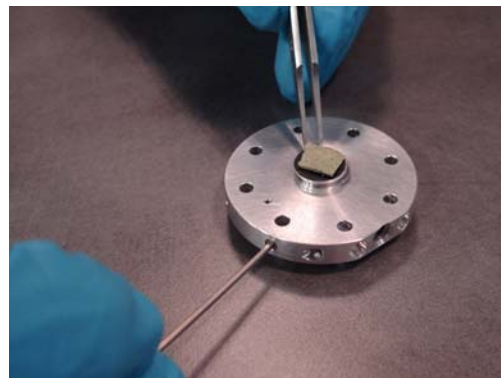
- 1 Attach the specimen to the stub by using conductive carbon, adhesive metal or carbon tape etc.
Ensure that the specimen area to be analysed is in proper contact with the stub.



- 2 Use the tweezers to insert the stub into the sample holder.



- 3 Properly fix the stub to the sample holder.
Use the Allen wrench to tighten the location screw.

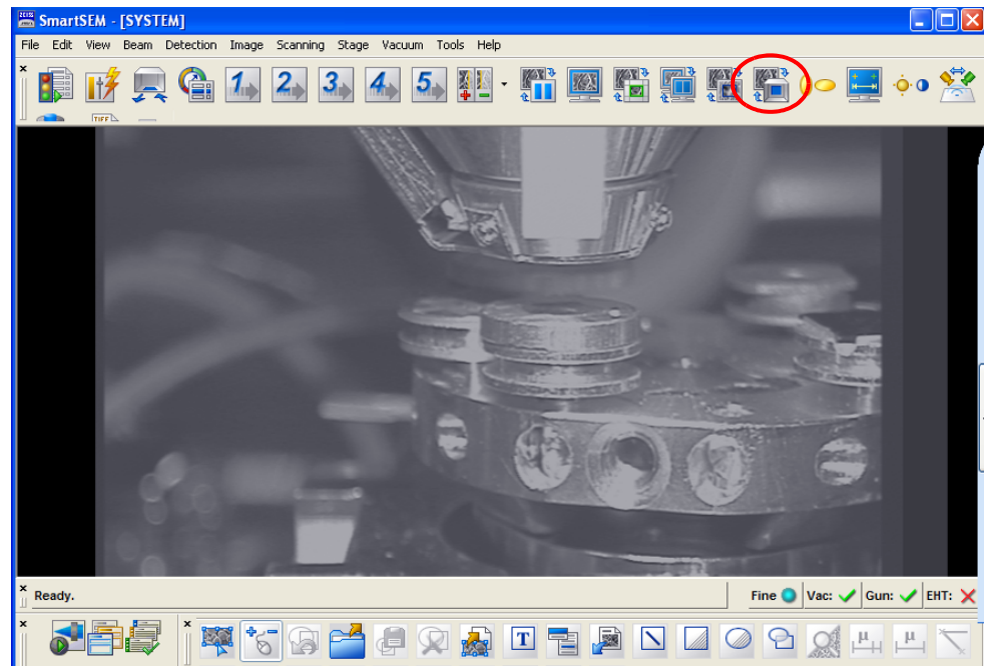


3.4.2. Loading the specimen chamber

- 1 Click the **ChamberScope** icon in the toolbar.



A TV view inside the specimen chamber is shown.



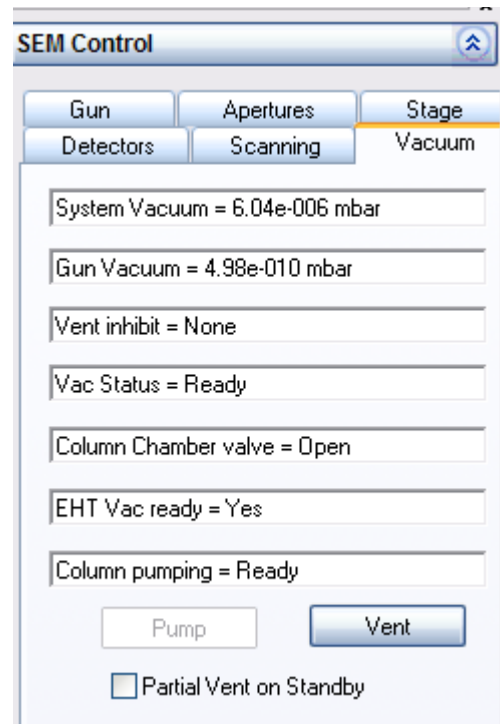
CAUTION

Risk of damaging the objective lens and/or your specimen
Ensure not to hit the objective lens while driving the stage. Change to TV mode to observe the moving stage.

3. First steps

Obtaining the first image

- 2 On the **SEM Controls** panel, select the **Vacuum** tab.
- 3 To ventilate the specimen chamber, click **Vent**.



A message appears asking: 'Are you sure you want to vent?'.

- 4 Confirm by clicking on **Yes**.

The specimen chamber is filled with gaseous nitrogen.



CAUTION

Suffocation hazard due to lack of oxygen, since the specimen chamber is ventilated with nitrogen.

After the specimen exchange, keep the chamber door open as short as possible. Avoid inhaling the air from within the specimen chamber.

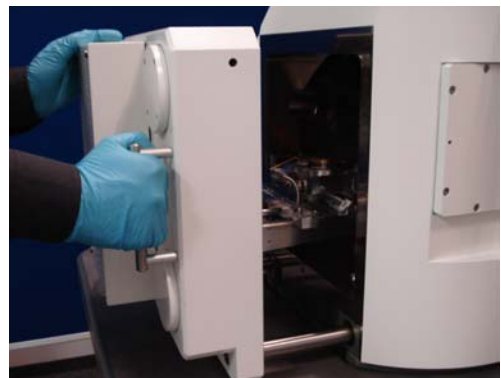
- 5 Take hold of the door handle and slowly open the chamber door.



IMPORTANT

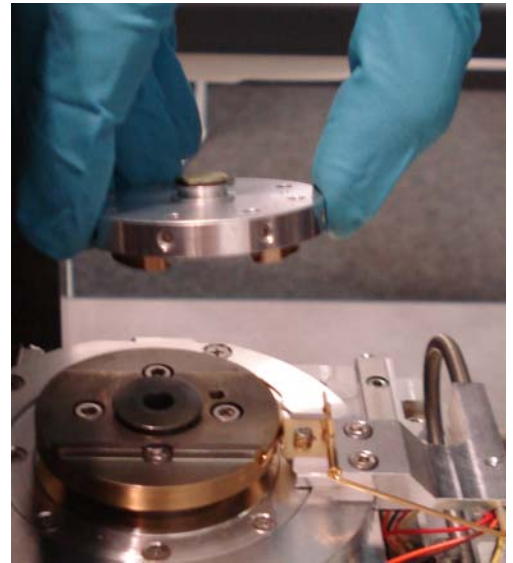
Contamination caused by fingerprints can lead to vacuum deterioration or prolonged pumping times.

Always wear lint-free gloves when touching specimen, sample holder or stage. Keep the chamber door open as short as possible.



All sample holders are equipped with a dovetail so that the position of the sample holder is exactly defined.

- 6 Mount the sample holder:
 - a Ensure that you place the dovetail in the correct orientation onto the holding device on the specimen stage.
 - b Make sure that the flat side of the dovetail of the sample holder is flush with the milled edge of the stage.



- 7 Look into the specimen chamber to ensure that the specimen cannot hit any components when it is introduced into the specimen chamber.



CAUTION

*Pinch hazard when closing the chamber door
Use the door handle to close the chamber door. Ensure not to get your fingers caught in the chamber door gap.*

- 8 Carefully close the chamber door.

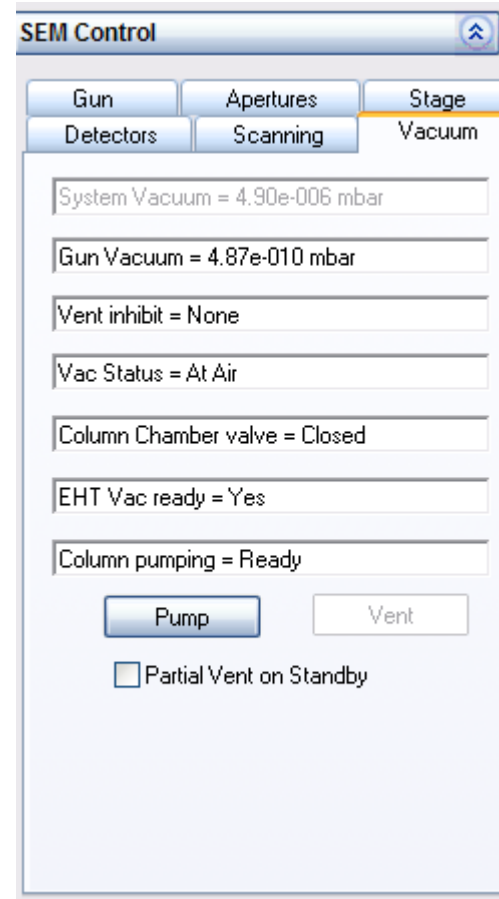


3. First steps

Obtaining the first image

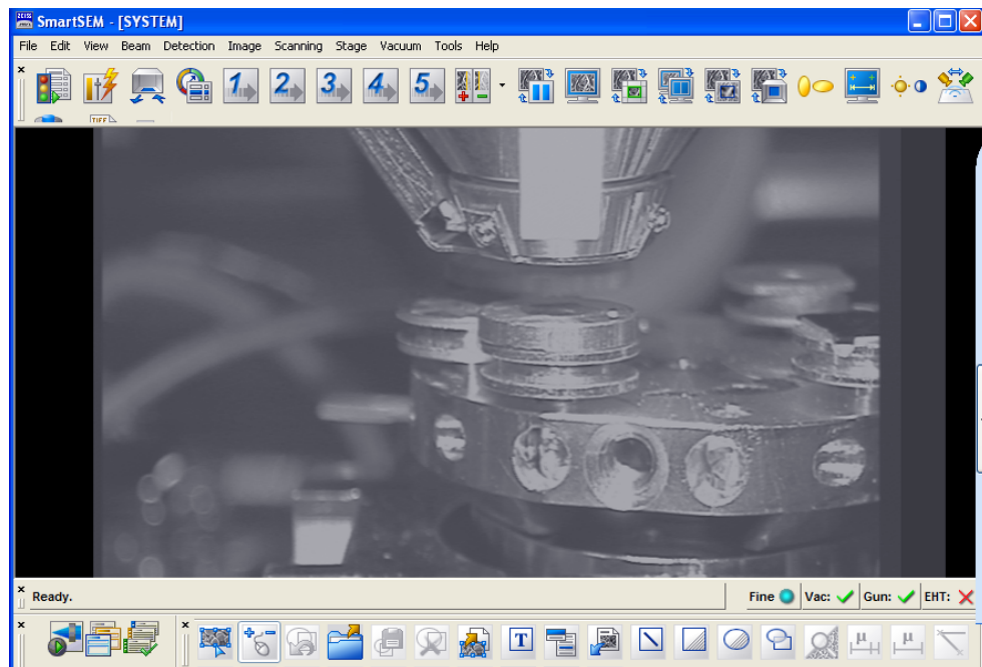
- 9 In the SEM Controls panel, click **Pump**.

The vacuum status messages show the current vacuum levels achieved.



3.4.3. Locating the specimen

- 1 In TV mode (ChamberScope), look into the specimen chamber.



CAUTION

***Risk of damaging the objective lens and/or your specimen.
Ensure not to hit the objective lens while driving the stage. Change to TV mode to observe the moving stage.***

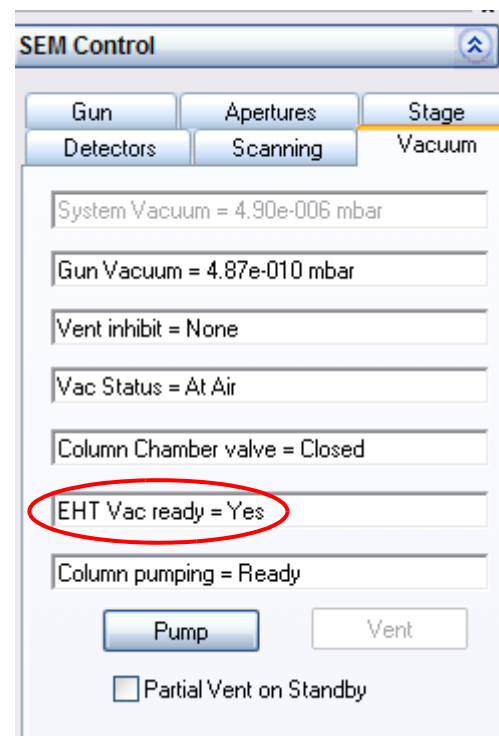
- 2 Move the specimen by using the dual joystick (optional) or by calling the Soft Joystick via **Panel Configuration Bar/Soft Joystick**.
- 3 Carefully move the specimen closer to the objective lens.
The distance between objective lens and specimen surface should be less than about 10 mm.

3. First steps

Obtaining the first image

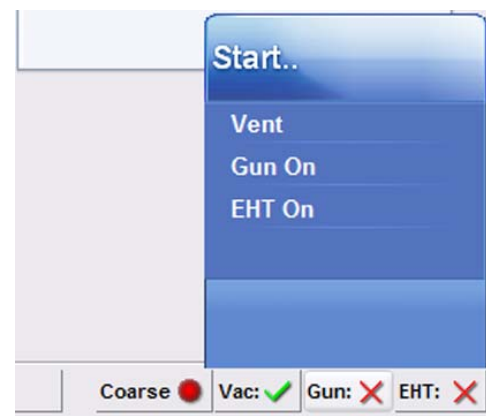
3.4.4. Switching on the gun

- 1 In the **Vacuum** tab:
Check that *EHT Vac ready*=Yes is indicated.



- 2 In the status bar, click **Gun**.
- 3 Select **Gun On** from the pop-up menu.

The gun is being run up.

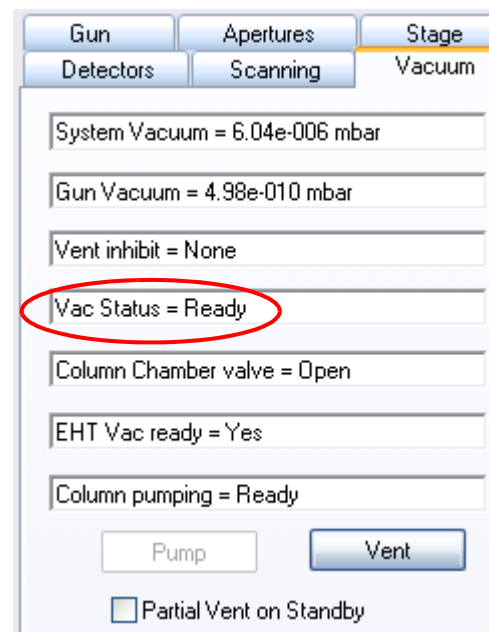


3.4.5. Switching on the EHT

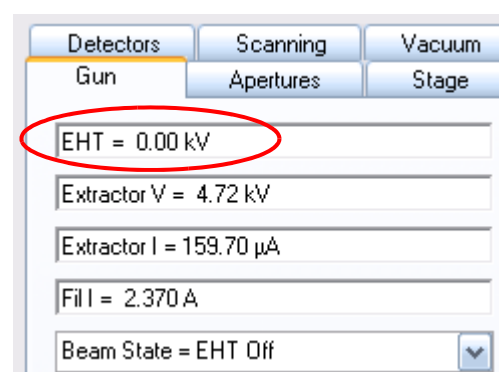
'EHT' stands for acceleration voltage. This voltage has to be applied to the gun in order to make it emit electrons.

- 1 Watch the vacuum status messages on the **Vacuum** tab of the **SEM Controls** panel.

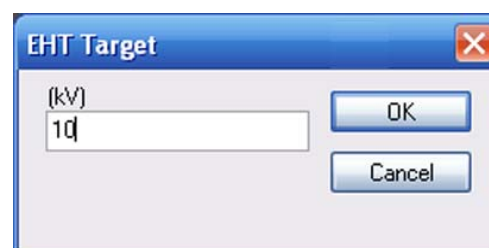
When the required vacuum has been reached you will see the message 'Vac Status = Ready'.



- 2 Go to the **Gun** tab.
- 3 Set the acceleration voltage:
 - a Double-click in the **EHT=** field.



- b Enter the desired acceleration voltage in the **EHT Target** field, e.g. 10 kV.
 - c Confirm by clicking on **OK**.

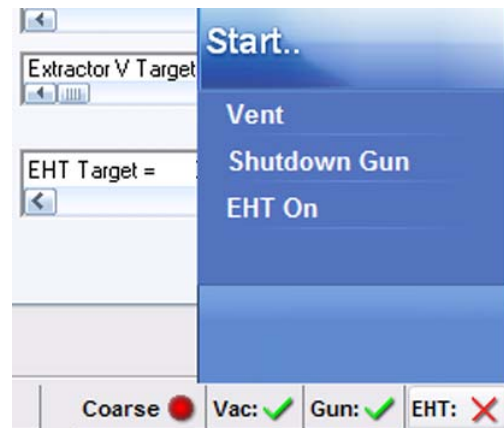


3. First steps

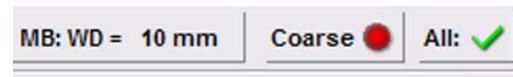
Obtaining the first image

- 4 Switch on the EHT:
 - a Click **EHT** in the status bar.
 - b Select **EHT On** from the pop-up menu.

The EHT is running up to 10 kV.



The status bar buttons are merged together, and the **All:** button appears.

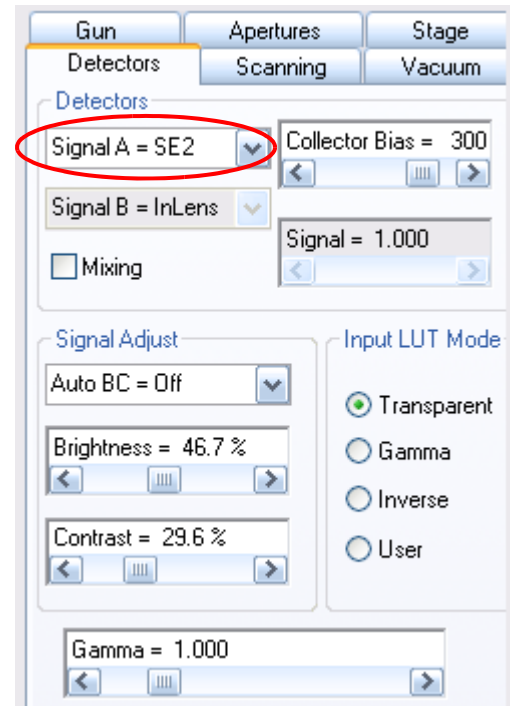


Now the electron beam is on.

3.4.6. Generating an image

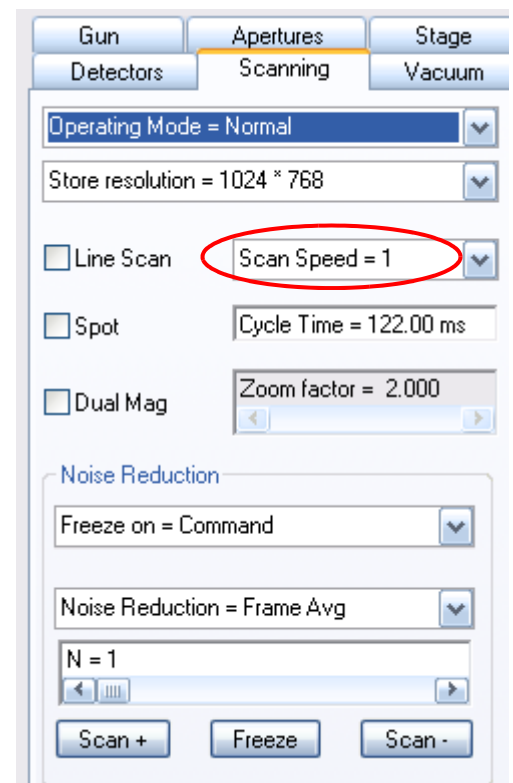
- 1 Go to the **Detectors** tab.
- 2 Select **SE2** from the **Detectors** drop-down list.

It is recommended that you select the SE2 detector to obtain the first image, as this detector provides a good signal-to-noise ratio even at large working distances.



- 3 Go to the **Scanning** tab.
Select a fast scan speed, e.g.
Scan Speed = 1 from the drop-down list.

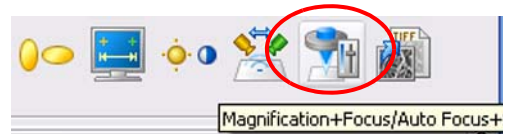
The lower the scan speed number, the faster the scan of the specimen by the electron beam. *Scan Speed = 1* allows you to get an image quickly.



3. First steps

Obtaining the first image

- 4 Set a low magnification e.g. $Mag = 500x$:
 - a Click the **Magnification/Focus** icon in the toolbar.
 - b Press the left mouse button and drag the mouse to adjust the magnification of $500x$.



The current magnification is indicated in the status bar.

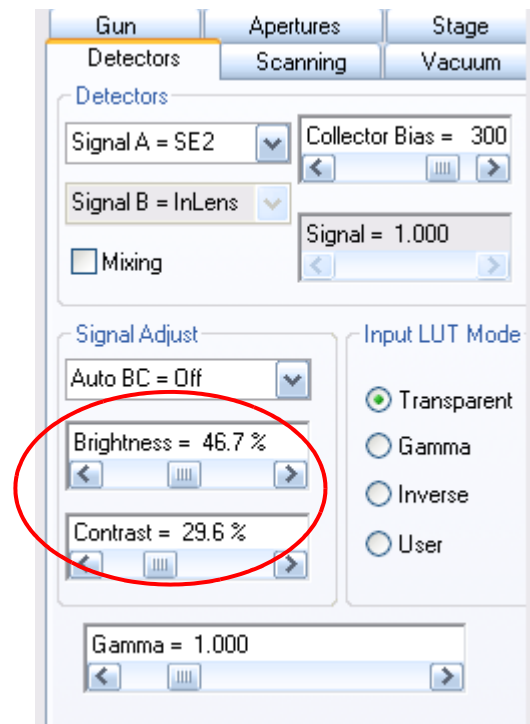
LB: Mag = 500 X | MB: WD = 10.2 mm

- 5 Set the focus:
 - a Press the middle mouse button and drag the mouse to focus.

The current working distance (WD) is indicated in the status bar.

LB: Mag = 500 X | MB: WD = 10.2 mm

- 6 Adjust contrast and brightness.
 - a Go to the **Detectors** tab.
 - b Use the **Brightness** and **Contrast** sliders.
- 7 Select a detail on the specimen surface.
Focus the detail.
- 8 Adjust contrast and brightness again.



3.4.7. Optimising the image

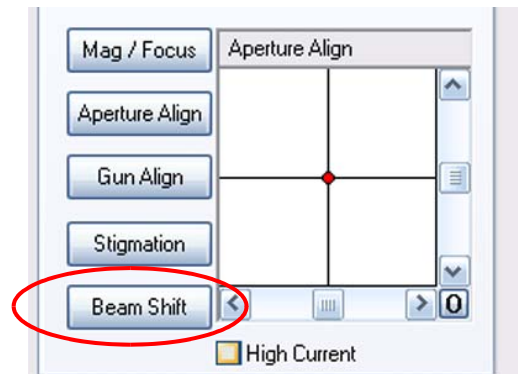
- 1 Set *Coarse* by toggling the **Coarse/Fine** button in the status bar.



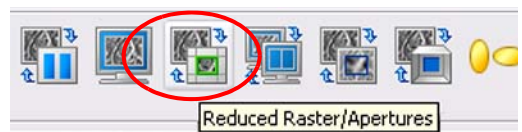
- 2 Step by step, set a high magnification,
e.g. Mag 50.000 x.
Focus in between.

When selecting high magnifications it is recommended that you move the specimen by using the beamshift function instead of driving the stage.

- 3 Use the Beam shift function:
 - a Go to the **Apertures** tab.
 - b Click **Beam Shift**.
 - c Use the slider or the red marker to shift the beam.



- 4 Click the **Reduced Raster** icon.

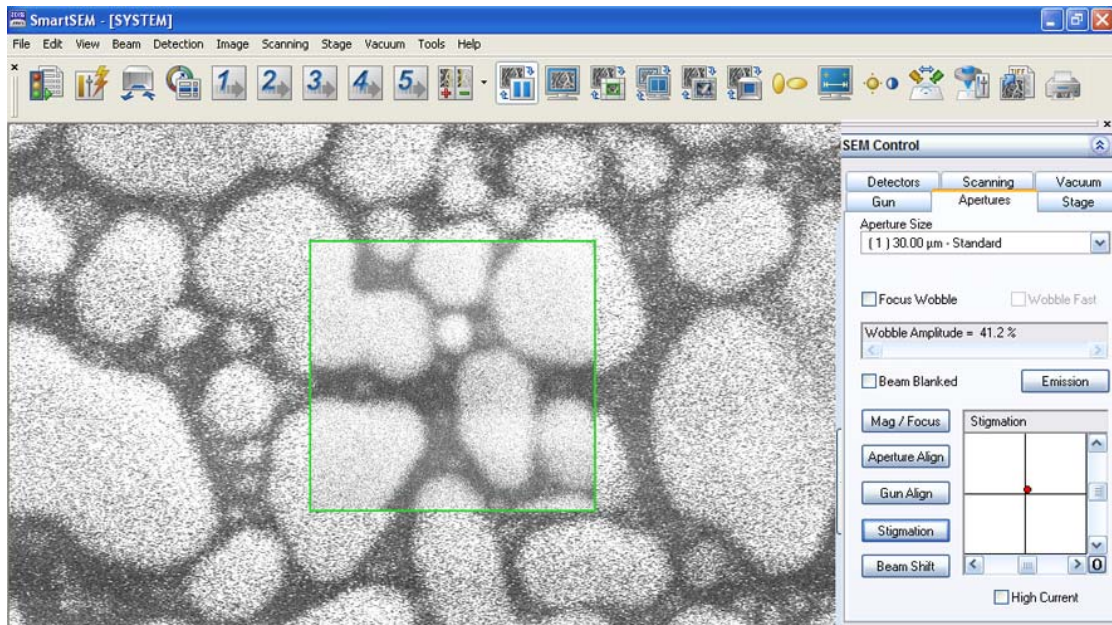


3. First steps

Obtaining the first image

A small scan frame is shown.

The image outside the scan frame is frozen. Size and position of the scan frame can be changed by dragging and dropping.



5 Focus the image in the reduced raster.

6 Align the aperture:

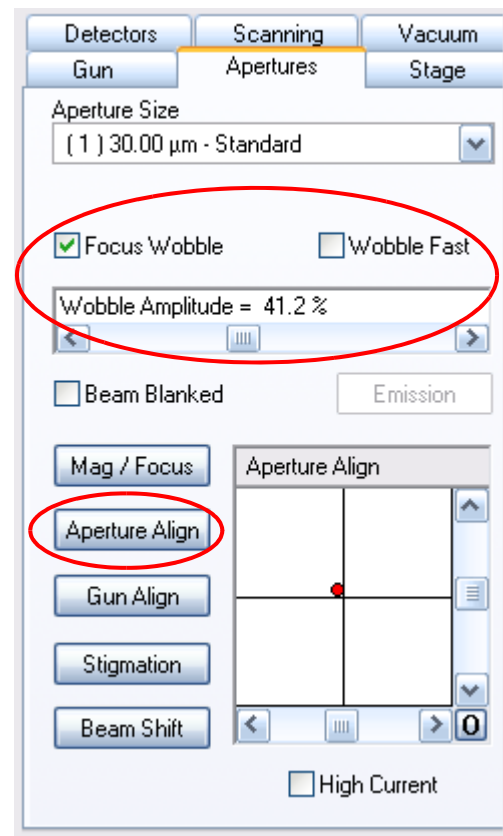
- a In the **Apertures** tab, tick the **Focus Wobble** checkbox.

The Focus Wobble is a function that sweeps the focus of the objective lens backwards and forwards through the focus on the specimen plane. If the aperture is slightly misaligned, a lateral shift can be observed.

Intensity of wobble can be adjusted by using the **Wobble Amplitude** scroll bar. Wobble speed can be accelerated by ticking the **Wobble Fast** checkbox.

- b Click **Aperture Align**.
Use the left and right slider of the **Aperture Align** box until there is no movement of the detail in X and Y direction.
The specimen detail should just be pulsating without shifting.

- c Untick the **Focus Wobble** checkbox.

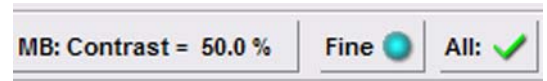


7 In the **Scanning** tab, set *Scan Speed* = 7.

8 Bring the image into focus.

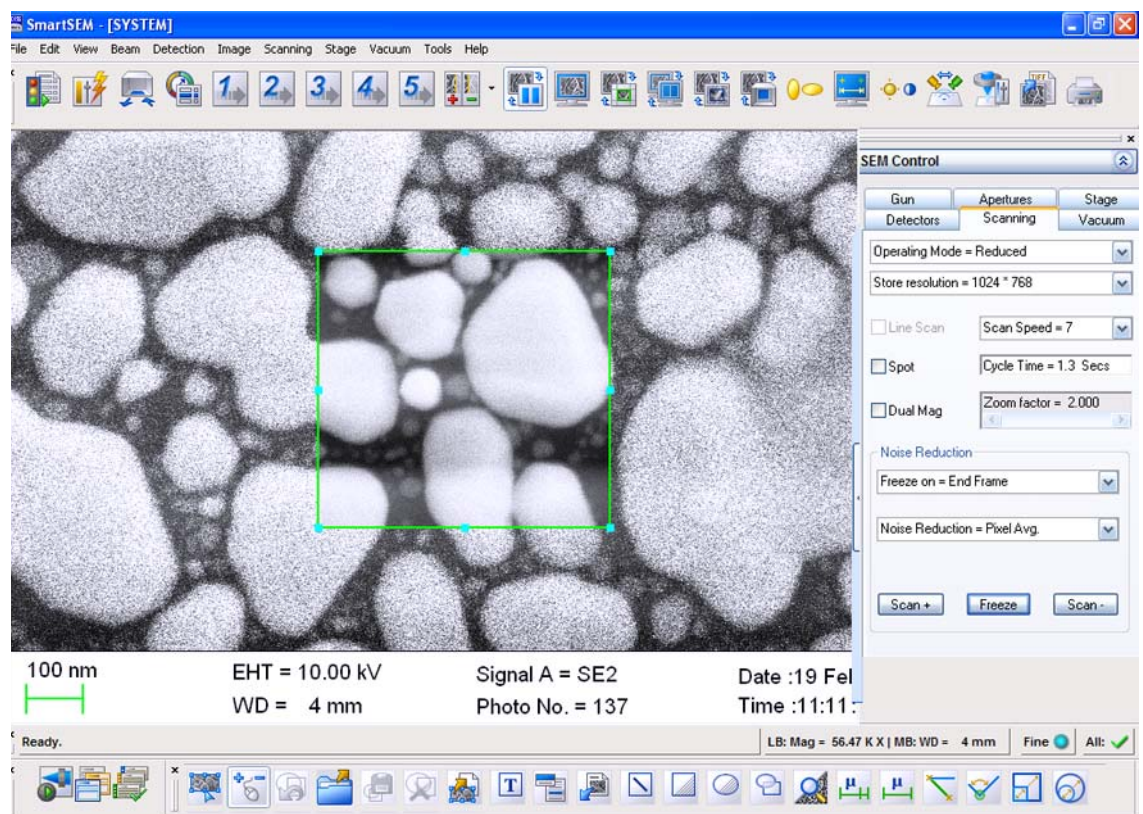
9 Toggle to **Fine** in the status bar.

Use **Coarse** and **Fine** mode of adjustment where appropriate.



10 Correct astigmatism:

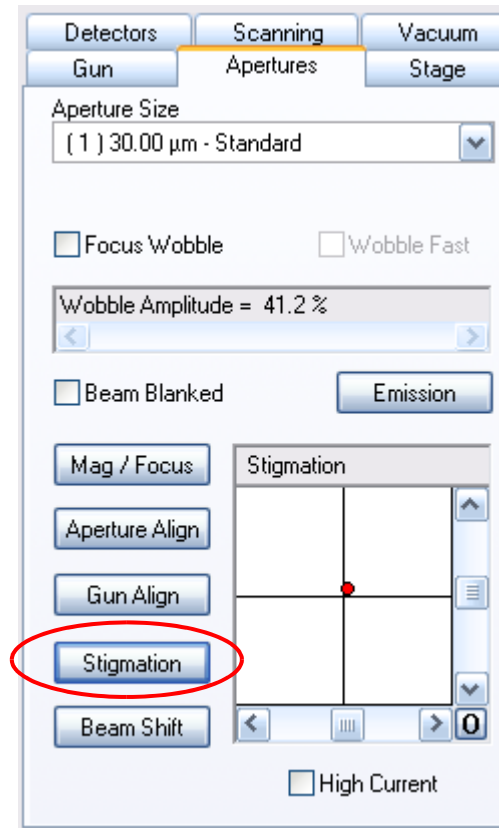
- a Select a detail (e.g. a mark or an edge) on the specimen surface.
- b Click the **Reduced Raster** icon.
 Ensure the selected detail is in the raster.



3. First steps

Obtaining the first image

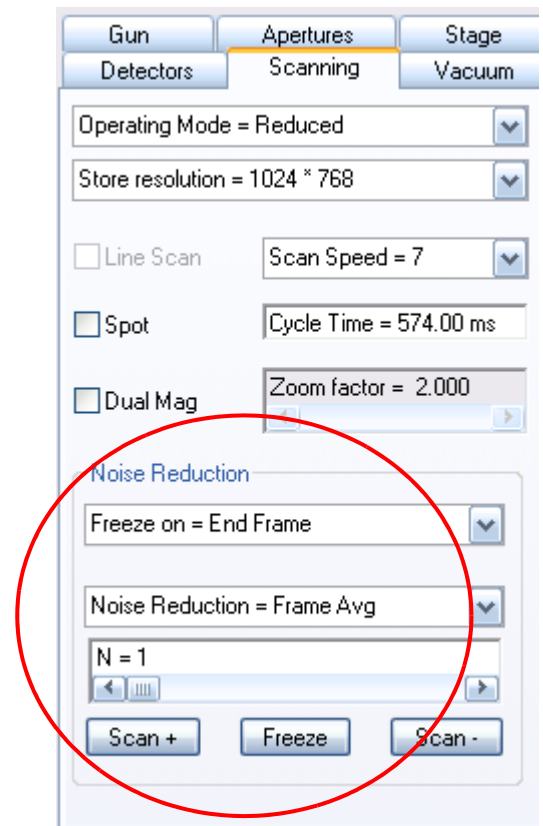
- c In the **Apertures** tab:
Click **Stigmation**.
- d In the **Stigmation** box, use the arrow buttons or the left and right slider to obtain the sharpest possible image.



- 11 Deactivate the reduced raster.
- 12 In order to reduce image noise select, a slower scan speed, e.g. scan speed 6 to 8.

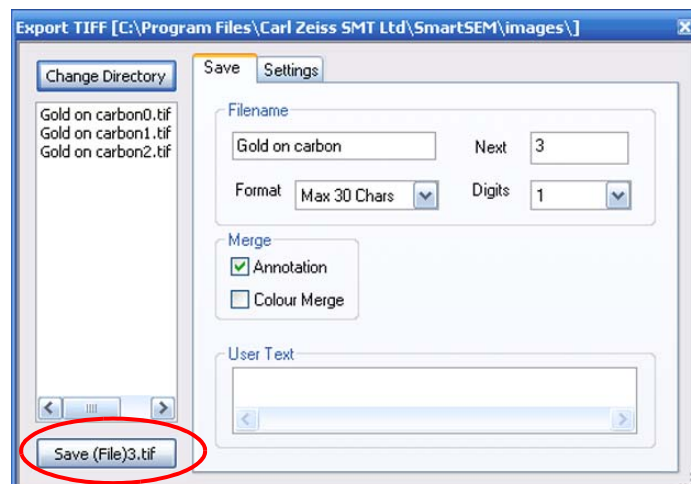
3.4.8. Saving the image

- 1 Stop the scan:
 - a Go to the **Scanning** tab.
 - b In the **Noise Reduction** section, select *Freeze on = End Frame* from the drop-down menu.
 - c Click **Freeze**.



A red dot at the right bottom of the image area indicates that the image is frozen.

- 2 Select **File/Save Image** from the menu.

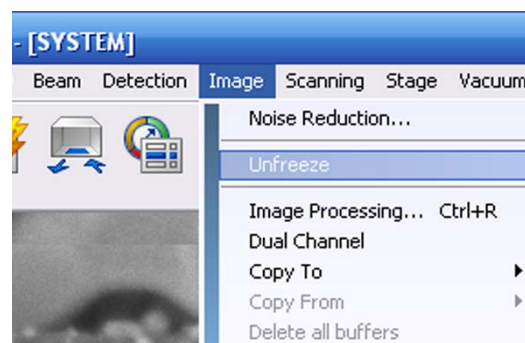


- 3 Enter a path and a file name.
- 4 Confirm by clicking on **Savetif**.

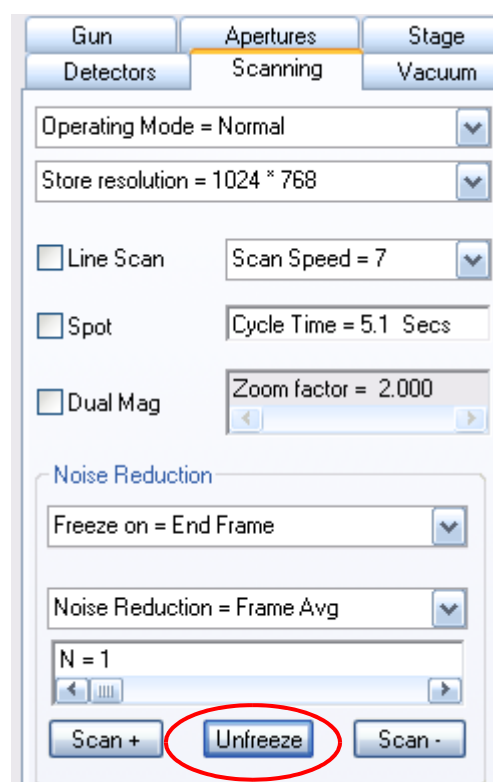
3. First steps

Obtaining the first image

To continue imaging, unfreeze the image by selecting **Image/Unfreeze** from the menu.



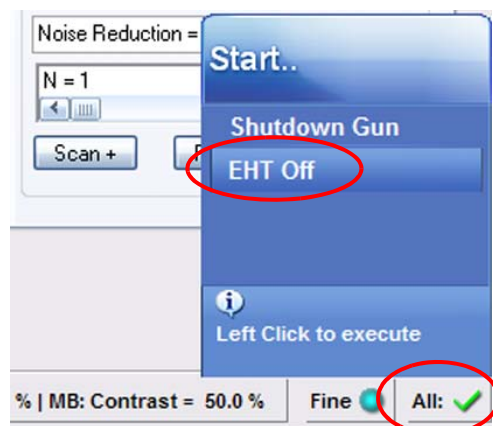
Alternatively, you can click **Unfreeze** in the **Scanning** tab.



To finish your work session, switch off the EHT:

- In the status bar, click **All**.
- Select **EHT Off** from the pop-up menu.

It is recommended that you leave the gun on during the working week. This should help to optimise lifetime of the filament.



3.5. Using the help functions

The SmartSEM[®] user interface offers a multitude of help texts containing information on the operation of the SEM/FESEM, the optimization of the images and the handling of accessory options.

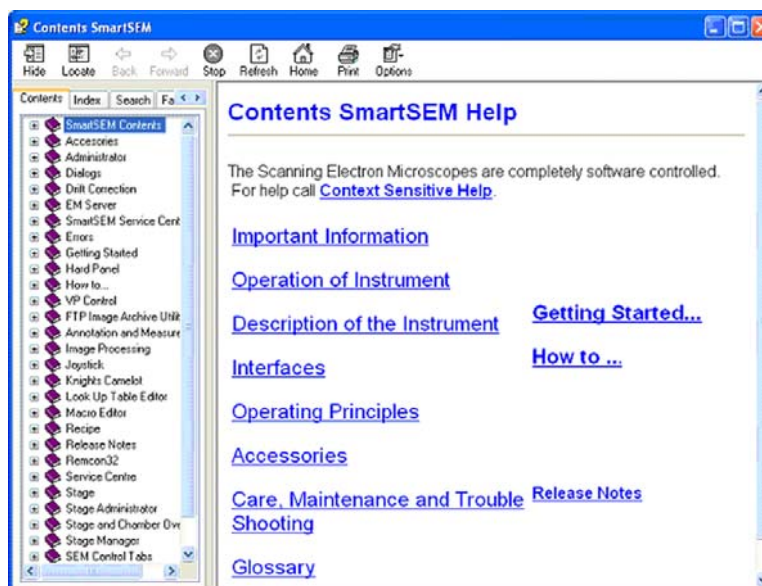
3.5.1. Calling the SmartSEM[®] help

- 1 Press <F1>.

Alternatively, select **Help/SmartSEM help** from the menu.

The SmartSEM[®] help start window opens.

If menus are opened in the SmartSEM[®] user interface, pressing <F1> will open the help text for the respective menu. This allows explaining the menu while the SEM/FESEM is being operated.



3.5.1.1. Printing help texts

- 1 Click the printer icon in the help window.

If a printer is installed, the help text is printed.

3.5.1.2. Bringing help texts to the foreground

- 1 Select **Help/Help Always On Top** from the menu.

The displayed help texts remain in the foreground.

3. First steps

Using the help functions

3.5.2. Calling the context-sensitive help

- 1 Press <**SHIFT+F1**>.
Alternatively, select **Help/What's This** from the menu.

The mouse cursor is equipped with a question mark.

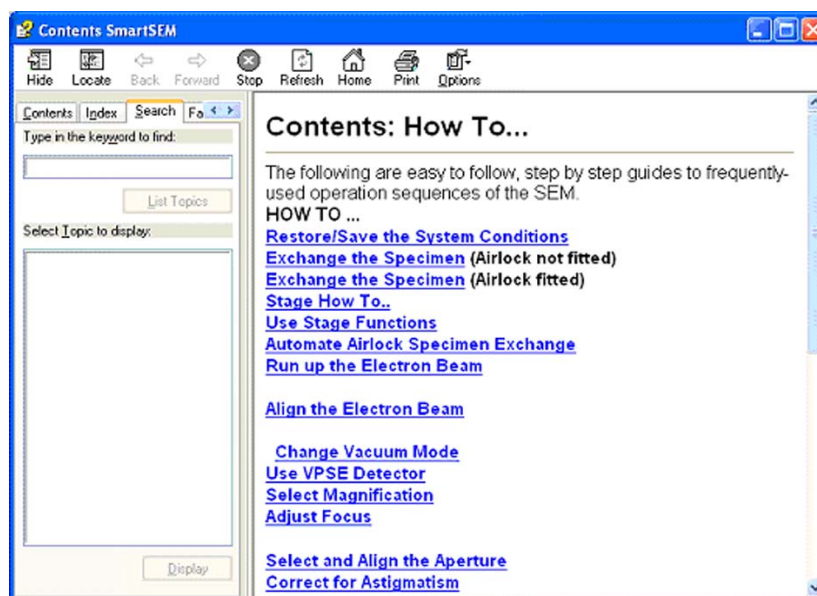
- 2 Click an area of interest on the screen.

The help text is shown.

- 3 To disable the context-sensitive help, press <**ESC**>.

3.5.3. Searching for a topic

- 1 Select **Help/Search** from the menu.
- 2 Click the **Search** tab.
- 3 Search for the desired topic.

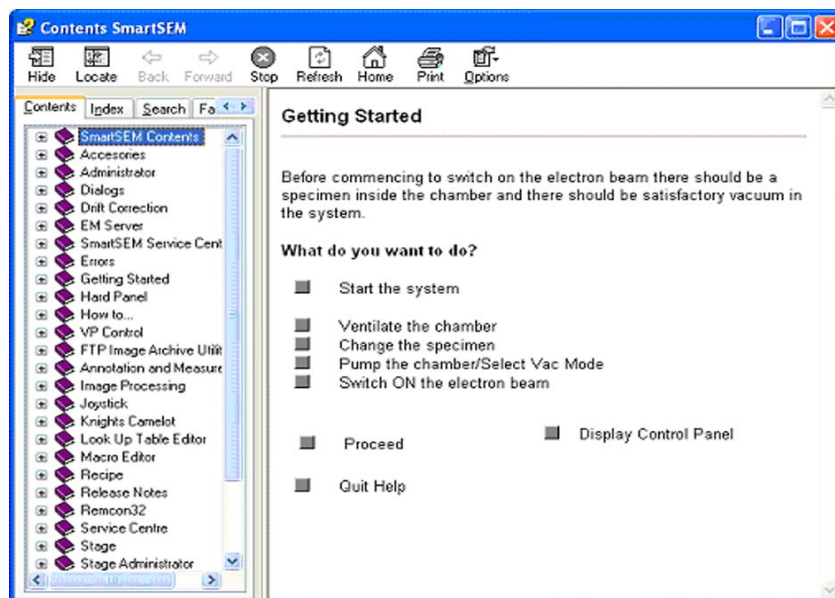


3.5.4. Using the step-by-step guides

The step-by-step guides provide quick information on important operation sequences.

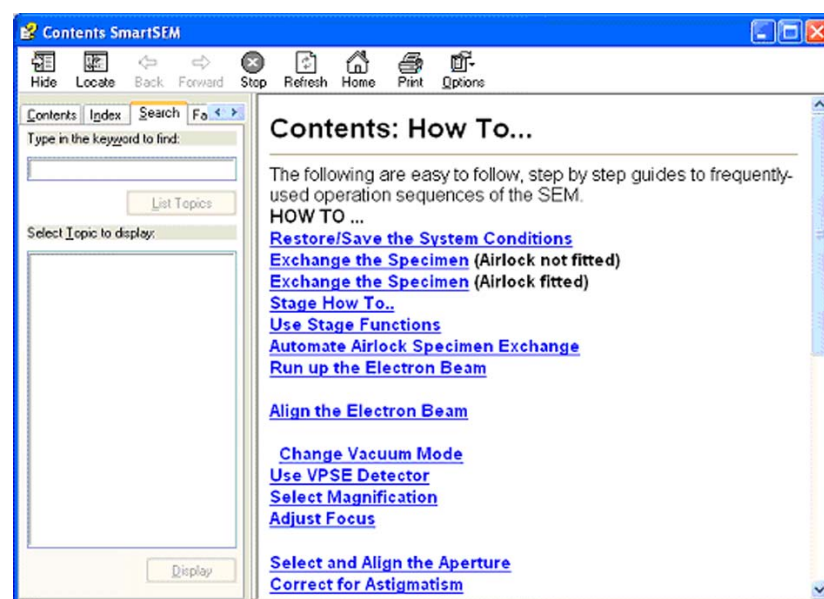
3.5.4.1. Getting started

- 1 Select **Help/Getting started** from the menu.
- 2 Click the topic of interest.



3.5.4.2. Frequently used operation sequences

- 1 Select **Help/How To** from the menu.
- 2 Click the topic of interest.



3. First steps

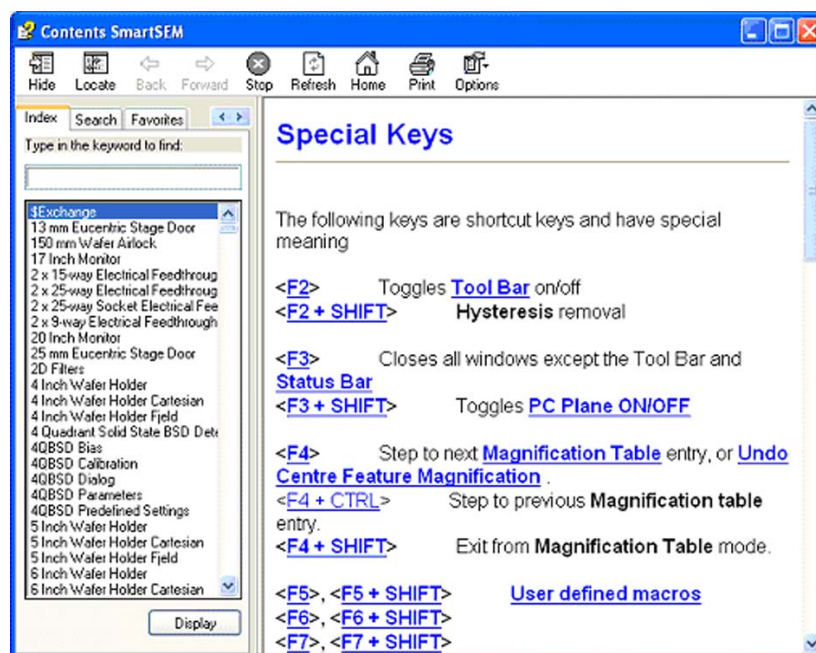
Using the help functions

3.5.5. Calling the shortcuts help

Many functions and menus which are often used in the SmartSEM[®] user interface can also be opened using the keyboard. A list of shortcuts (key combinations) can be displayed in the SmartSEM[®] help.

- 1 Press < **F9** >.

Alternatively, select **Help/Keys help** from the menu.



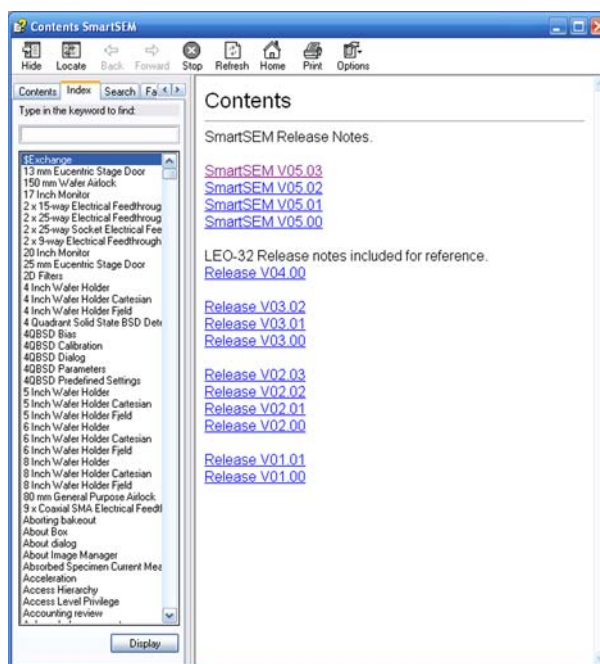
Refer to section 6.6.

3.5.6. Showing information about SmartSEM®

3.5.6.1. Version history

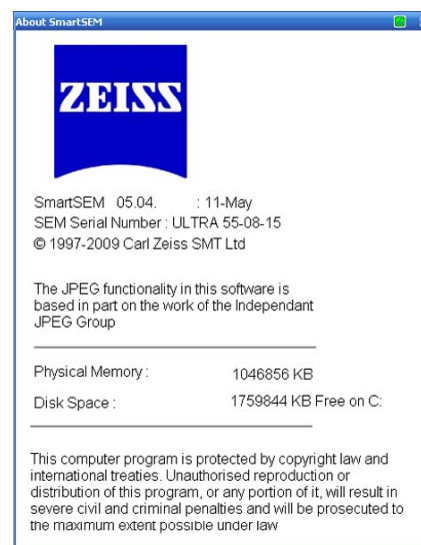
The Release Notes summarise important information about the software version history. New functions, bug fixes and special features of the different versions are explained.

- 1 Select **Help/Release Notes** from the menu.



3.5.6.2. About SmartSEM®

- 1 Select **Help/About SmartSEM** from the menu.



3.6. Closing the SmartSEM® software

3.6.1. Logging off

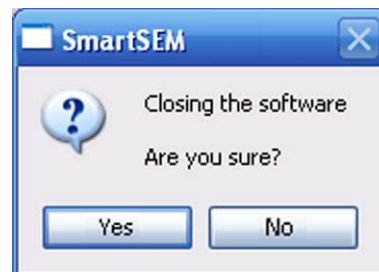
- 1 Select **File/Log Off** from the menu.

A window appears asking for confirmation to close the session.

- 2 Confirm by clicking on **Yes**.

The electron-optical parameters are filed in a macro in the individual user directory.

The **EM Server** remains active.



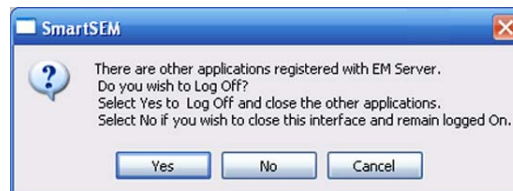
3.6.2. Exiting

- 1 Select **File/Exit** from the menu.

A window appears asking for confirmation to close the session.

- 2 Confirm by clicking on **Yes**.

The electron-optical parameters are filed in a macro in the individual user directory.



4. Operation

4.1. Controlling the vacuum

4.1.1. Checking the current vacuum status

Because a good vacuum is essential for the operation of the SEM/FESEM it is recommended keeping always an eye on the vacuum in specimen chamber and gun head.

- 1 On the **SEM Controls** panel, select the **Vacuum** tab.

Alternatively:
Select **Vacuum/Vacuum Status** from the menu.

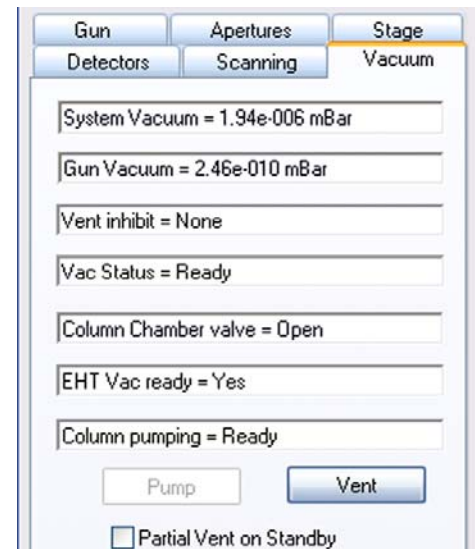
Alternatively:
Type **<CTRL+SHIFT+V>**.

The *System Vacuum* is the vacuum in the specimen chamber.

The *Gun Vacuum* is the ultra high vacuum in the gun head area.

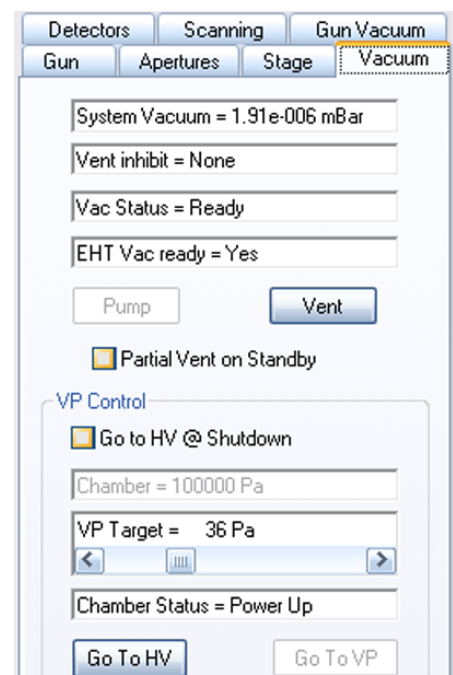
The value of the *Gun Vacuum* should be less than about 5×10^{-9} mbar.

To indicate another pressure unit (*mbar, Pa, Torr*) click in the *System Vacuum* or the *Gun Vacuum* field.



VP instruments

If you work with a VP instrument, the **Vacuum** tab looks slightly different.

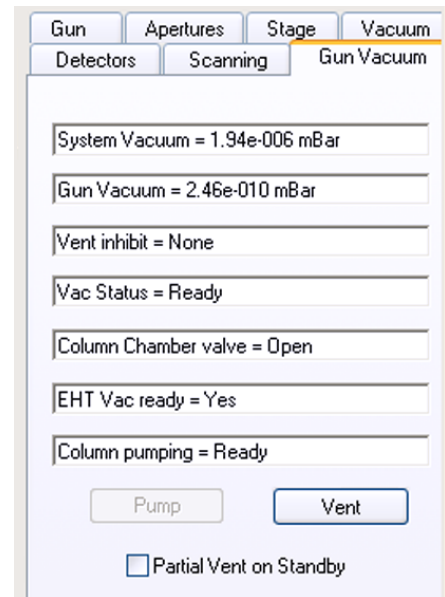


4. Operation

Controlling the vacuum

Moreover, there is an additional tab: The **Gun Vacuum** tab.

- 1 To show the gun vacuum, go to the **Gun Vacuum** tab.



The screenshot shows the 'Gun Vacuum' tab selected in a software interface. The tab is part of a group including 'Gun', 'Apertures', 'Stage', 'Vacuum', 'Detectors', 'Scanning', and 'Gun Vacuum'. The 'Gun Vacuum' tab is highlighted with a yellow border. The main area of the tab displays several status fields:

- System Vacuum = 1.94e-006 mBar
- Gun Vacuum = 2.46e-010 mBar
- Vent inhibit = None
- Vac Status = Ready
- Column Chamber valve = Open
- EHT Vac ready = Yes
- Column pumping = Ready

At the bottom of the tab, there are two buttons: 'Pump' and 'Vent'. Below these buttons is a checkbox labeled 'Partial Vent on Standby', which is currently unchecked.

4.1.2. Ventilating the specimen chamber

In order to be able to open the specimen chamber for specimen exchange, the vacuum has to be broken in a controlled manner. This is done by filling the specimen chamber with gaseous nitrogen.

- 1 In the toolbar, click the **Specimen Change** icon.

The EHT is switched off.

The specimen chamber is ventilated.



Alternatively:

- 1 Go to the **Gun** tab and select **EHT Off** from the drop-down list.
- 2 In the Vacuum tab, click **Vent**.



4. Operation

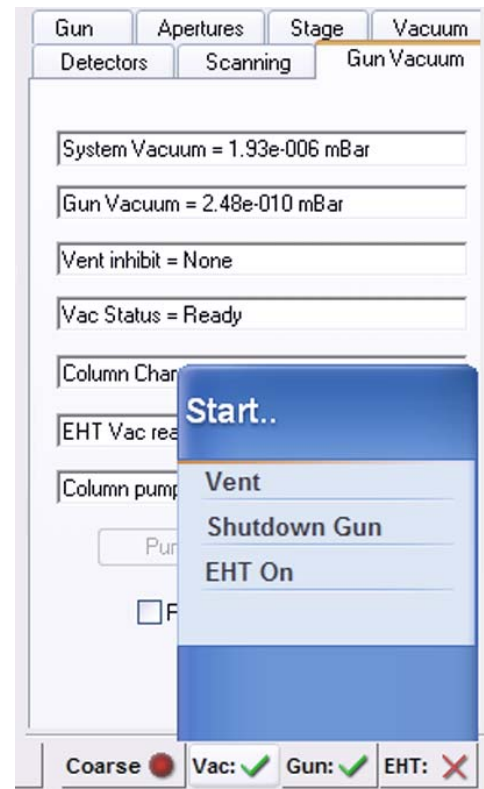
Controlling the vacuum

Alternatively:

- 1 In the status bar, click **All**.
- 2 Select **EHT Off** from the pop-up menu.

The **Vac** button appears.

- a Click **Vac**.
- b Select **Vent**.



Alternatively:

- 1 In the MiniBar, click **Start**.
- 2 Select **EHT Off**.

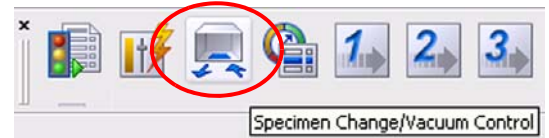
- 3 Select **Start/Vent** from the MiniBar.



4.1.3. Evacuating the specimen chamber

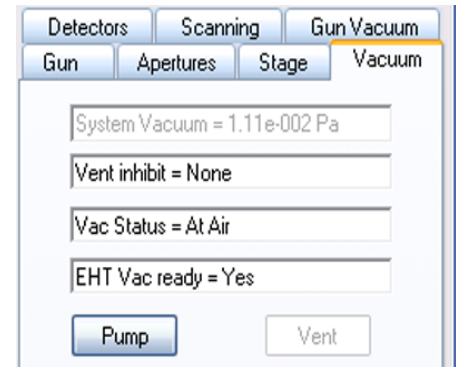
To continue operation after a specimen exchange, the specimen chamber has to be evacuated again.

- 1 In the toolbar, click **Specimen Change**.
- 2 Confirm the message 'Press OK To Pump'.



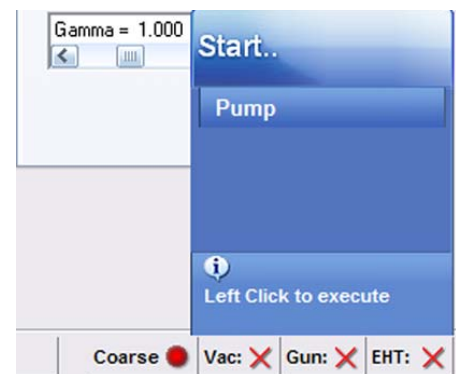
Alternatively:

- 1 In the Vacuum tab, click **Pump**.



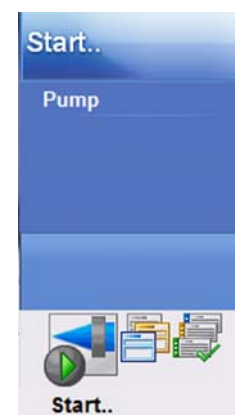
Alternatively:

- 1 In the status bar, click **Vac:**.
- 2 Select **Pump** from the pop-up menu.



Alternatively:

- 1 Select **Start/Pump** from the MiniBar.



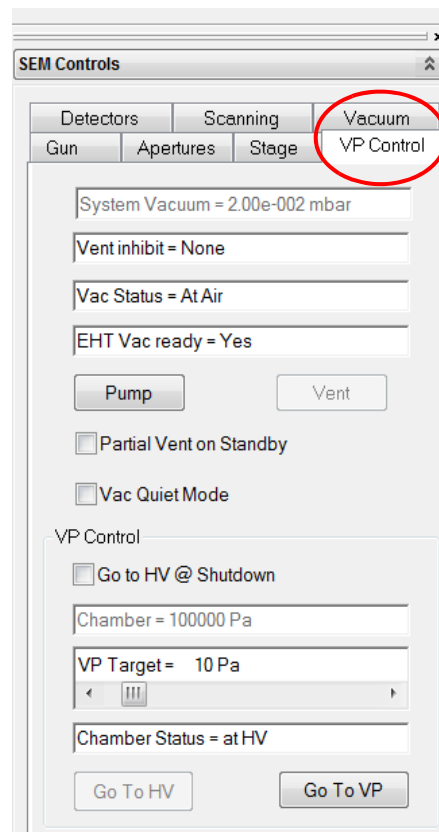
4.1.4. Working with variable pressure (VP instruments only)

Working with variable pressure (VP) allows you to analyse and image non-conducting, strongly gassing or humid specimens. This is made possible by a special pumping system, which allows setting partial pressures of 1 to 133 Pa in the specimen chamber, while preserving the ultra high vacuum in gun area and beam path.

Using VP mode is only possible with a VP type SEM/FESEM.

4.1.4.1. Switching to variable pressure (VP) mode

- 1 Go to the **VP Control** tab of the **SEM Controls** panel.

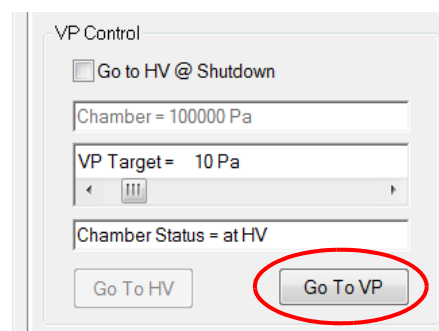


- 2 Select a *VP target* by using the slider.

Alternatively:

Double-click the *VP Target* field and enter the pressure value.

- 3 Click **Go To VP**.



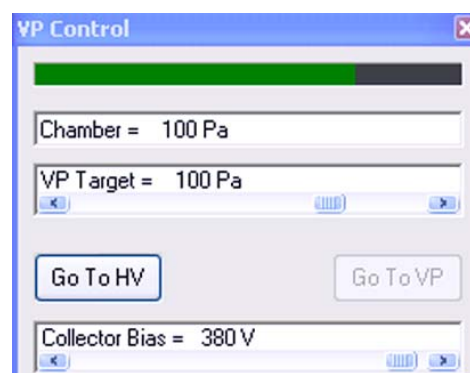
IMPORTANT

In VP mode, InLens detector and SE2 detector cannot be used. Instead, backscattered electron detectors or specially designed VPSE detectors should be selected.

4.1.4.2. Returning to high vacuum (HV) mode

- 1 Click **Go To HV**.

The vacuum in the specimen chamber is reduced to high vacuum conditions.



4.2. Navigating the specimen

4.2.1. Moving the specimen with the soft joystick

Alternatively to the dual joystick, you can navigate the specimen by using the software function **Soft joystick**. This function is helpful when you wish to move a single axis without the risk of moving another axis as well.

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Soft Joystick**.

The **Soft Joystick** panel opens.

- 3 Move the stage by using the respective sliders or the red marker in the navigation box.

To stop the moving stage:

- 1 Release the slider.

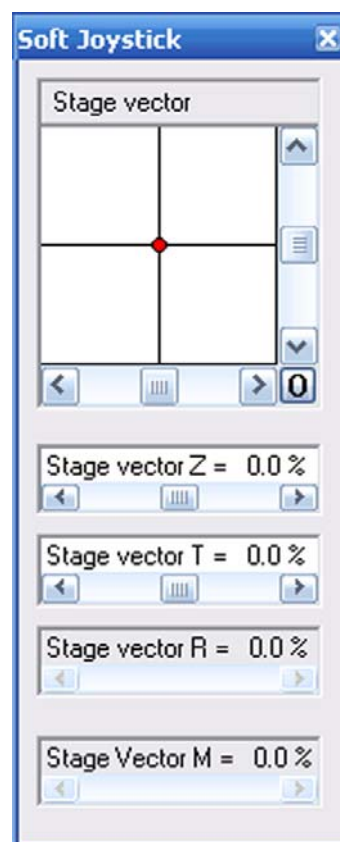
To stop the moving stage immediately:

- 1 Type **<F12>**.

Alternatively:

Click **Stage stop** in the **Stage** tab of the **SEM Controlss** panel.

When tilting a specimen ensure that the specimen to be analysed is always the one next to the objective lens.



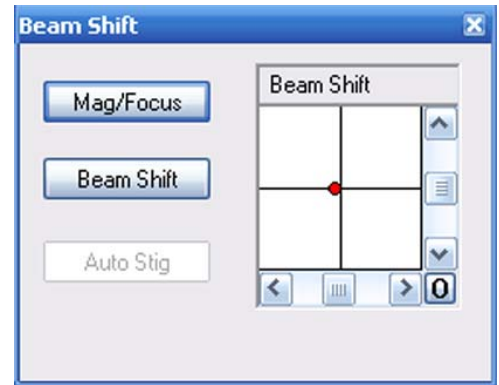
IMPORTANT

To prevent damage, a touch alarm is integrated in the SEM/FESEM: If specimen or sample holder touch chamber walls, detectors or objective lens, the stage is stopped immediately. An audible warning and an on-screen message are given.

4.2.2. Moving the specimen at high magnifications (Beam Shift)

The **Beam Shift** function is helpful when moving the specimen at magnifications above 100,000 x. At this magnification range it is generally difficult to exactly position an image feature by driving the stage. Therefore, the image of the specimen can be moved by shifting the electron beam instead of displacing the specimen itself.

- 1 Select **Beam/Beam Shift** from the menu.
The **Beam Shift** panel is shown.



Alternatively:

From the **Panel Configuration Bar**, select **Beam Shift**.

- 2 Click **Beam Shift**.
- 3 Use the red marker in the navigation box or the sliders to position the specimen.

The left mouse button is assigned to Beam Shift X and Y. The middle mouse button keeps the current assignment.

The electron beam can be shifted by +/- 7.5 μm in the X and Y directions.

4.2.2.1. Working with an expanded beam shift (licence: LARGE-BEAMSHIFT)

When you use different apertures sizes it might be helpful to move the image of the specimen by means of the beam shift function instead of moving the specimen itself. For this reason the range of the beam shift has to be enlarged.

Requires the licence LARGE-BEAMSHIFT.

Requires particular hardware.

- 1 Open the **SEM** status.
- 2 Go to the **Select** tab.
- 3 Tick the **Large Beamshift** checkbox.

The electron beam can be shifted by +/- 100 μm in the X and Y directions.

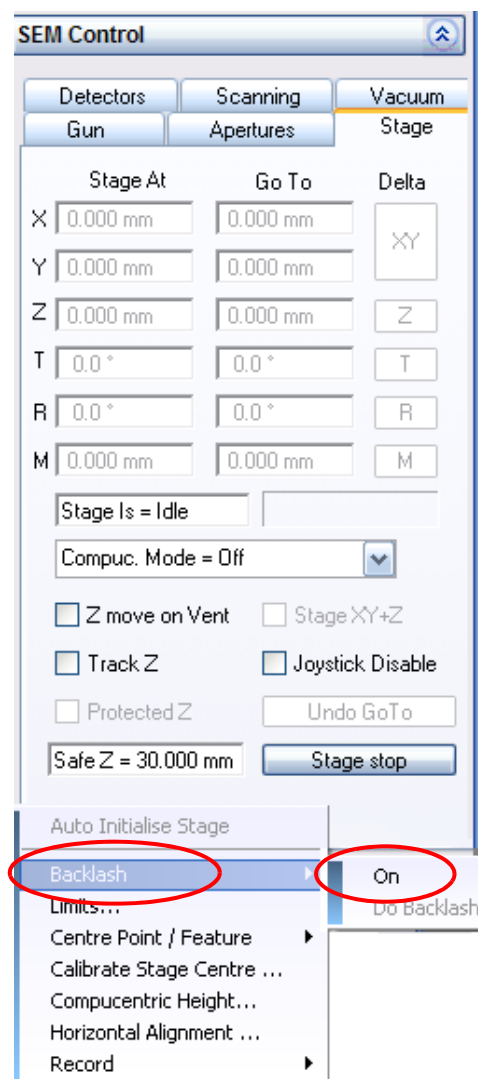
4.2.3. Improving stage repeatability by activating the function

is employed to take up the necessary mechanical play in the stage motors, so that any absolute stage position is always approached from the same direction, improving the repeatability of motorised stage movement.

- 1 Go to the **Stage** tab of the **SEM Controlss** panel.
- 2 Right-click in the **Stage** tab.

A submenu opens.

- 3 Select **/On**.



4.2.4. Compensating for image drift by shifting the beam (licence: DRIFT CORR)

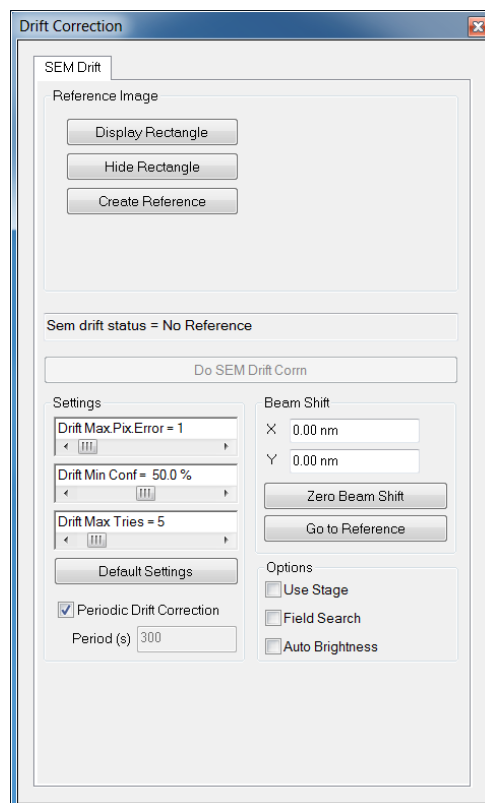
The drift correction is a program to compensate for the drift of the specimen by using a reference image and by controlling the beam shift. This function has two main applications:

- Improvement of the drive precision of the stage
When viewing a specific image section and driving the stage to another point, a drift is often observed when moving back to the specific point.
- Long-term analysis
If an image section is scanned for a longer time, mechanical, thermal and electrical effects will always cause a drift of the respective image section.

It is essential to find a striking detail of the specimen to be defined as a reference image. This detail will be sought later on in the current image by using image analytical algorithms. Requires the licence DRIFT CORR and the installation of the Matrox Imaging Library, which is protected by a dongle.

- 1 Select **Start/Programs/SmartSEM**.
SEM/FESEM: Select **Drift Prepare**.
XB: Select **SEM Drift Correction**.

The **Drift Correction** window opens.



4. Operation

Navigating the specimen

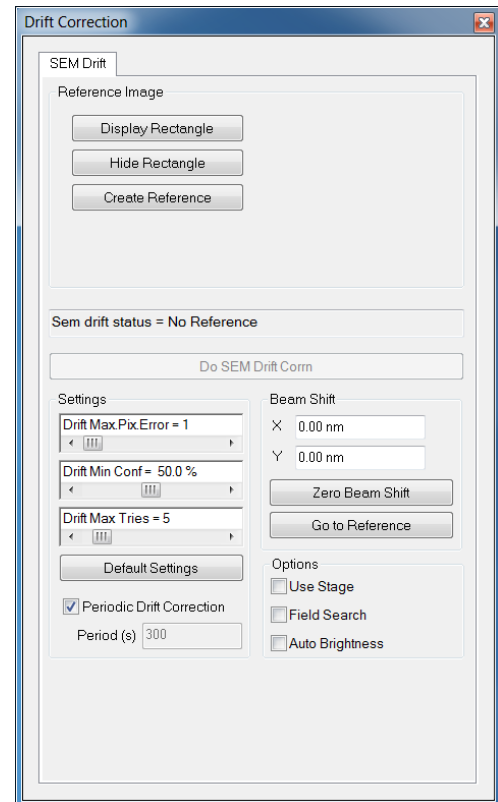
- 2 Click **Display Rectangle**.

A movable frame is shown. The image range inside the frame defines the reference image for the drift correction.

- 3 Change position and size of the frame to define a striking detail as reference image. The reference image should present a good signal-to-noise ratio.
Do not use Frame Avg, Line Avg as noise reduction methods.

- 4 In order to cancel any beam shift settings, click **Zero Beam Shift**.

- 5 If you wish to hide the frame, click **Hide Rectangle**.



- 6 Set the following parameters:
 - a **Drift Max. Pix. Error** = Drift maximum pixel error

Defines the precision of the drift correction. Indicates the largest allowed pixel distance between the current image and the corrected image. If this pixel distance is exceeded, the drift correction will not be accepted.

For most applications this parameter should be set to 1 to 4.

- b **Drift Max. Tries** = Drift maximum tries

Defines how often the algorithm will try to compensate a possible image drift by using the beam shift.

For most applications this parameter should be set to 5 to 15.

- c **Drift Min. Conf.** = Drift minimum confidence

Defines the precision of the correlation between reference image and found image section. For most applications this parameter should be set to 40% to 60%.

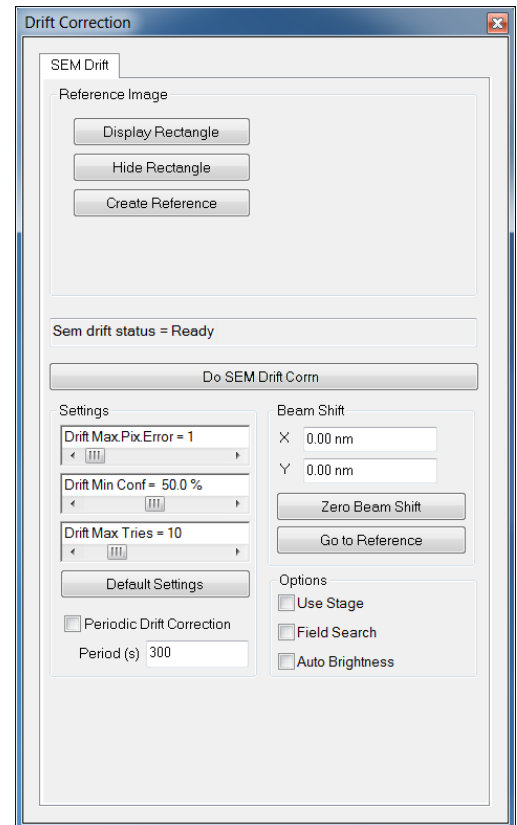
7 Click **Create Reference**.

A reference is acquired. In the field **Sem drift status** 'Ready' is indicated.

The button **Do SEM Drift Corr** becomes available.

8 Click **Do SEM Drift Corr**.

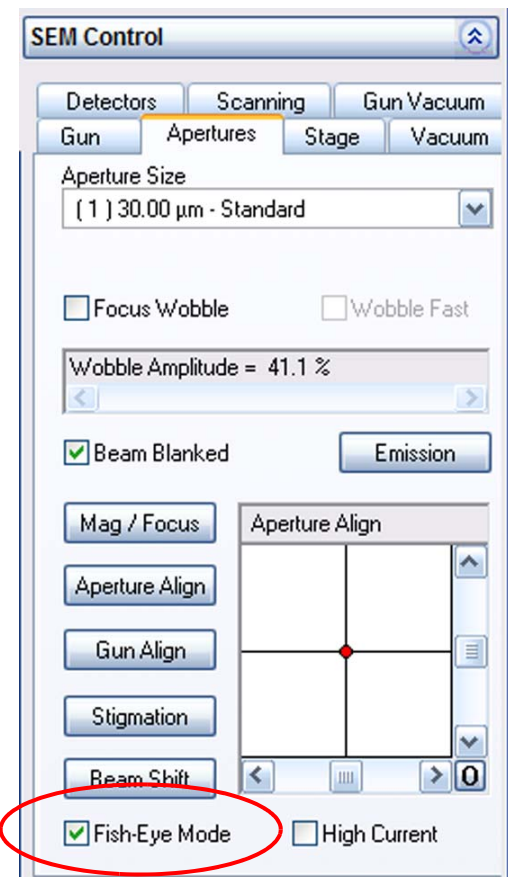
If the drift correction was successful, '*Success*' is indicated in the field **SEM drift status** .



4.2.5. Using fisheye mode (licence: FISHEYE)

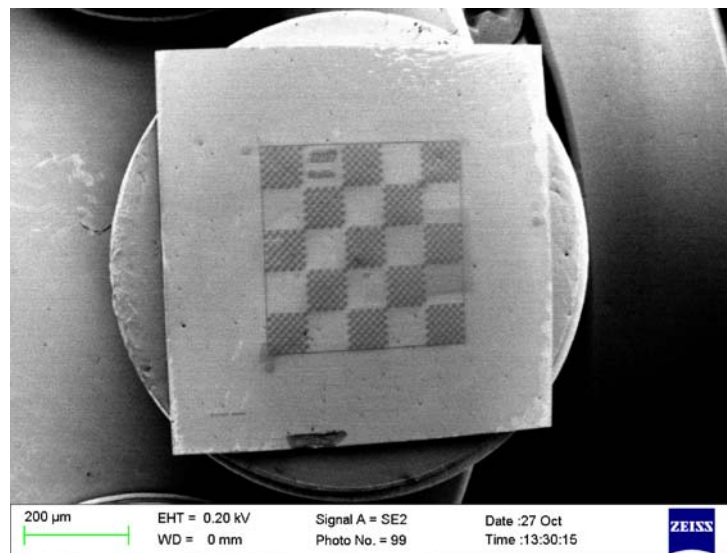
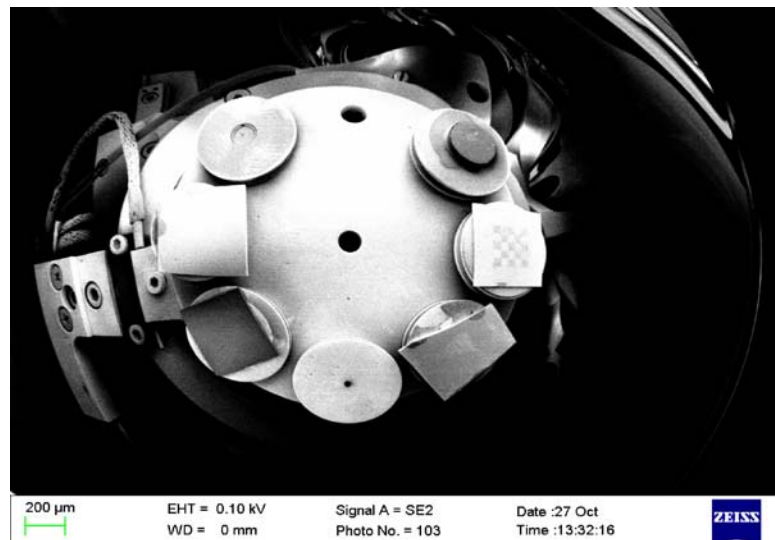
Fisheye mode allows you to get a survey of the complete specimen chamber by providing a top view on the sample holder at a low Z.
Requires the licence FISHEYE.

- 1 On the **SEM Controls** panel, select the **Apertures** tab.
- 2 Tick the **Fisheye Mode** checkbox.



IMPORTANT

Since the image is deformed due to the fisheye lens effect, measurements and the exact specification of the magnification are not possible. Therefore, a question mark is shown next to the micron marker.



- 1 To quit Fisheye mode, untick the **Fisheye mode** checkbox.
- 2 Under TV control, carefully drive the stage to the required Z.

4.2.6. Using the stage navigation functions

The Stage Navigation has the following characteristics:

- Plan view of the sample holder
- Display of the specimen chamber with chamber door
- Display of the stage hard limits
- Support for all different ZEISS sample holders
- Ability to zoom in to view the sample holder in great detail

Requires the licence COMPU.



IMPORTANT

This function requires the stage to be initialised.

4.2.6.1. Showing the specimen chamber schematics

- 1 Select **Stage/Navigation** from the menu.

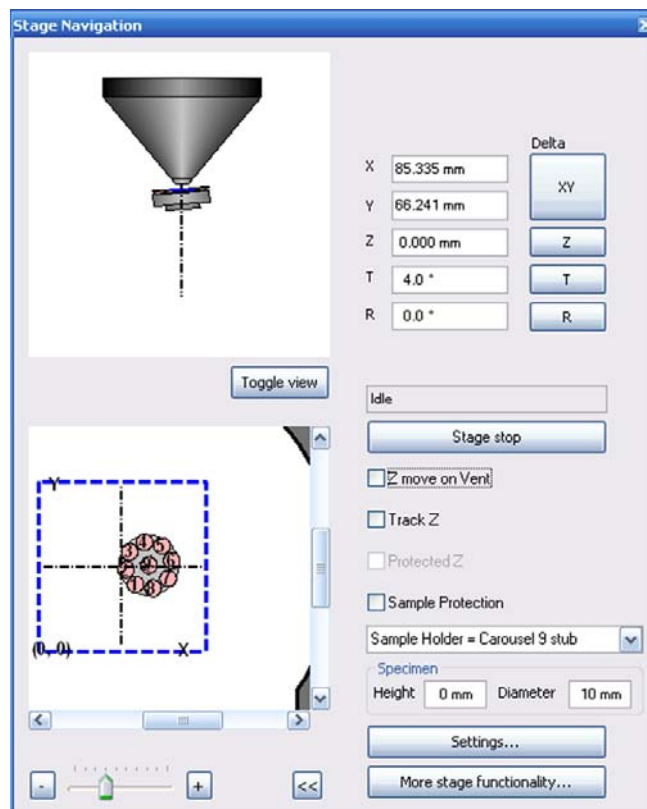
Alternatively:

Double-click **Stage Navigation** in the **Panel Configuration Bar**.

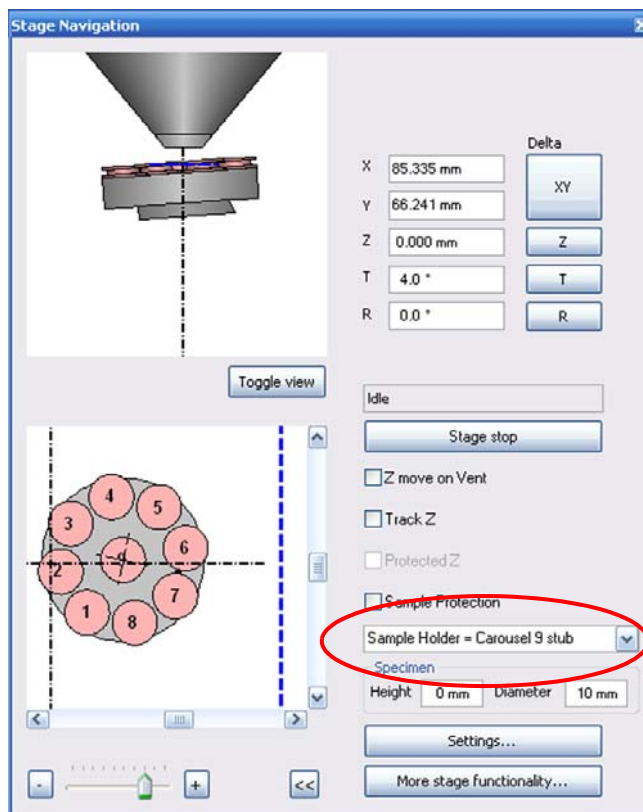
The **Stage Navigation** window opens.

The top window shows the lateral view of the stage inside the specimen chamber.

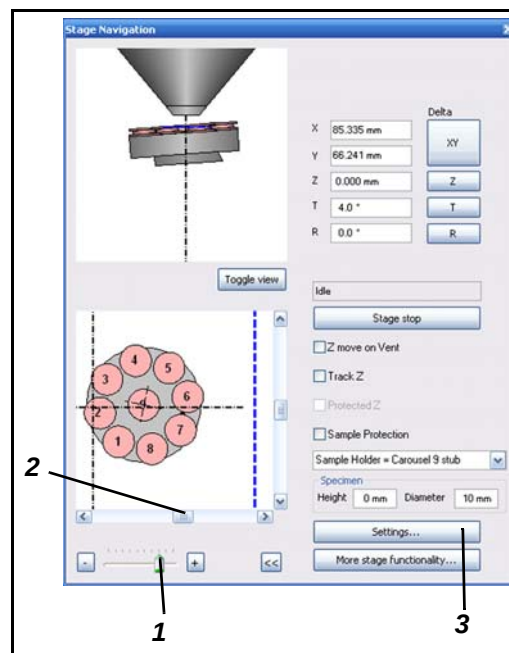
The bottom window shows the plan view of the stage.



- 2 Select your type of sample holder from the **Sample Holder** drop-down list.



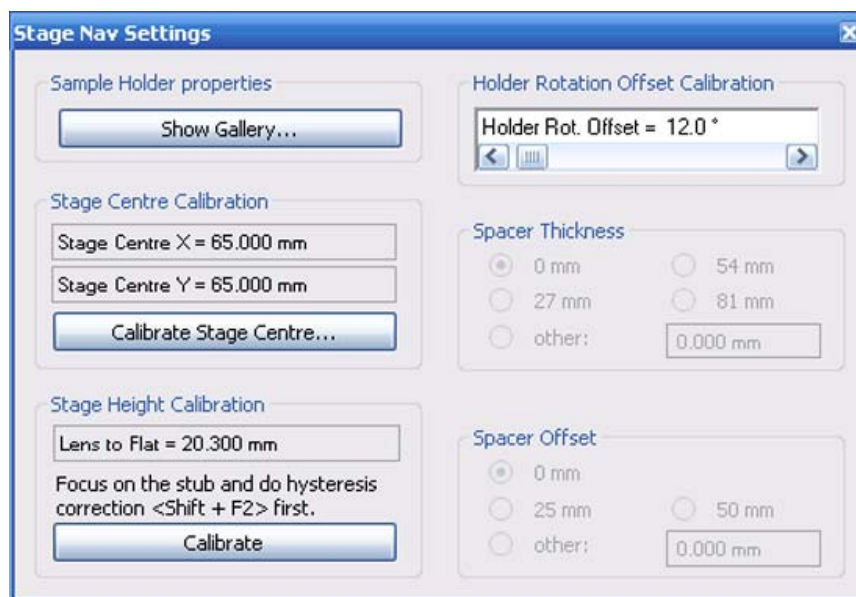
- 3 You can change the view:
 - a To zoom in, move the zoom control slider to the right (**1**).
 - b To change the detail, use the lateral sliders (**2**).
 - c To toggle the size of the window, click the << button.
- 4 To move the stage, double-click the sample position you wish to move under the electron beam.
- 5 To access the stage navigation settings, click **Settings** (**3**).



4. Operation

Navigating the specimen

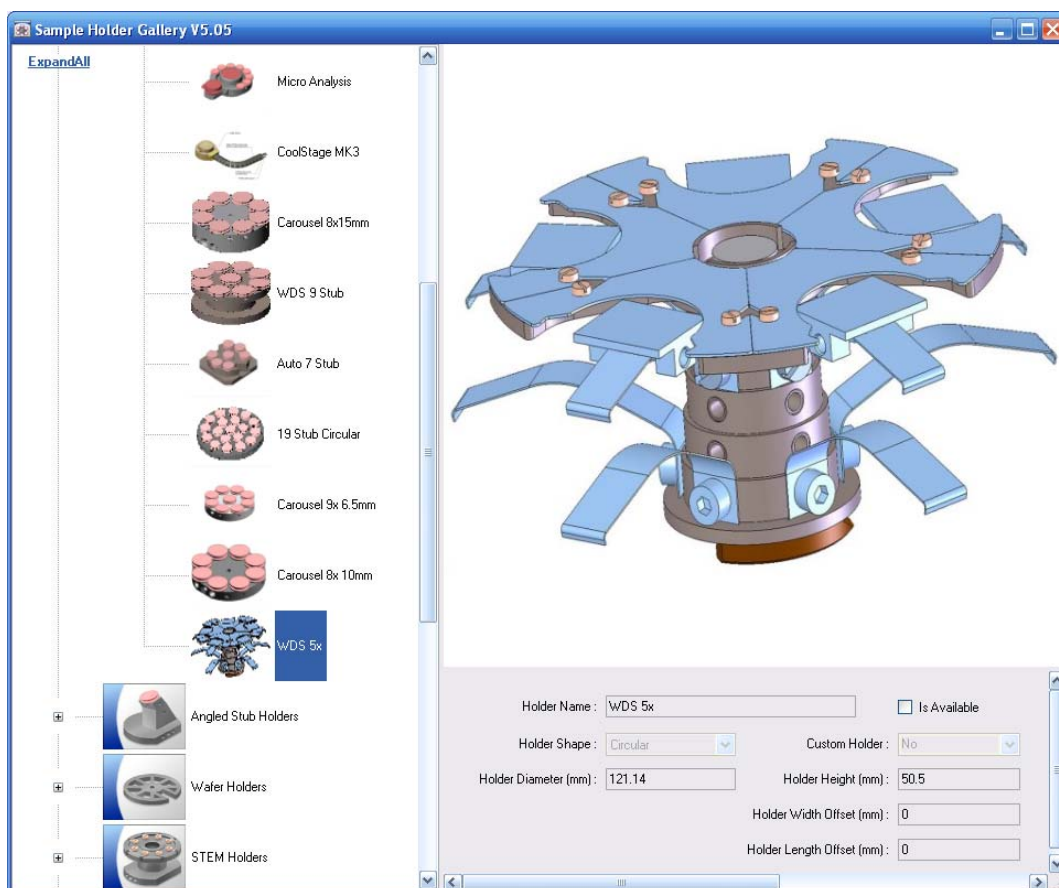
The **Stage Nav Settings** dialog opens.



4.2.6.2. Using the Sample Holder Gallery

The Sample Holder Gallery lets you inspect the dimensions of all possible sample holders. Additionally, it allows setting of the dimensions of custom stage holders.

- 1 Select **Stage/Navigation** from the menu.
- 2 Click **Settings**.
- 3 Click **Show Gallery**.



- 4 Select the installed sample holder from the list of icons on the left.
The **Is available** checkbox is ticked to indicate that the selected sample holder can be installed on the system.
- 5 If you use a custom sample holder:
 - a Select one of the custom sample holders.
 - b Enter the individual dimensions of your sample holder.
 - c Tick the **Is available** checkbox.

4.2.7. Eucentrically driving a non-eucentric stage (licence: COMPU)

This function allows rotation-eucentric and tilt-eucentric control of a non-eucentric stage by using software.

Requires the licence COMPU.

Different calibration procedures are required before the compucentric software can be used:

- Calibration of the rotation centre of the stage
(required for rotation-eucentric control and tilt-eucentric control)
- Calibration of the distance between specimen surface and rotation centre of the tilt axis
(additionally required for tilt-eucentric control)

4.2.7.1. Calibrating the stage centre

It is a prerequisite for all compucentric functions that the centre of the stage rotation is accurately known. This will normally only need to be performed once each time the stage is serviced. However, to achieve the ultimate accuracy it may be necessary to recalibrate the rotation centre each time the stage is initialised.



IMPORTANT

The calibration of the rotation centre is independent of the used sample holder and the used specimen. Therefore, this calibration can be use generally.

It is recommended that you use a single stub holder and a calibration grid or a TEM grid as specimen. The specimen must be mounted centrally on the stub.

- 1 Initialise the stage:
Select **Stage/Stage Initialise** and confirm.
- 2 Open the **Panel Configuration Bar**.
- 3 Double-click **Calibrate Stage Centre**.

Alternatively:

- a Go to the **Stage** tab of the **SEM Controlss** panel.
- b Right-click in the background of the **Stage** tab.
- c Select **Calibrate Stage Centre**.

The **Calibrate Stage Centre** dialog opens.

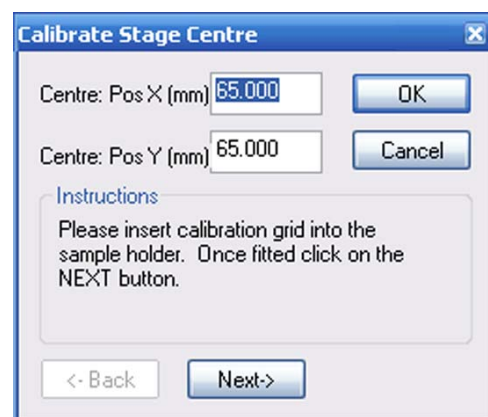
The last coordinates of the centre are indicated.

4 Click **Next**.

The stage is initialised.

After initialisation, a magnification of 30 x is automatically set.

Crosshairs are displayed.

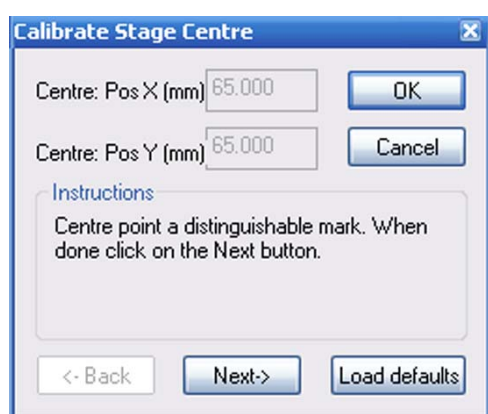


5 Select a striking feature on the specimen surface, that is positioned outside the centre.

6 Move the striking feature to the centre by using the joystick or the **Centre Point** function.

7 Click **Next**.

The stage is driven back to its initial position.



8 Click **Next**.

The stage rotates by 180°.

During stage rotation observe the striking feature on the specimen in order to be able to relocate it after rotation.



4. Operation

Navigating the specimen

- 9 Again, move the striking feature to the centre by using joystick or the Centre Point function.

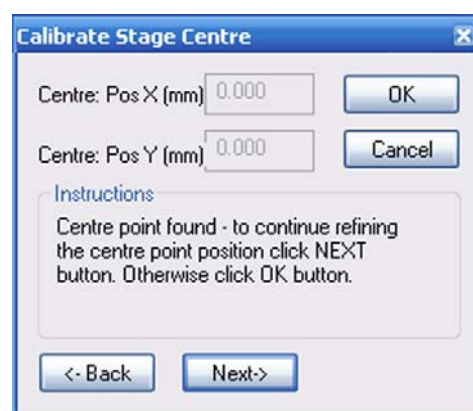


- 10 Confirm by clicking on **Next**.

The software has now calculated the new rotation centre and indicates the values for X and Y.

- 11 Click **Next**.

The stage returns to the initial position.



- 12 Set the next higher magnification (200 x).
- 13 Repeat the calibration procedure (steps 5 to 11).
- 14 Repeat the procedure for the magnifications 500 x, 1500 x and 2000 x.
- 15 After having calibrated the position with Mag = 2000 x, click **OK**.
- This will finish the calibration routine.

The calculated calibration values are used for stage navigation and eucentric movement.

4.2.7.2. Calibrating the compucentric height

If you want to tilt the specimen eucentrically or if you want to rotate a tilted specimen eucentrically, the software has to accurately know the distance between rotation centre of the tilt axis and specimen surface.

This is managed by the additional calibration of the compucentric height.



IMPORTANT

As the calibrated distance depends on specimen and sample holder, this routine must be performed separately for each specimen and sample holder.

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Compucentric Height**.
- 3 Follow the steps on the panel:
 - a Centre a feature and click **Read**.
 - b Tilt the stage.
 - c Centre the feature again and click **Calculate**.
- 4 Confirm by clicking on **OK**.

Compucentric Height :

1) Centre a feature then press Read

☐ Stage Backlash

2) Tilt the stage

Tilt To
8

Nudge size
0.05

3) Centre it again, and press calculate

Compu. Height = 0.000 mm

Compu. Tilt Error = 0.2664

4. Operation

Navigating the specimen

4.2.7.3. Activating the compucentric software functions

Prerequisite: The compucentric software has been calibrated properly. Refer to section 4.2.7.1. and section 4.2.7.2.



IMPORTANT

The more precisely and thoroughly the calibration is done, the more precisely the stage can be driven by the compucentric software.



IMPORTANT

If only the stage centre has been calibrated, only rotation-eucentric control in the horizontal line (Tilt = 0) will be possible.

- 1 On the **SEM Controls** panel, Select the **Stage** tab.

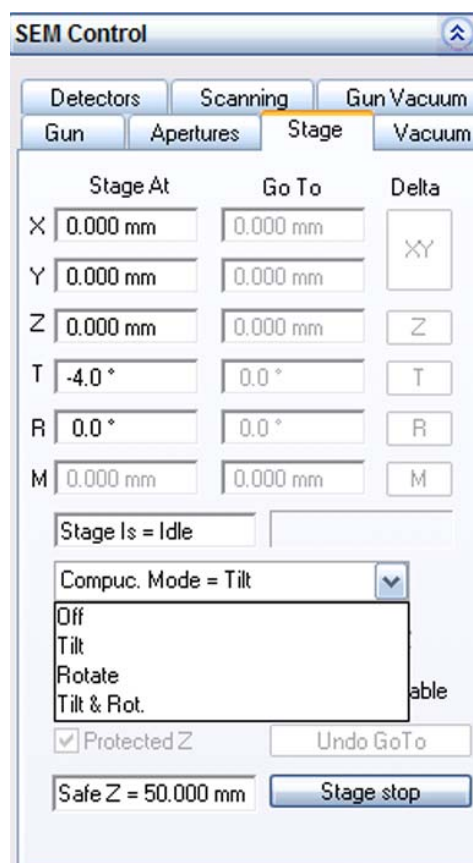
- 2 From the drop-down menu **Compuc. Mode**, select the desired mode:

Off: Disables the compucentric software

Tilt: Enables tilt-eucentric control

Rotate: Enables rotation-eucentric control

Tilt & Rot: Rotation- and tilt-eucentric control



CAUTION

Danger of malfunction of the stage, when using the joystick.

After activating the compucentric software functions, only drive the stage to absolute or relative coordinates. To do so, use the 'Go To' fields or the 'Delta' buttons.

4.2.7.4. Stage Horizontal Alignment

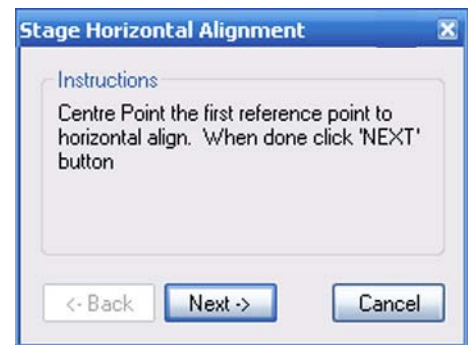
This function allows you to automatically move an image feature in the horizontal line. The stage centre must be calibrated.

A wizard is used to drive the stage such that a linear feature on the specimen, identified by two points, is horizontal with the second of the two points visible on screen.

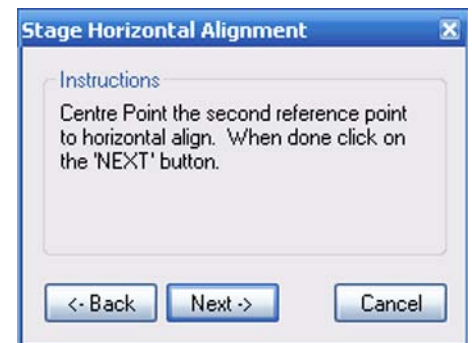
- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Stage Horizontal Alignment**.

The **Stage Horizontal Alignment** wizard opens. Crosshairs are displayed.

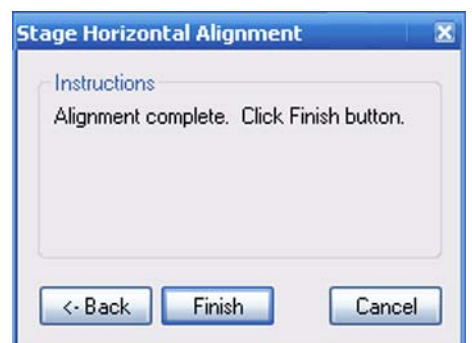
- 3 Centre the first reference point. To do so, use the joystick or the Centre point function.
- 4 Click **Next**.



- 5 Centre the second reference point.
- 6 Click **Next**.



- 7 Click **Finish**.



4.2.8. Saving and recalling stage coordinates (licence: STAGECO)

This function offers the possibility to save a list of stage positions together with magnification and working distance. Thus, the user can recall these positions easily.
Requires the licence STAGECO.

4.2.8.1. Saving and editing stage coordinates

- 1 Select **Stage/Store/Recall** from the menu.
- 2 To enter the current stage position, click on **Add**.
- 3 Enter a name and confirm.



The stage position is displayed on the Stage Position List.

- 4 To edit a stage position, mark the position and click **Edit**.
- 5 To delete a stage position, mark the position and click **Delete**.

4.2.8.2. Recalling stage coordinates

- 1 To move the stage to a stored position:
 - a Select the position.
 - b Click **On Goto**.

To cancel the last stage move, click **Undo Stage Goto**.

4.2.9. Centering a spot or an area (licence: CENTRE)

This function offers the following possibilities:

- **Point:**
Allows marking a spot in the image which is then automatically moved to the centre of the image area.
- **Feature:**
Allows selecting a feature or area in the image which is automatically centered and magnified so that the selected feature fills the complete image area.

Requires the licence CENTRE.

4.2.9.1. Using the Centre Point function

- 1 Select **Stage/Centre Point** from the menu.
Alternatively, type <Ctrl + Tab>.

The mouse cursor is displayed as a cross.

- 2 Place the cross on the interesting feature.
- 3 Click.

The feature is being moved to the centre of the image area.

- 4 To quit this function, right-click.

4.2.9.2. Using the Continuous Centre Point function

If selected, the software remains in centre point mode after each point selection allowing repetitive centre point actions.

- 1 Select **Stage/Continuous Centre Point** from the menu.
- 2 To quit this function, right-click.

4.2.9.3. Using the Centre feature function

- 1 Select **Stage/Centre Feature** from the menu.
Alternatively, type <Ctrl + Shift + Tab>.

The mouse cursor is displayed as a cross.

- 2 Place the cross on the interesting feature.
- 3 Drag the mouse to open a frame, which comprises the area of interest.
- 4 Click.

The feature range is being moved to the centre of the image area and magnified.

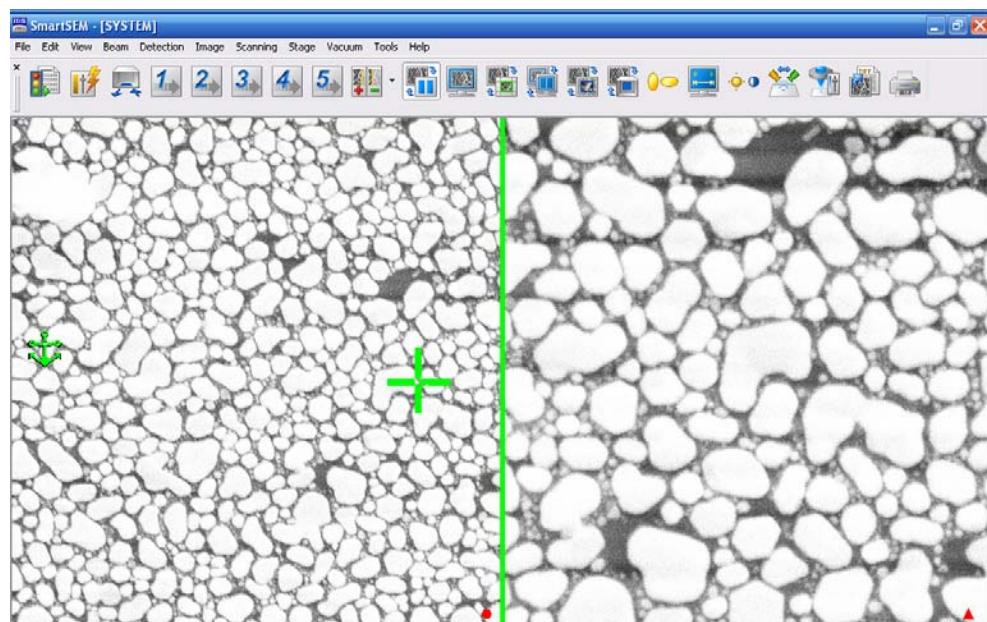
- 5 To quit this function, right-click.

4.2.10. Using Stage Map (licence: CENTRE)

This function allows using a frozen image in the left zone (zone 0) as an overview for the selection of interesting features on the specimen surface. Requires the licence CENTRE.

- 1 Select a low magnification.
- 2 Move the stage to the interesting specimen area.
This setting will be used as stage map.
- 3 Select **Scanning/Split** in order to change to spot mode.
- 4 Select **Stage/Stage Map**.

The left zone (zone 0) is frozen and serves as an overview.



- 5 Select a feature of interest in the left zone by placing the cross and clicking.

In the right zone (zone 1), the selected feature is displayed. You can modify the image, e.g. magnify as required.

4.2.11. Scanning defined image fields (licence: STAGESCAN)

This function allows you to scan an exactly defined series of regularly distributed image fields. This is useful when searching for particles or other objects in a large sample range, as it is ensured that no part of the interesting area will be omitted. Four scan patterns and several methods are available to determine the scan range. Requires the licence STAGESCAN.

- 1 Select **Stage/Stage Scan** from the menu.

The **Stage Scanning** window opens.

- 2 Define the stage scan fields:
 - a Click **Setup Wizard**.
 - b Follow the instructions given in the wizard.



Jumps to the first position



Moves to the previous position



Moves to the next position



Jumps to the last position



Selects the scan pattern (sequence)

4.2.12. Toggling between survey view and detail view (licence: SURVEY)

This function offers the possibility to save two different settings for magnification and working distance and to switch between these settings. The settings are called *Survey Mode* (provides a survey view) and *Resolution Image* (provides a detail view).

Requires the licence SURVEY.

4.2.12.1. Entering survey view and detail view settings

Survey view settings

- 1 Set the survey view settings:
Set a low magnification and a large working distance to achieve a wide field of view.
- 2 Select **Stage/Survey/Settings** from the menu.
- 3 Enter the desired settings in the **Survey Mode** field:
 - a To automatically set the lowest possible magnification, tick the **Lowest Mag** radio button.
 - b To take the current magnification and WD settings, click the **Get Current** buttons.

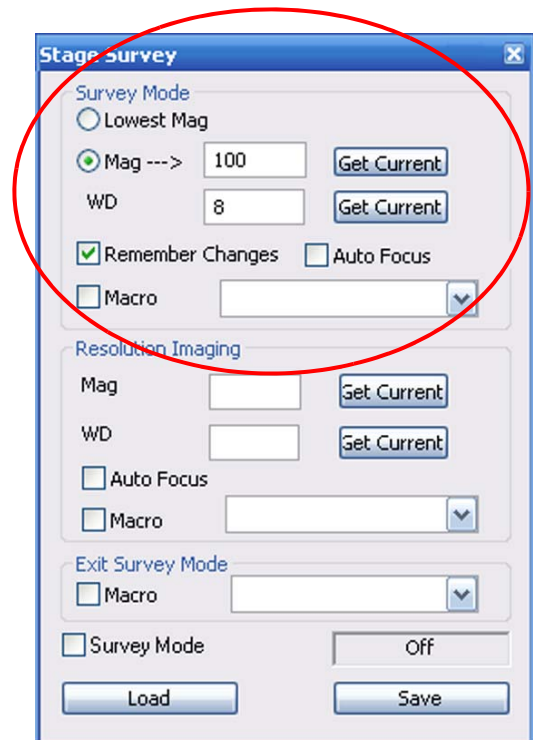
You can also manually enter the desired values.

- 4 Select additional functions:
 - a Tick the **Remember Changes** checkbox.

When switching to **Survey Mode** State, especially for the first time, it may be necessary to adjust focus.

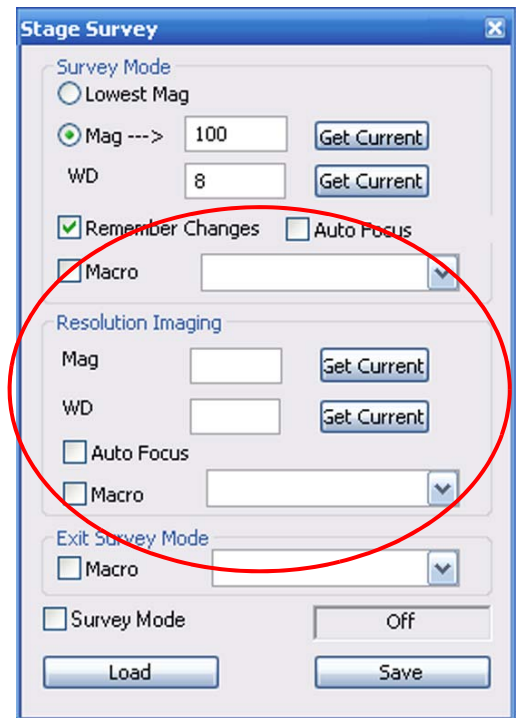
When **Remember changes** is ticked, the new working distance as a result of focusing will replace the target WD in the settings.

- b To start an automatic focus adjustment after start of the respective operation mode, tick the **Auto Focus** checkbox.
 - c To execute a macro, tick the **Macro** checkbox and select a macro from the drop-down list.



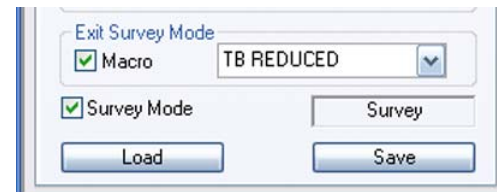
Detail view settings

- 5 Enter the detail view settings:
Set a higher magnification and a smaller WD.
- 6 Enter the desired settings in the **Resolution Imaging** field:
Click the **Get Current** buttons after Mag and WD.
- 7 Select additional functions:
 - a If you wish to start an automatic focus adjustment after the respective operation mode, tick the **Auto Focus** checkbox.
 - b To execute a macro, tick the **Macro** checkbox and select a macro from the drop-down list.



If you wish to execute a macro when quitting Survey Mode:

- a In the **Exit Survey Mode** field, tick the **Macro** checkbox.
- b Select a macro from the drop-down list.



4.2.12.2. Activating the Survey Mode function



IMPORTANT

This function requires the stage to be initialised.

- 1 Tick the **Survey Mode** checkbox.

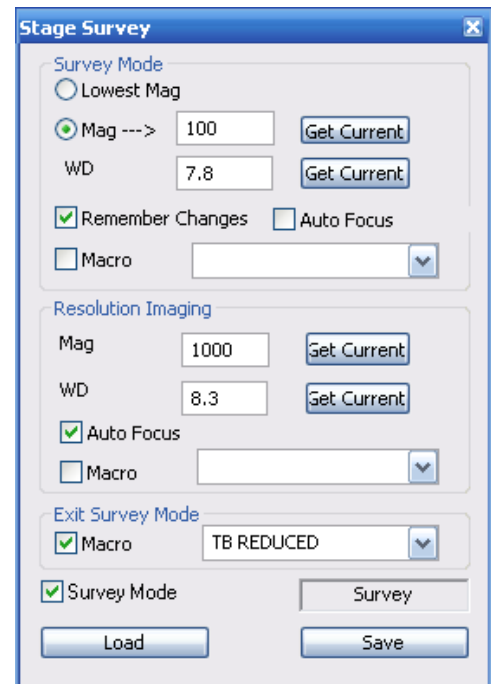
Alternatively:

Select **Stage/Survey/Survey Mode** from the menu.

- 2 To quit Survey Mode, untick the **Survey Mode** checkbox.

Alternatively:

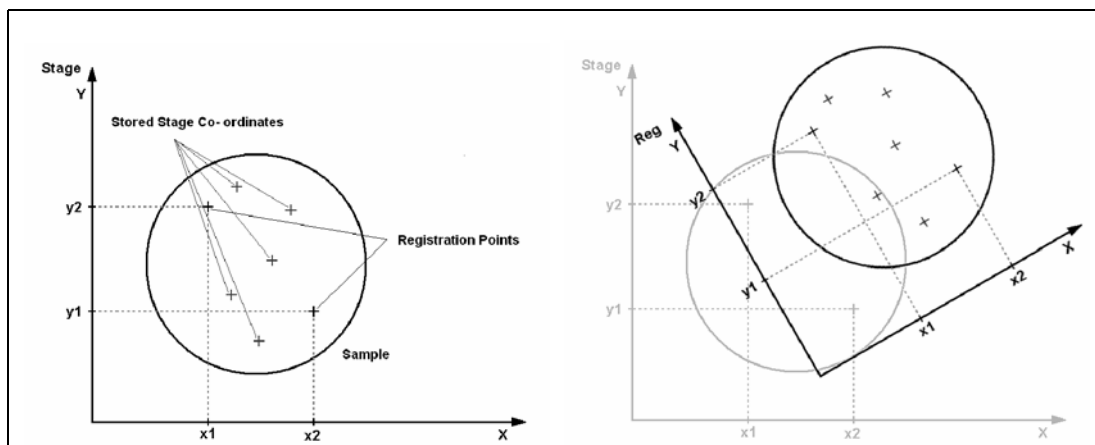
Select **Stage/Survey/Survey Mode** in order to untick the function in the menu.



4.2.13. Defining a user specific coordinate system (licence: STAGEREG)

This function offers the possibility to define a user specific 2D coordinate system based on three reference points. Within this coordinate system, the stage can move to specific spots on the specimen, while the stage coordinates can be saved.

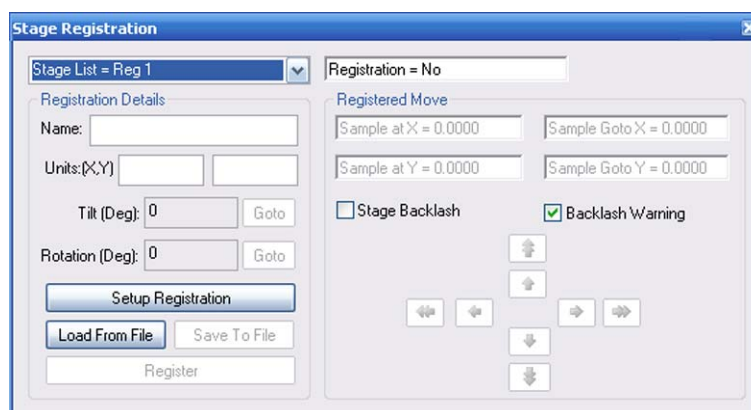
Requires the licence STAGEREG.



If there are three spots on the specimen, whose distances to the saved stage coordinates are defined, these spots can be used as reference points.
It is possible to create up to nine different coordinate systems.

- 1 Ensure the stage has been initialised.
- 2 Load a suitable specimen e.g. a chessy.
- 3 Open the **Panel Configuration Bar**.
- 4 Double-click **Stage Registration**.

The **Stage Registration** window opens.



- 5 Under **Stage List**, select a new coordinate system.

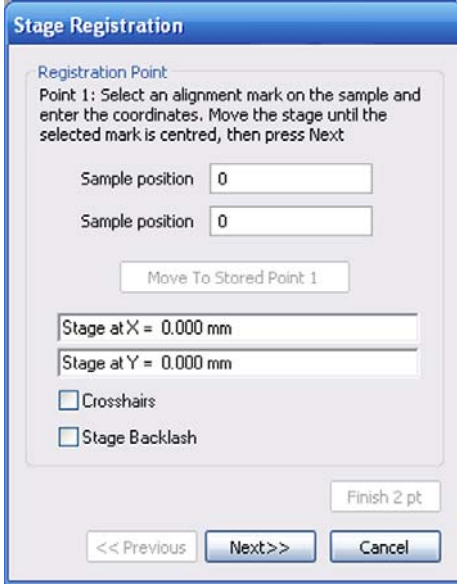
4. Operation

Navigating the specimen

- 6 Enter a name.
- 7 Click **Setup Registration**.

The **Stage Registration** window opens.

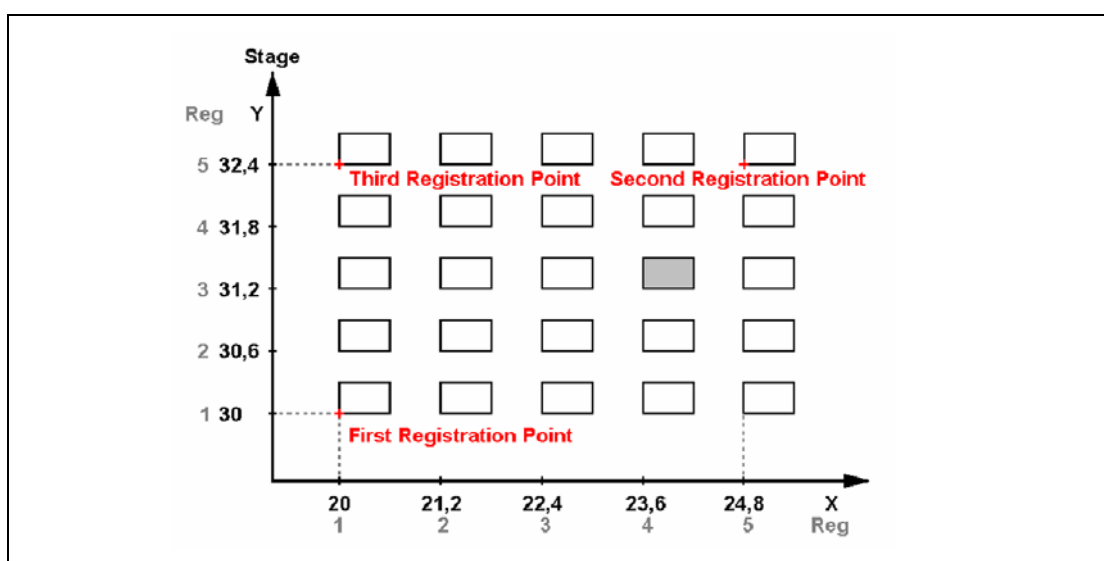
- 8 To show crosshairs, tick the **Crosshairs** checkbox.
- 9 Select an alignment mark on the specimen.
- 10 Enter the coordinates.
- 11 Move the stage to the selected alignment mark.
- 12 Click **Next**.



The **Stage Registration** dialog box contains the following elements:

- Registration Point** section with instructions: "Point 1: Select an alignment mark on the sample and enter the coordinates. Move the stage until the selected mark is centred, then press Next".
- Two input fields for "Sample position", both containing the value "0".
- A button labeled "Move To Stored Point 1".
- Two input fields for stage coordinates: "Stage at X = 0.000 mm" and "Stage at Y = 0.000 mm".
- Two checkboxes: "Crosshairs" and "Stage Backlash", both currently unchecked.
- A button labeled "Finish 2 pt" at the bottom right.
- Navigation buttons at the bottom: "<< Previous", "Next >>", and "Cancel".

- 13 Repeat steps 7 to 10 for the second registration point.
- 14 Repeat steps 7 to 10 for the third registration point.
- 15 Click **Finish**.

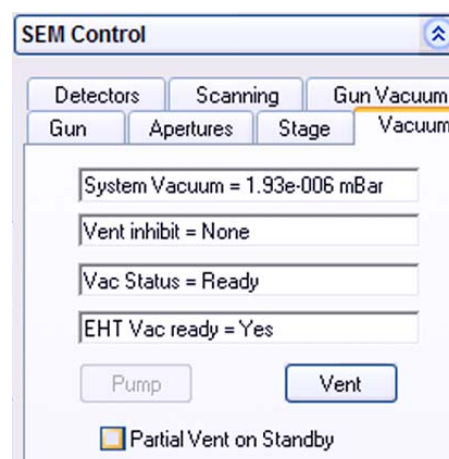


4.3. Setting SEM conditions

4.3.1. Controlling the gun

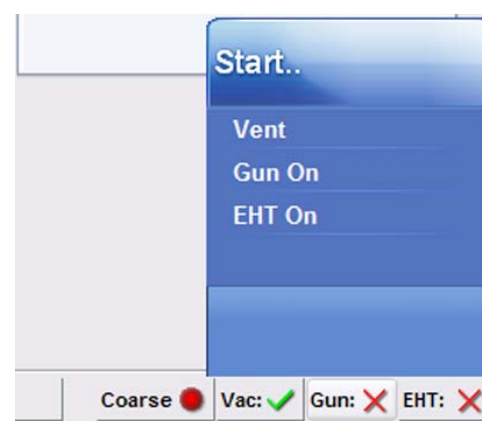
4.3.1.1. Switching on the gun

- 1 On the **SEM Controls** panel, select the **Vacuum** tab.
Check that *EHT Vac ready*=Yes is indicated.



- 2 In the status bar, click **Gun**.
- 3 Select **Gun On** from the pop-up menu.

The gun is being run up.



4.3.1.2. Switching off the gun

It is recommended leaving the gun on during the working week. This should help optimise life time of the Schottky field emitter.
Only at longer breaks such as weekends or holidays you should switch off the gun.

4. Operation

Setting SEM conditions

- 1 In the status bar, click **All:**.
- 2 Select **Shutdown Gun** from the pop-up menu.



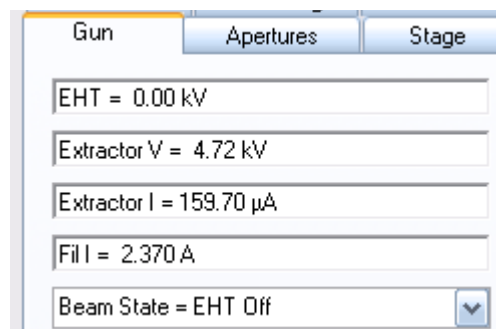
4.3.2. Controlling the EHT

4.3.2.1. Switching on the EHT

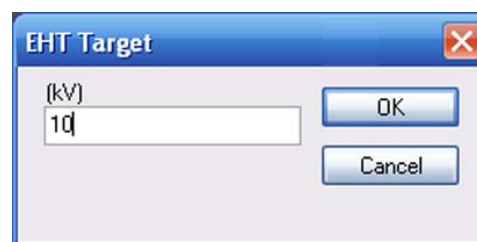
The electrons emitted by the gun have to be accelerated by applying the acceleration voltage EHT.

Setting the
EHT

- 1 On the **SEM Controls** panel, select the **Gun** tab.
- 2 Set the acceleration voltage:
 - a Double-click in the **EHT=** field.



- b Enter the desired value (kV).
- c Confirm by clicking on **OK**.



IMPORTANT

The In-lens detector can be used up to an acceleration voltage of 20 kV. At higher acceleration voltages the efficiency of the In-lens detector will be markedly reduced.



IMPORTANT

SUPRA™ 25 only:

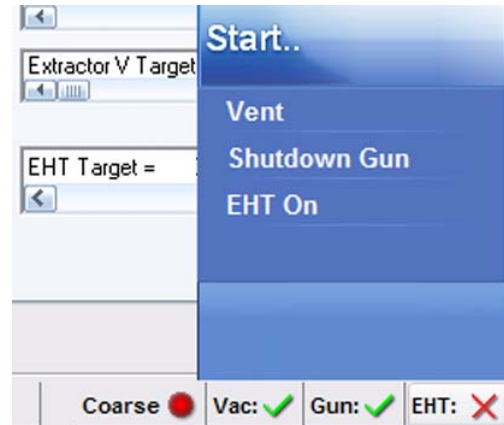
To be able to set a value below 0.5 kV, the licence LOWVOLTS is required.

To be able to set a value from 20 kV to 30 kV, the licence EXTVOLTS is required.

4. Operation

Setting SEM conditions

- Switching on
- 3 Switch on the EHT:
 - a In the status bar, click **EHT**.
 - b Select **EHT On** from the pop-up menu.

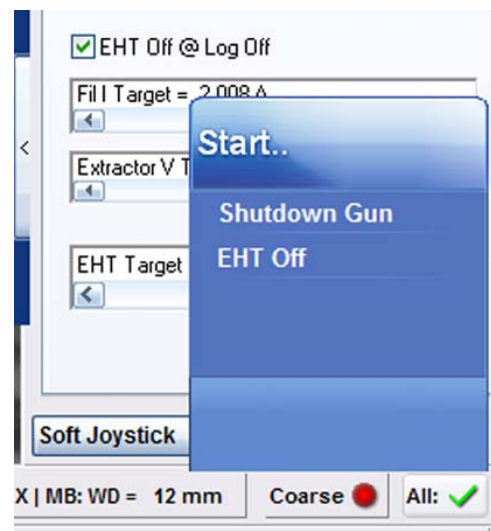


Alternatively:
Select **Beam/EHT On** from the menu.

The EHT (acceleration voltage) is run up to the set value.
The status bar buttons are pushed together, and the **All:** button appears.

4.3.2.2. Switching off the EHT

- 1 In the status bar, click **All**.
- 2 Select **EHT Off** from the pop-up menu.



Alternatively:
Select **Beam/EHT Off** from the menu.

4.3.3. Blanking the beam

To protect sensitive specimens from the electron beam, you can blank the beam.



IMPORTANT

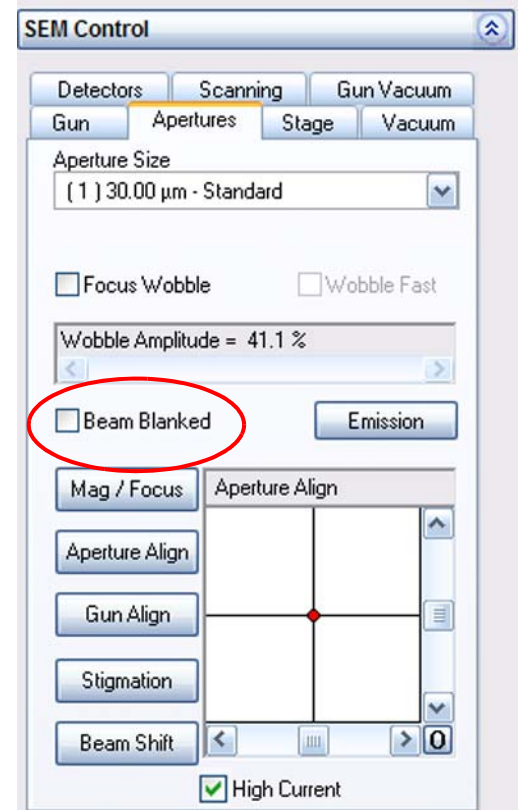
This procedure does not refer to the optional Beam Blanker for MERLIN®. For information on the optional MERLIN® Beam Blanker, refer to the Instruction Manual Beam Blanker delivered with the Beam Blanker.

- 1 On the **SEM Controls** panel, select the **Apertures** tab.

Alternatively:

Select **Beam/Aperture** from the menu.

- 2 Tick the **Beam Blanked** checkbox.



4.3.4. Modifying the probe current

The probe current (beam brightness) is determined by aperture size and extractor voltage. Moreover, it can be increased by using the high current mode.

Depending on your application, choose one of these three possibilities to modify the probe current.

Using the option OptiProbe offers the possibility to automatically set the probe current.

4.3.4.1. Changing the aperture size

- 1 On the **SEM Controls** panel, select the **Apertures** tab.

Alternatively:

Select **Beam/Aperture** from the menu.

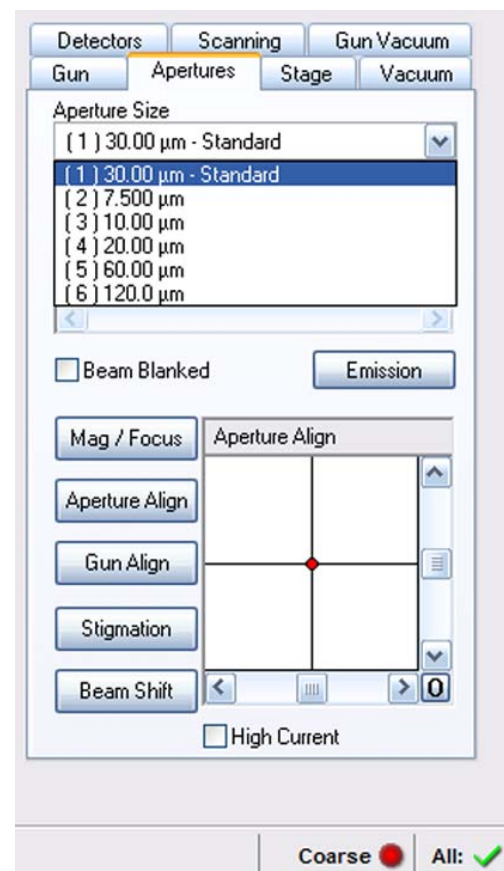
- 2 Click in the **Aperture Size** field and select an aperture from the drop-down menu.

Standard aperture is a multihole aperture with a central 30 μm aperture hole which is suitable for most applications.

Large apertures (120 μm , 60 μm diameter) are used for certain applications that require a high beam brightness, e.g. EDX, or a large depth of field.

Small apertures (20 μm , 10 μm , 7.5 μm diameter) are suitable for high resolution imaging or current-sensitive specimens.

- 3 Continue with aligning the newly set aperture as described in section 4.3.5.



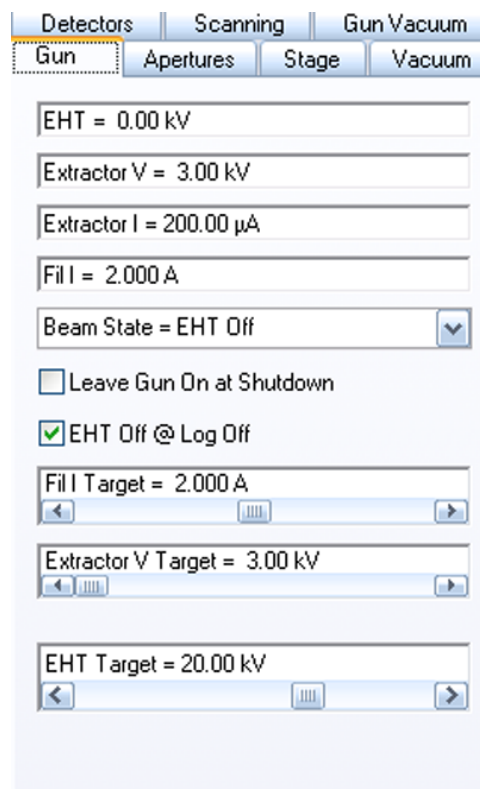
4.3.4.2. Changing the extractor voltage

The extractor voltage is preset by the factory, respectively by the ZEISS service representative. Within certain limits, the operator may carefully alter the extractor voltage in order to optimise the probe current for particular applications.

- 1 On the **SEM Controls** panel, select the **Gun** tab.

- 2 Use the arrow buttons of the **Extractor V Target** slider to increase the extractor voltage.

Increasing the extractor voltage may be suitable to increase the probe current.



CAUTION

Performance and resolution of the SEM/FESEM can be impaired.

Avoid reducing the extractor voltage.

If at all, reduce the extractor voltage only for a short time (1-2 h) and by maximum 500 V.



IMPORTANT

The newly set extractor voltage is only valid for the current work session.

After a restart of the SmartSEM[®] software, the SEM/FESEM will restore the nominal voltage.

4.3.4.3. Using high current mode (licence: HIGH CURRENT)

High current mode increases the active probe current. This is obtained by a stronger activation of the condenser lens.

Typical applications are images with a large depth of field.

Requires the licence HIGH CURRENT. Not available with SUPRA™ 25.

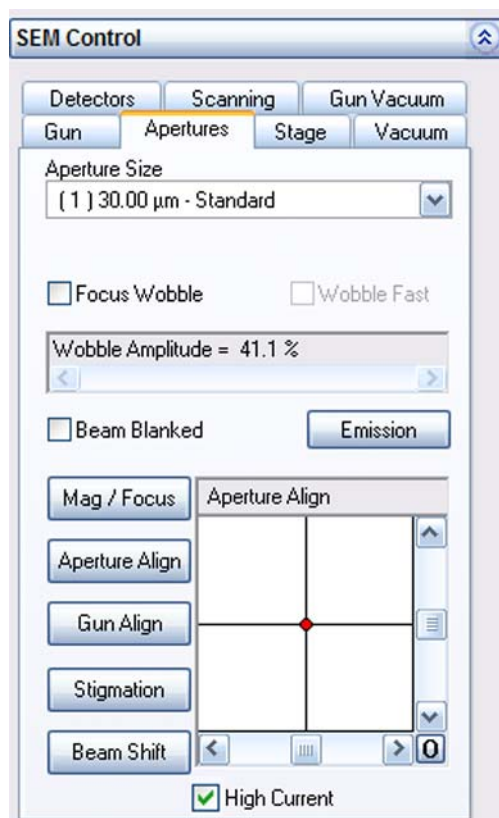
- 1 On the **SEM Controls** panel, select the **Aper-**
tures tab.

Alternatively:

Select **Beam/Aperture** from the menu.

- 2 Tick the **High Current** checkbox.

To quit high current mode, untick the **High Current** checkbox.



4.3.4.4. Continuously modifying the probe current (licence: OPTIPROBE)

OptiProbe allows you to continuously adjust the probe current.

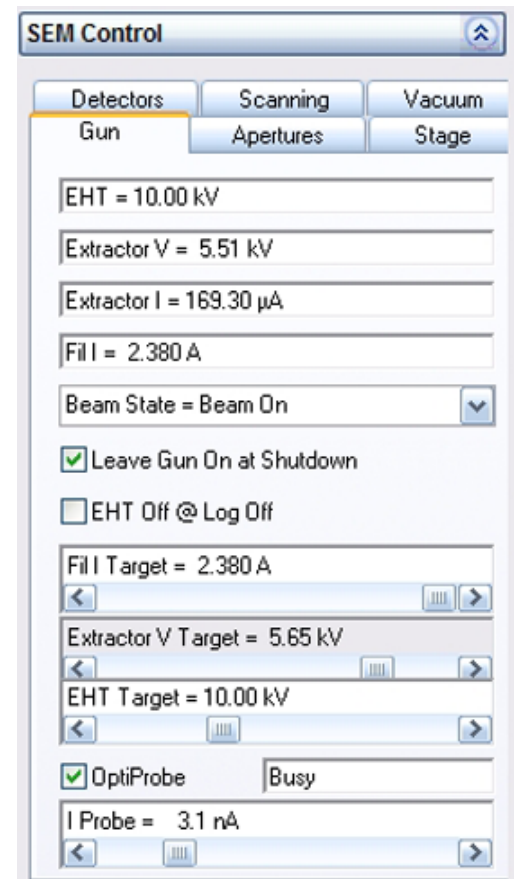
The function automatically selects a suitable aperture and the current mode while the extractor voltage is adjusted to meet the probe current selected by the user.

Requires the licences OPTIPROBE and HIGH VOLTAGE.

Requires particular hardware as well as the installation of the specimen current amplifier.

Not available with SUPRA™ 25.

- 1 On the **SEM Controls** panel, select the **Gun** tab.



- 2 Tick the **OptiProbe** checkbox.
- 3 Use the **I Probe** slider to set the desired probe current.

As soon as the probe current adjustment is finished, the status display changes from *Busy* to *Ready*.

The indicated probe current **I Probe=** corresponds to the actual probe current (+/- 15 %).

- 4 To deactivate the function, untick the **OptiProbe** checkbox.
Even if **OptiProbe** is deactivated, **I Probe=** indicates the actual probe current (+/- 15 %).

**IMPORTANT**

After cathode replacement or after re-alignment of the electron optical column, OptiProbe has to be calibrated. Refer to section 5.3.

4.3.5. Aligning the aperture

The alignment of the aperture in the beam path has a decisive effect on resolution and sharpness of the image.

The aperture alignment should therefore be adjusted or checked anytime the aperture is changed and after major modifications of the EHT setting.

Whenever the image is shifting while you are focusing, the aperture should be re-aligned.

- 1 On the **SEM Controls** panel, select the **Aper-**
tures tab.

Alternatively:

Select **Beam/Aperture** from the menu.

- 2 Tick the **Focus Wobble** checkbox.

The Focus Wobble is a function that sweeps the focus of the objective lens backwards and forwards through the focus on the specimen surface. If the aperture is slightly misaligned, a lateral shift can be observed.

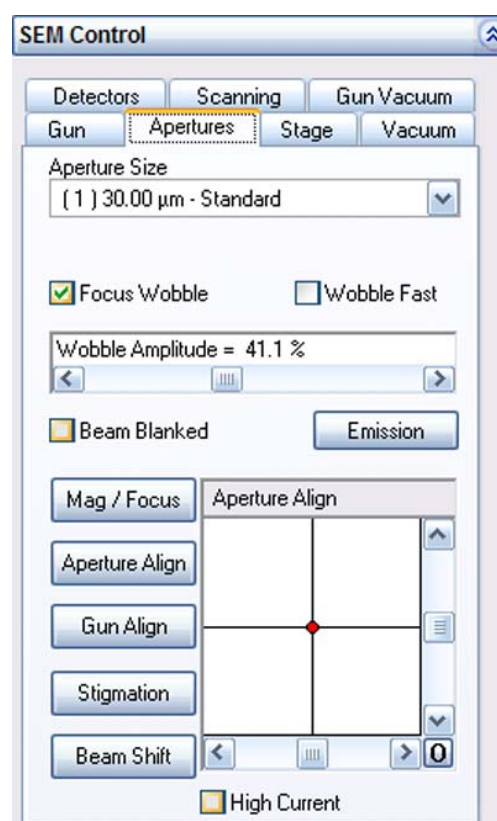
- 3 Set wobble intensity by using the **Wobble Am-**
plitude slider.
- 4 If required, select a higher wobble frequency by
ticking the **Wobble Fast** checkbox.

- 5 Adjust the aperture in X and Y direction by
means of the slider in the **Aperture Align**
navigation box.

Alternatively, you can move the red marker by
holding the left mouse button and dragging.

Adjust until the image pulsates, i.e. there is only
a continuous change from a sharp to a blurry
image without shifting.

- 6 Untick the **Focus Wobble** checkbox.
- 7 Refocus the image.

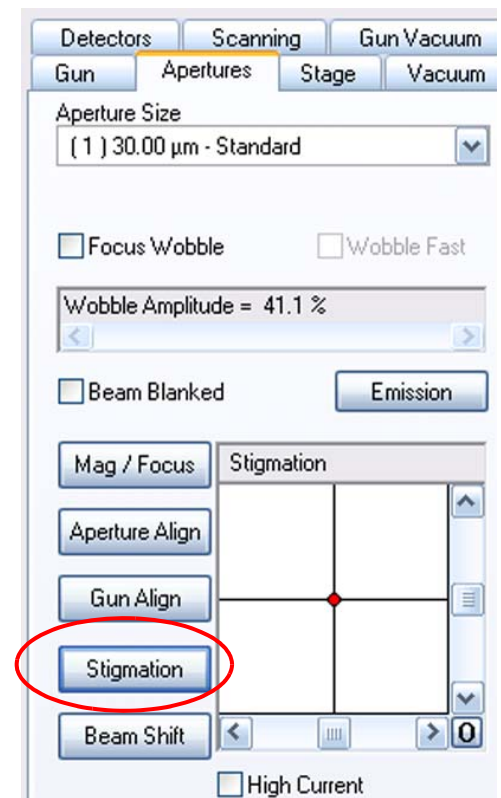


4.3.6. Correcting astigmatism

Astigmatism is an aberration of lenses, that can be corrected by means of the so-called stigmator.

4.3.6.1. Setting the stigmator

- 1 On the **SEM Controls** panel, select the **Apertures** tab.
- 2 Click **Stigmation**.
Adjust the stigmation by using the X and Y sliders or the arrow buttons in the **Stigmation** box.

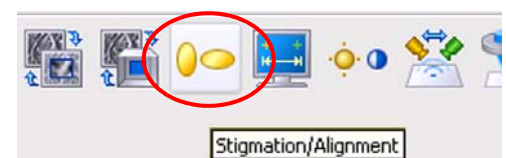


Alternatively:

- 1 In the toolbar, click the **Stigmation/Alignment** icon.

The mouse assignment is indicated in the status bar.

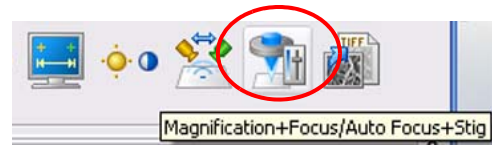
- 2 To adjust stigmation hold the left mouse button and drag.



4.3.6.2. Using the Auto Stigmatism function

- 1 In the toolbar, middle-click the **Auto Focus+Stig** icon.

A fine auto focus correction is performed followed by an automatic astigmatism algorithm.

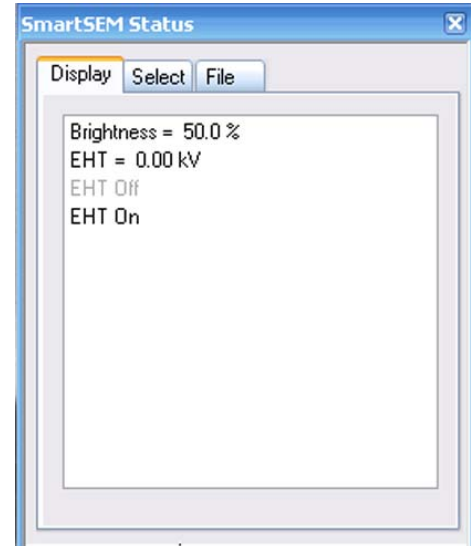


4.3.7. Showing SEM parameters (SEM status window)

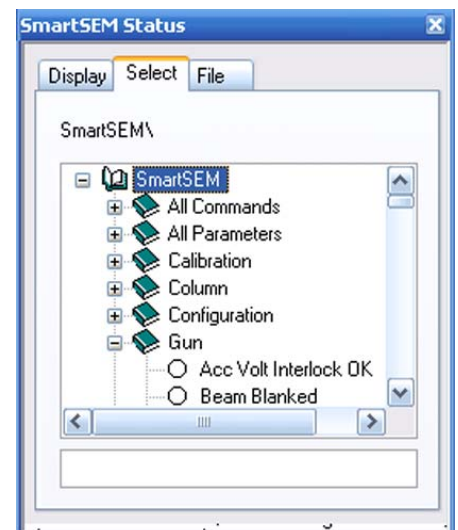
The SEM status window is helpful to show, edit and set frequently used parameters. The SEM status window lists the operation parameters selected by the individual user.

- 1 Select **View/SEM Status** from the menu.

Alternatively, type <CTRL+ I>.



- 2 Select the parameters to be displayed:
 - a Go to the **Select** tab.
 - b Click the parameter you wish to be displayed.
The parameter is shown in the **Display** tab.



- 3 To change the setting of the displayed parameter:
 - a Go to the **Display** tab.
 - b Double-click the parameter name.

4. Operation

Setting SEM conditions

- 4 To load a saved combination of parameters:
 - a Go to the **File** tab.
 - b Click **Load**.
 - c Select the file.
- 5 To save a selected combination of parameters:
 - a Go to the **File** tab.
 - b Click **Save As**.
 - c Enter a file name and confirm.
- 6 To delete the complete list of parameters:
 - a Go to the **File** tab.
 - b Click **Clear Display**.

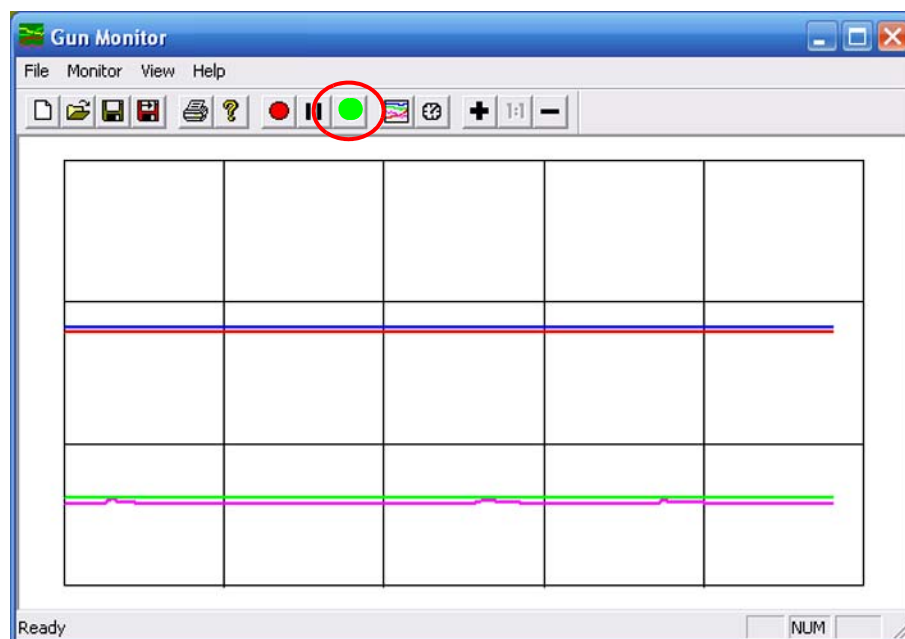


4.3.8. Recording SEM parameters

The Gun Monitor utility offers the possibility of recording and displaying important parameters of the SEM/FESEM at defined intervals during operation of the SmartSEM® user interface.

- 1 Select **Start/Programs/SmartSEM Service/Gun Monitor** from the Windows desktop.

The **Gun Monitor** window opens.



- 2 To start the record, select **Monitor/Start**.

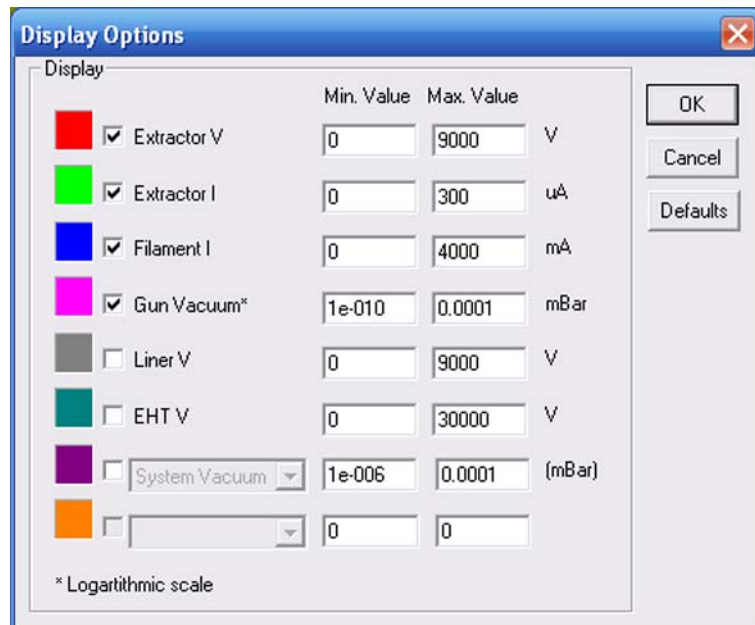
Alternatively, click the green dot.

Eight different channels are available, six of them are predefined to record extractor voltage, extractor current, filament current heating, gun vacuum, liner tube voltage, and acceleration voltage.

4. Operation

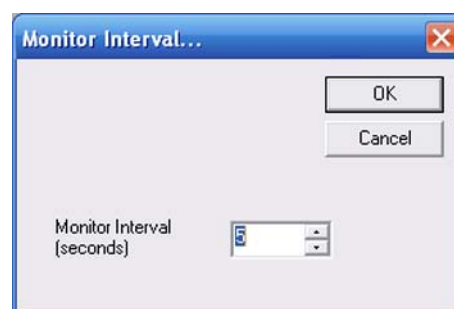
Setting SEM conditions

- 3 To modify channel assignments:
 - a Select **Monitor/Options**.
The **Display Options** window opens.
 - b To remove the checkmark, click it.

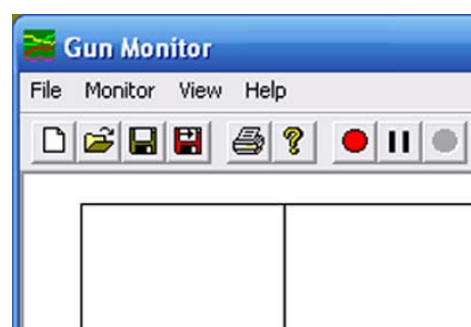


- 4 To change the colour:
 - a Click the colour square.
 - b Select another colour and confirm.
- 5 To enter the minimum and maximum values to be displayed in the diagram:
 - a Click into the **Min Value** or **Max Value** field.
 - b Enter a minimum value or maximum value.
- 6 Confirm by clicking on **OK**.
By clicking on **Defaults** you can cancel all settings and reset them to the basic settings.

- 7 To set the recording interval:
 - a Select **Monitor/Interval**.
The monitor interval window opens.
 - b Enter an interval in seconds.



- 8 To freeze the record, select **Monitor/Freeze**.
- 9 To stop the record, select **Monitor/Stop**.
- 10 To save the record, select **File/Save As**.
- 11 To print the record, select **File/Print**.



4.4. Imaging

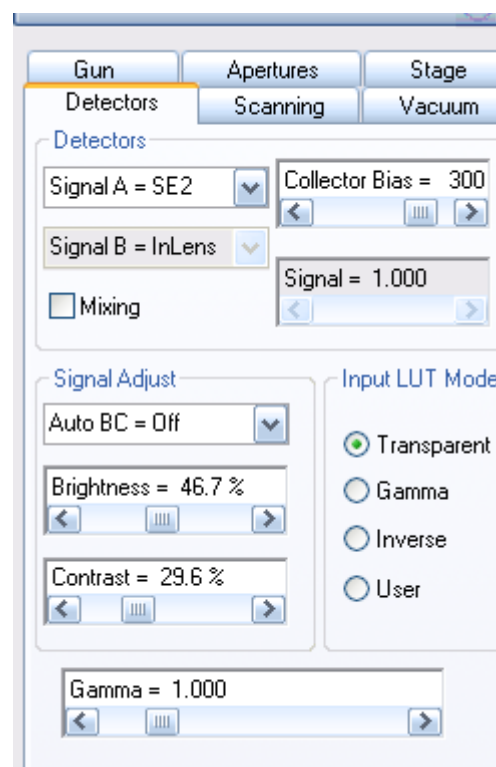
4.4.1. Setting detection parameters

4.4.1.1. Selecting a detector

Detectors provide the signals to be displayed on the monitor. A drop-down list shows the detector types adapted to your SEM/FESEM. Depending on the detector type selected, different information is shown in the image.

- 1 On the **SEM Controls** panel, select the **Detectors** tab.
- 2 Select the desired detector Signal A.

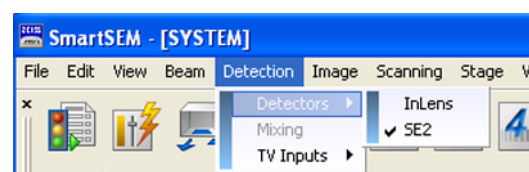
Signal A is always the active signal displayed on the monitor.



Alternatively:

Select **Detection/Detectors** from the menu.

A list of the adapted detectors is shown.
The active detector is ticked.



4.4.1.2. Setting the collector voltage of the SE2 detector

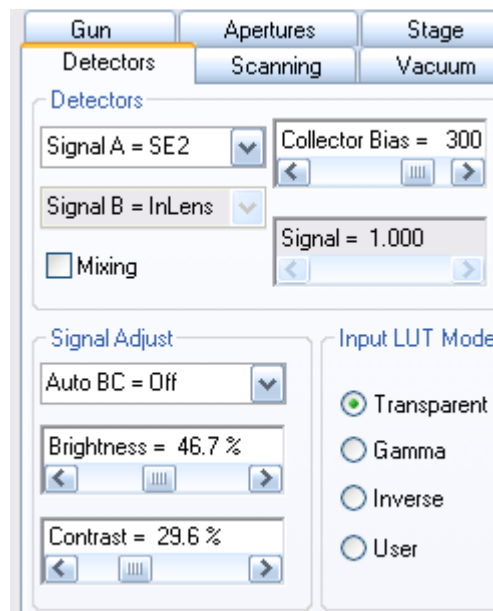
In front of the SE2 detector an electrical field is generated that allows you to influence the detection. This collector voltage can be varied at a range between -250 V and +400 V.

- 1 On the **SEM Controls** panel, select the **Detectors** tab.
- 2 To set the collector voltage use the **Collector Bias** slider.

For standard applications the Collector Bias should be set to +300 V.

At higher magnification it is recommended varying the Collector Bias so that the best possible signal is obtained in the image.

To generate a so-called pseudo-backscattered image set a negative Collector Bias. This will produce an extreme topography but nearly no surface qualities and material contrasts.

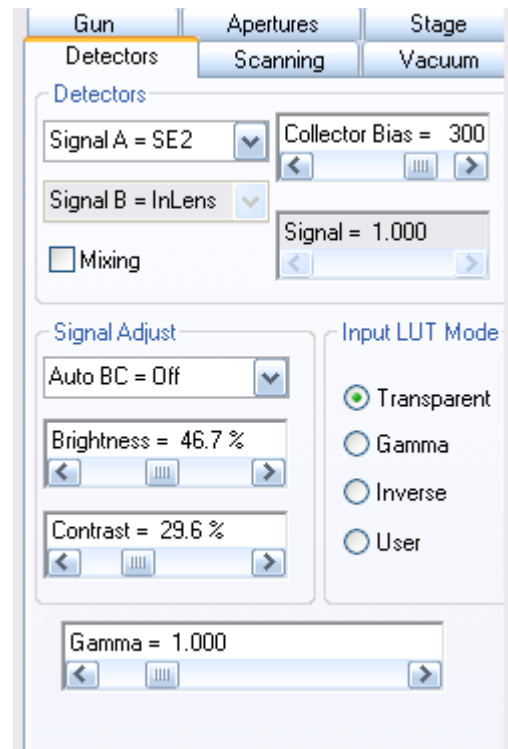


4.4.1.3. Adjusting brightness and contrast

Changing the signal to more brightness shifts all grey levels in the image to lighter levels and vice versa.

Changing the signal to more contrast expands the range of grey levels in the image and vice versa.

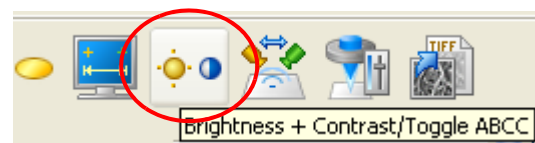
- 1 On the **SEM Controls** panel, select the **Detectors** tab.
- 2 To adjust brightness, use the **Brightness** slider.
To adjust contrast, use the **Contrast** slider.



Alternatively:

- 1 In the toolbar, click the **Brightness + Contrast** icon.

The mouse assignment is indicated in the status bar.

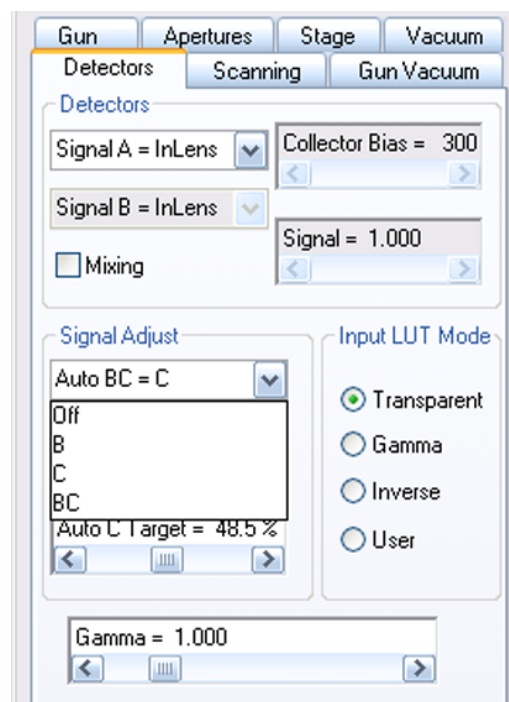


- 2 To adjust brightness hold the left mouse button and drag.
To adjust contrast hold the middle mouse button and drag.

4.4.1.4. Using AutoBC

The Auto BC function allows you to automatically adjust brightness or contrast or both brightness and contrast.

- 1 On the **SEM Controls** panel, select the **Detectors** tab.
- 2 Select one of the settings from the drop-down menu:
Off: Switches the function off
B: Automatic adjustment of brightness
C: Automatic adjustment of contrast
BC: Automatic adjustment of brightness *and* contrast

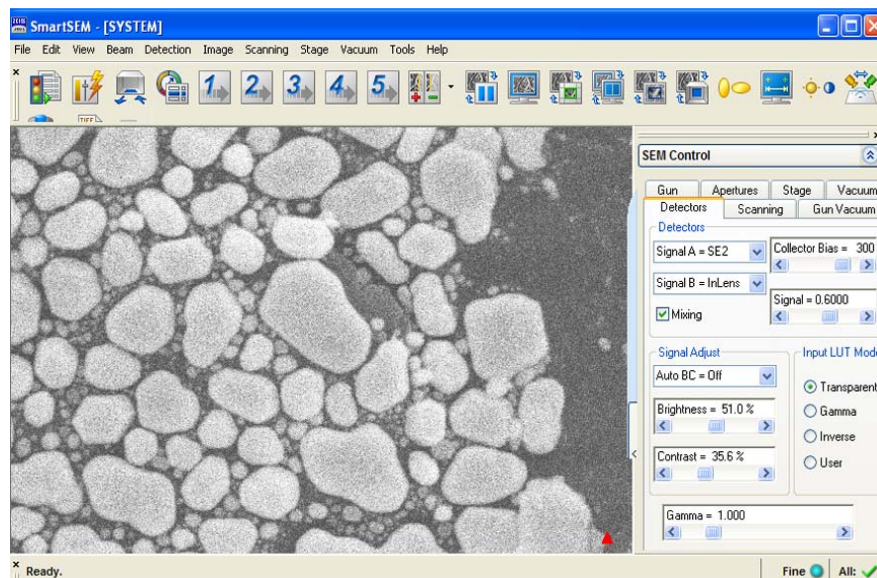
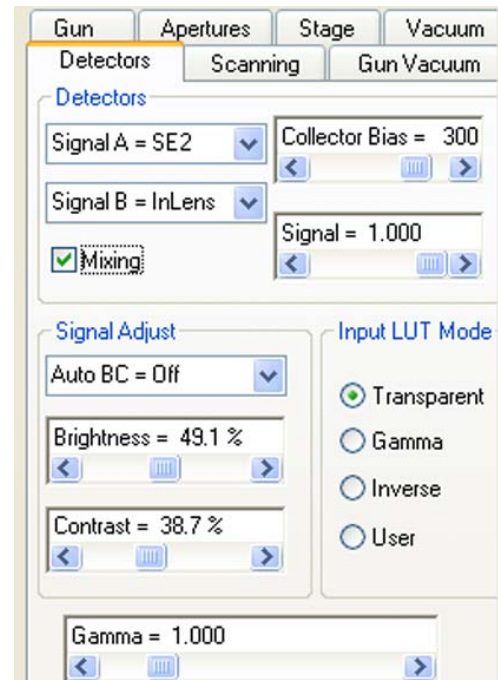


4.4.1.5. Mixing two detector signals (licence: SIGMIX)

This function allows mixing the signals of the detectors selected in Signal A= and Signal B=. Information registered by one single detector (e.g. topographic contrast) can thus be overlapped with another detector signal to increase the information of the image. Requires the licence SIGMIX.

- 1 On the **SEM Controls** panel, select the **Detectors** tab.
- 2 Tick the **Mixing** checkbox.
- 3 Use the **Signal** slider to adjust the percentage of mixing between 0 and 1 (i.e. 0 to 100%).
For example, adjusting *Signal = 0.6000* means that the image is composed of 60 % signal A and 40 % signal B.

To quit the mixing function, untick the **Mixing** checkbox.

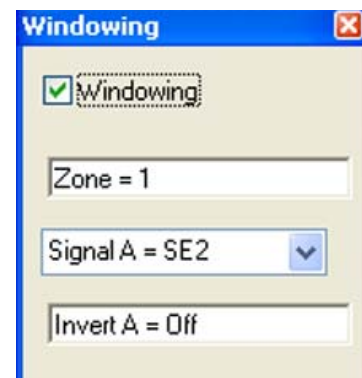


To quickly activate/deactivate the mixing function, select **Detection/Mixing** from the menu. When active, the function is ticked.

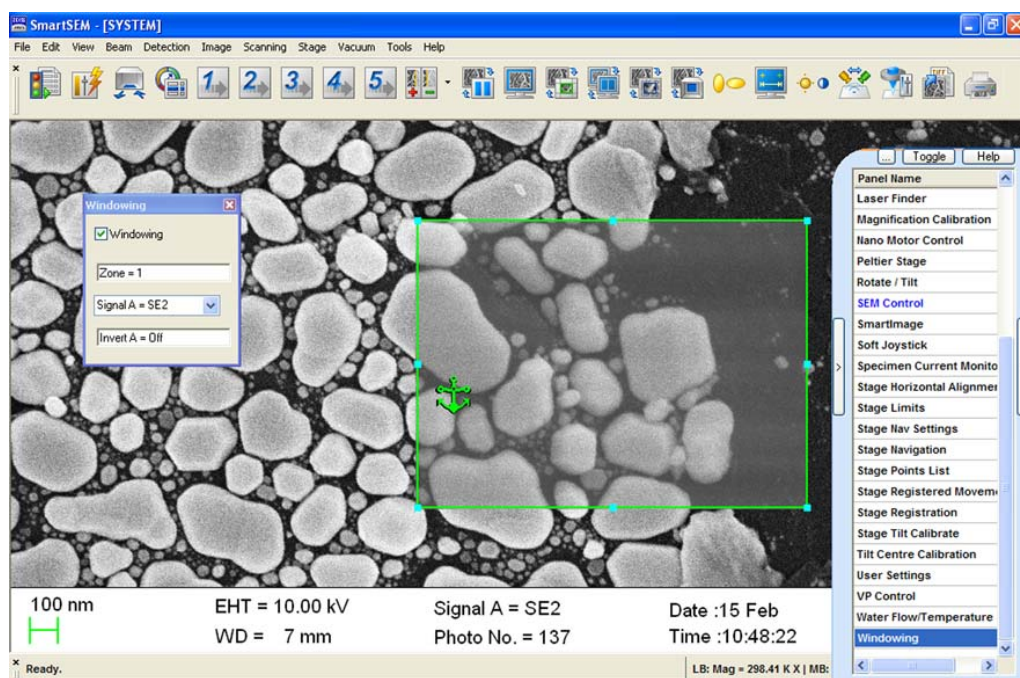
4.4.1.6. Displaying two detector signals on the same monitor (Windowing)

The windowing function allows displaying two different detector signals on the monitor without requiring an optional licence.

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Windowing**.
The **Windowing** dialog opens.
- 3 Tick the **Windowing** checkbox.



A reduced raster is shown.
There are two zones (Zone 0 = outside, Zone 1 = inside the reduced raster).
Image modifications apply to the zone marked with the anchor symbol.



- 4 To displace the anchor symbol, hold the left mouse button and drag.
- 5 To invert the signal of the respective zone, select *Invert A = On*.

To quit the Windowing mode, untick the **Windowing** checkbox and close the **Windowing** dialog.

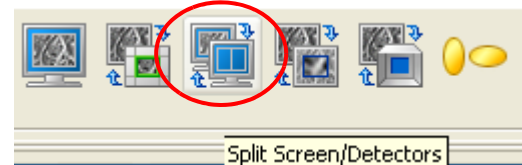
4.4.1.7. Displaying two image areas (licence: SPLIT)

This function subdivides the image area into two zones. Different detectors can be assigned to each zone. Each zone can be frozen independently from each other. Requires the licence SPLIT.

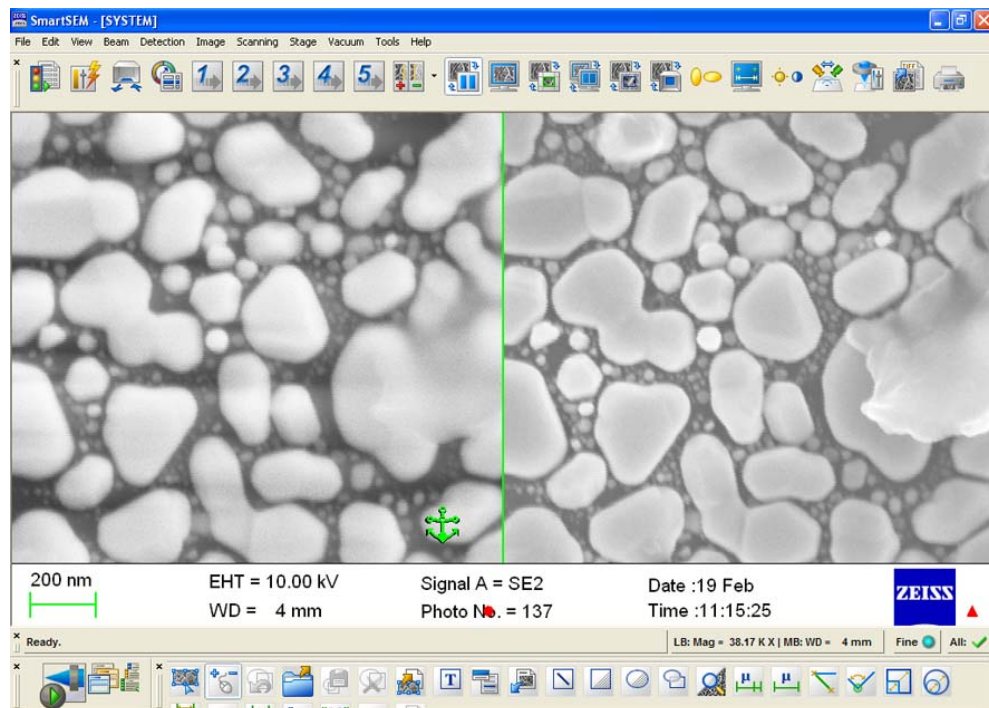
- 1 In the toolbar, click the **Split Screen** icon.

Alternatively:

Select **Scanning/Split** from the menu.



The image area is split into two zones.
The anchor symbol marks the zone for detector selection, setting of brightness and contrast, freezing or deleting.



- 2 To displace the anchor symbol hold the left mouse button and drag.

To apply image modifications to both zones simultaneously, double-click the anchor symbol.

The colour of the anchor symbol changes.



To quit the split function, click the **Split Screen** icon.
Alternatively, select **Scanning/Normal** from the menu.

4.4.1.8. Displaying detector signals on two different monitors (licence: DUAL-CHANNEL)

This function allows displaying the live image on the second monitor and to select different signal sources monitors. Panels can be moved to the second monitor.
Requires the licence DUAL-CHANNEL.

- 1 Select **Image/Dual Channel** from the menu.

The anchor symbol marks the zone for detector selection, setting of brightness and contrast and freezing or deleting.

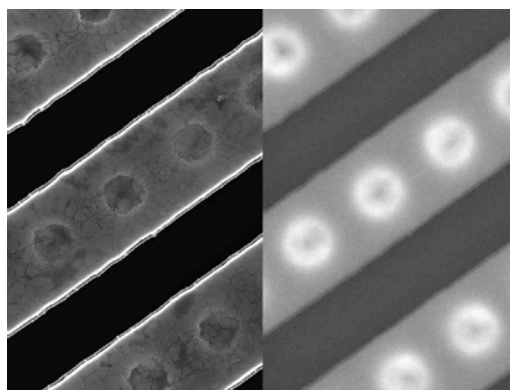


To displace the anchor symbol, hold the left mouse button on the anchor while dragging it to the other monitor.

4.4.1.9. Producing composite images from two detectors (licence: COLOUR MODE)

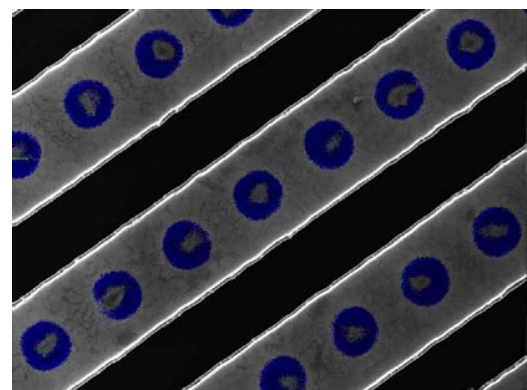
Colour mode offers the possibility to convert and combine signals from two different detectors and display a live false colour image without losing important information. Requires the licence COLOUR MODE.

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Colour Mode**.
The **Colour Mode** window opens.
- 3 Select *Colour Mode = 2 LUT* from the **Colour Mode** drop-down menu.
This enables the checkboxes in column 1 and 2.
- 4 Adjust contrast and brightness of the two detector signals A and B by using the respective sliders.

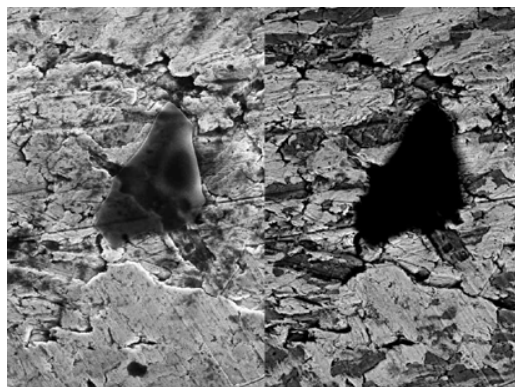


SE image

BSE image

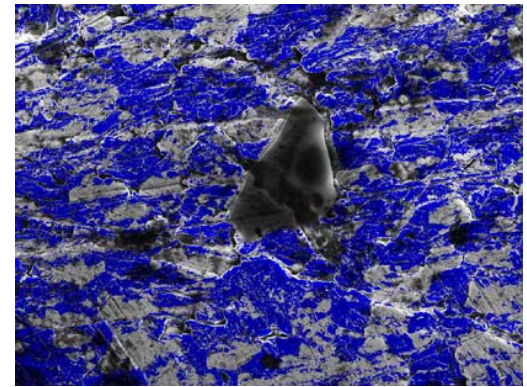


Compositional image (colour mode)



SE image

BSE image



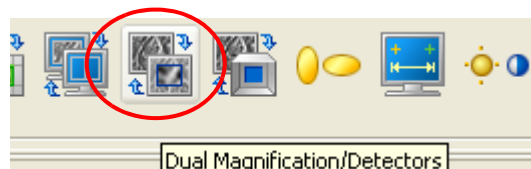
Compositional image (colour mode)

4.4.1.10. Displaying images with different magnifications (licence: DUALMAG)

This function allows you to zoom an image without freezing the image at basis magnification. Dual Mag is recommended in order to accentuate a detail in an image and to simultaneously realise a view of the specimen at low magnification.

Requires the licence DUALMAG.

- 1 In the toolbar, click the **Dual Magnification** icon.



Alternatively:

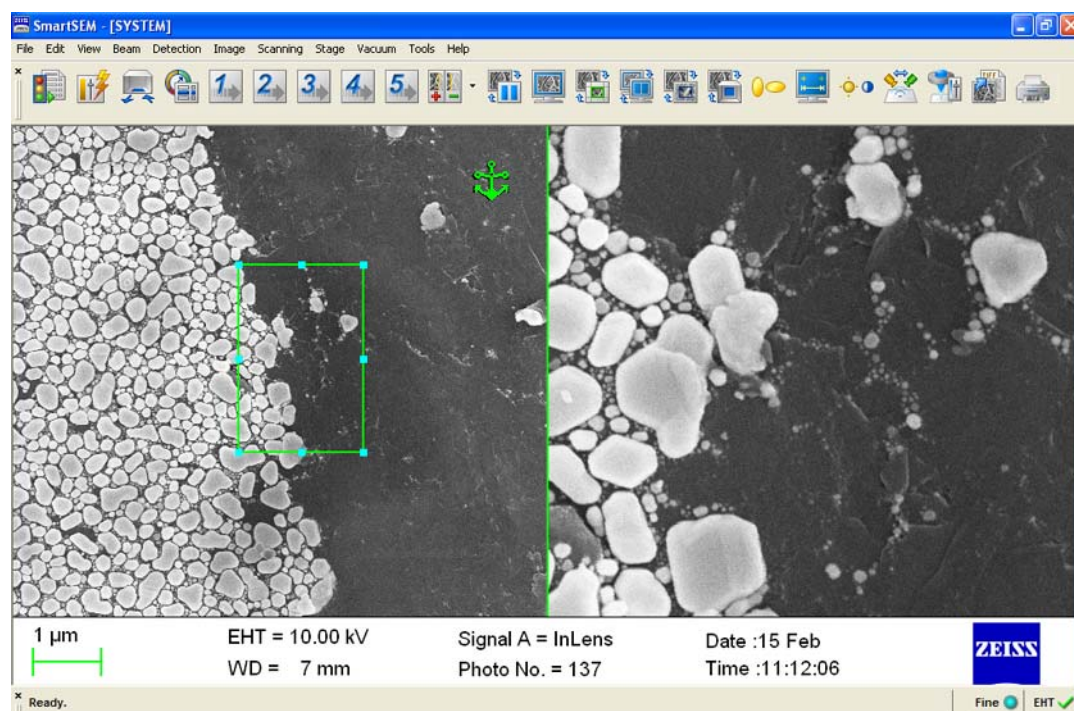
Select **Scanning/Dual Mag** from the menu.

Alternatively:

Tick the **Dual Mag** checkbox under **SEM Controlss Panel/Scanning**.

The image area is divided into two zones.

The left zone is displayed at the current magnification. At the same time a frame pops up which defines the range to be displayed in the right zone.



- 2 To modify size and position of the frame, click it with the left mouse button:
 - a To change the size of the frame, place the mouse cursor on a mark.
Alternatively, double-click the **Zoom factor** field in the **SEM Controlss/Scanning** tab and enter the zoom factor.
The zoom factor determines the magnification ratio between the left and the right zone.
 - b To displace the frame, place the mouse cursor between two marks.

The anchor symbol marks the zone for detector selection, setting of brightness and contrast and freezing or deleting.



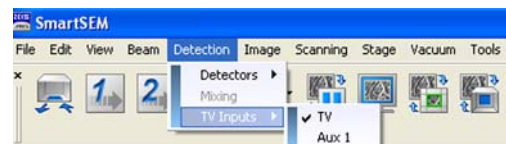
- 3 To displace the anchor symbol hold the left mouse button and drag.
- 4 To apply image modifications to both zones simultaneously, double-click the anchor symbol.
The colour of the anchor symbol changes.



4.4.1.11. Using a second CCD camera

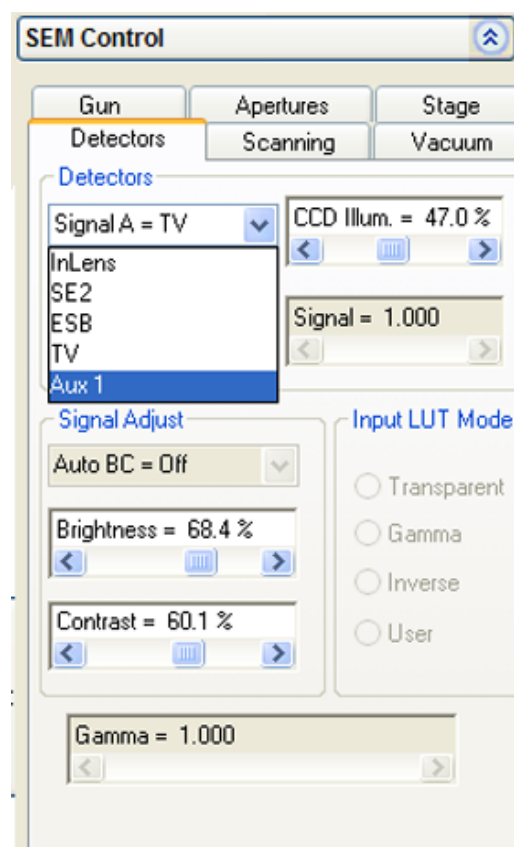
If a second CCD camera is attached, it is usually installed as 'Auxiliary 1'.

- 1 Select **Detection/TV Inputs** from the menu.
- 2 Select **Aux 1**.



Alternatively:

- 1 Select the **Detectors** tab of the **SEM Control** panel.
- 2 Select **Aux 1** from the **Signal A =** drop-down list.



Icon assignment

It might be helpful to assign the pre-defined TOGGLE TV macro to the **ChamberScope** icon. This will make the second CCD camera available by middle-clicking on the **ChamberScope** icon.

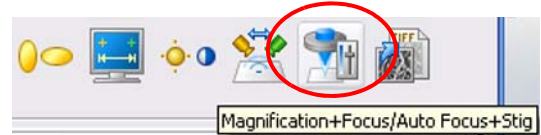
Refer to section 4.9.6.



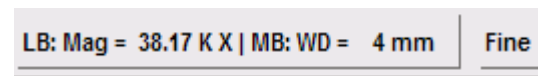
4.4.2. Setting the working distance

The working distance (WD) is the distance between the focused specimen surface and the end of the objective lens. The WD determines the possible resolution, the signal-to-noise ratio, the depth of focus and the lowest possible magnification (low power magnification).

- 1 In the toolbar, click the **Magnification/Focus**.
- 2 Hold the middle mouse button and drag the mouse in order to focus.



The current WD is indicated in the status bar.



4.4.3. Setting scan parameters

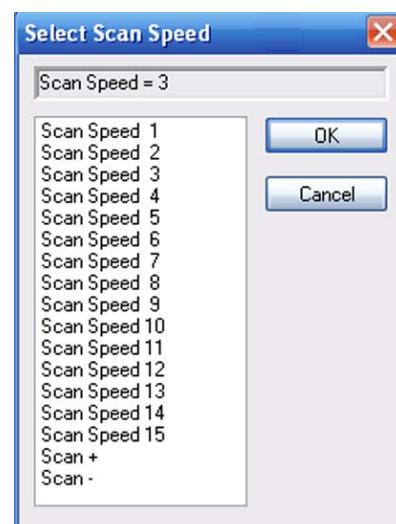
4.4.3.1. Selecting a scan speed

A focused beam of electrons is scanned across the specimen. The speed of the scan can be modified which has an influence on the speed of image generation on the one hand and the extend of image noise on the other hand.

- 1 Select **Scanning/Speeds** from the menu.
A drop-down list shows all available scan speeds.
- 2 Select a scan speed and confirm with **OK**.

The higher the scan speed number, the slower the scan of the specimen by the electron beam and the less the noise of the image.

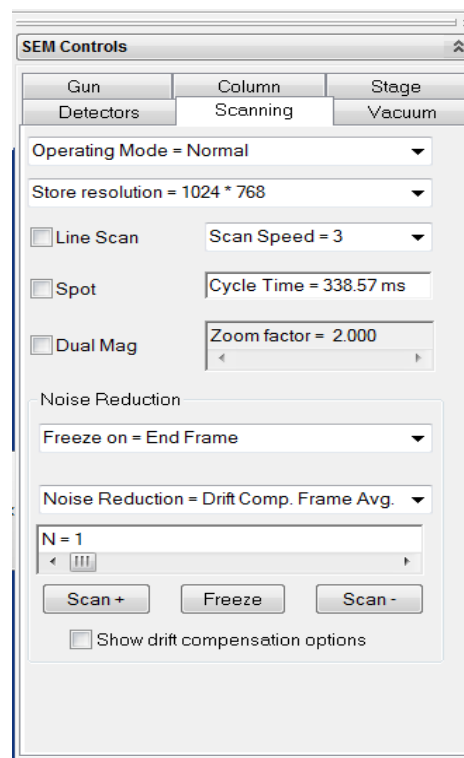
Selection of fifteen scan speeds requires the licence SCANEXP. Without this licence only three scan speeds are available.



Alternatively:

- 1 On the **SEM Controls** panel, select the **Scanning** tab.
- 2 To display the drop-down list, click the **Scan Speed =** field.

You can use the **Scan+** and **Scan-** buttons to increase, respectively decrease the scan speed.



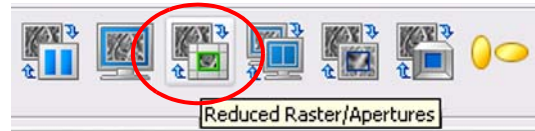
4.4.3.2. Scanning a small frame (reduced raster)

The reduced raster function allows you to scan only a small frame. This is recommended for alignment procedures such as focusing, aligning the stigmator or using the focus wobble.

Moreover, this function is helpful when using an EDX system: Only the information of this selected range is shown in the EDX spectrum.

The possibility to adjust size and position of the reduced raster requires the licence REDUCED.

- 1 In the toolbar, click the **Reduced Raster**.

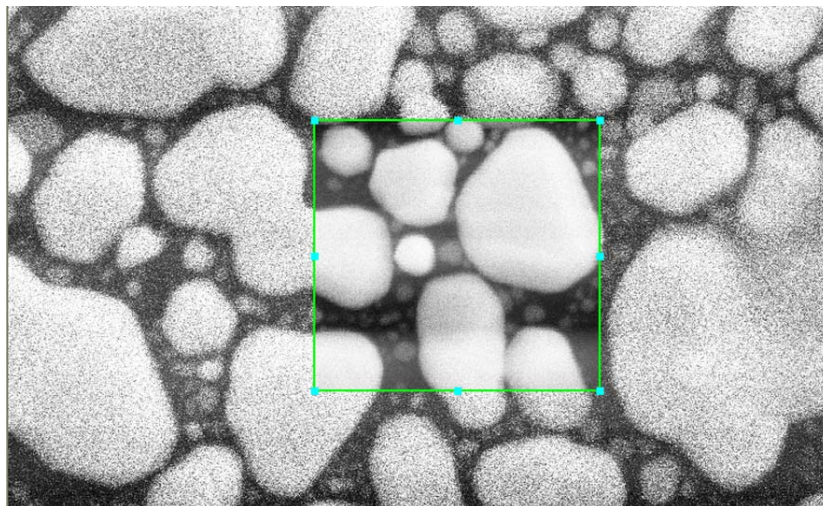


Alternatively:

Select **Scanning/Reduced** from the menu.

A frame is displayed in the image area, which defines the specimen area to be scanned by the electron beam.

The image outside the frame is frozen.



With licence REDUCED:

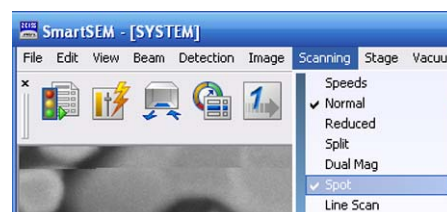
- 1 To modify size and position of the frame, click it:
 - a To change the size of the frame, place the mouse cursor on a mark (cursor is double arrow), hold the left mouse button and drag.
 - b To displace the frame, place the mouse cursor between two marks (cursor is rectangular symbol), hold the left mouse button and drag.

4.4.3.3. Scanning a spot (licence: SPOT)

In spot mode the electron beam is positioned on a particular spot on the specimen surface. This mode is recommended for the use with an EDX/WDX system or for the measurement of the specimen current.

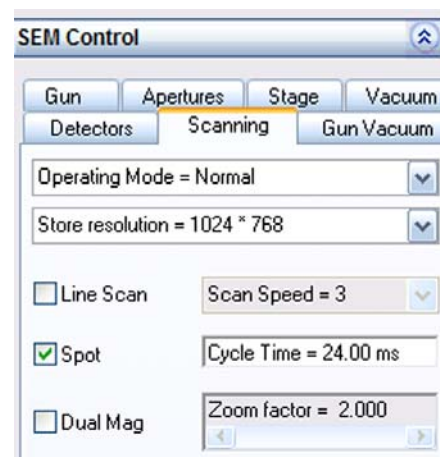
Requires the licence SPOT.

- 1 Select **Scanning/Spot** from the menu.
The submenu **Spot** is ticked.



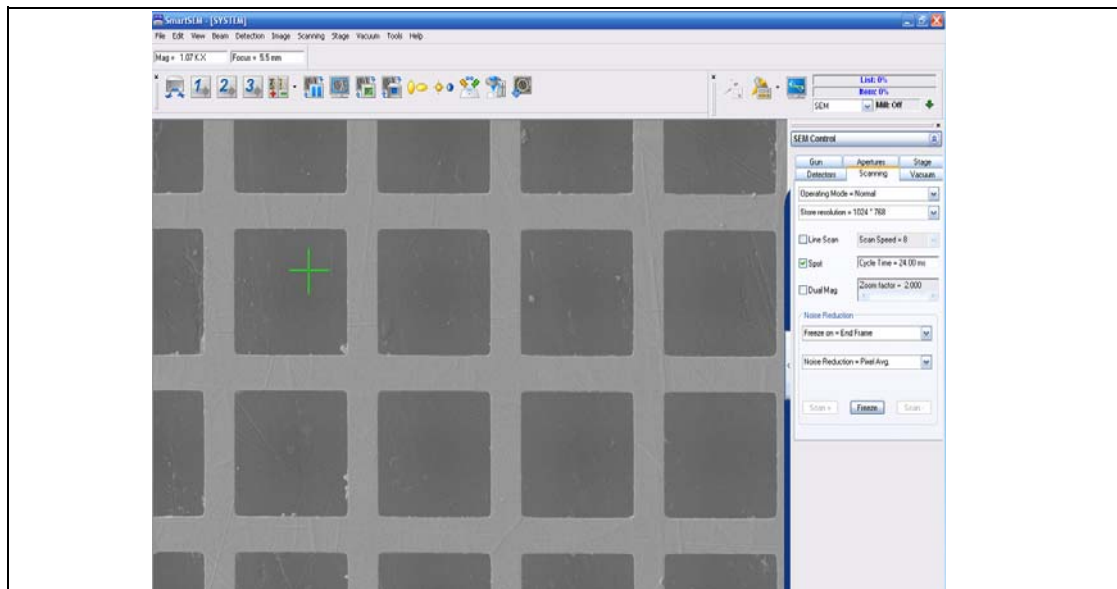
Alternatively:

On the **SEM Controls** panel, select the **Scanning** tab and tick the **Spot** checkbox.



A cross is displayed on the monitor.
The image is frozen.

4. Operation Imaging



- 2 To displace the cross:
 - a Hold the left mouse button to drag the cross on the screen.

Alternatively:

- a Open the SEM Status window: Select **View/SEM Status** from the menu.
- b Display *Spot at X* and *Spot at Y*.
- c Double-click *Spot at X* and *Spot at Y* in order to enter fixed values.

To quit spot mode, deactivate the submenu **Spot** or untick the **Spot** checkbox.

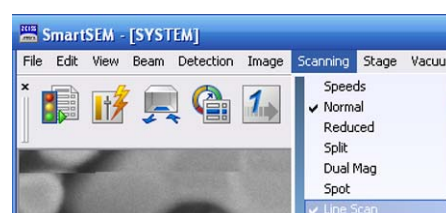
4.4.3.4. Scanning a line

This function is used to scan along a defined line while the image is frozen. It is recommended for measuring and adjusting signals, e.g. for optimising brightness and contrast.

CAUTION

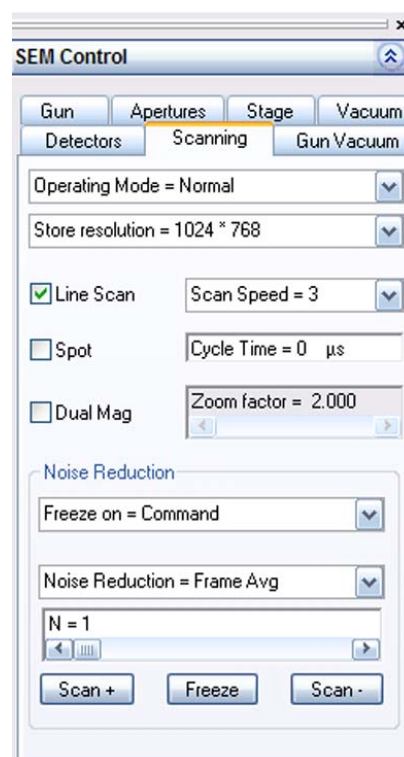
*Danger of damaging the specimen if the electron beam scans along the same line position a longer period of time. This can result in a scan mark on the specimen.
When using the Line Scan function for image optimisation place the Line Scan on a specimen area adjacent to the actual area of interest.*

- 1 Select **Scanning/Line Scan** from the menu.
The submenu **Line Scan** is ticked.



Alternatively

On the **SEM Controls** panel, select the **Scanning** tab and tick the **Line Scan** checkbox.



4. Operation

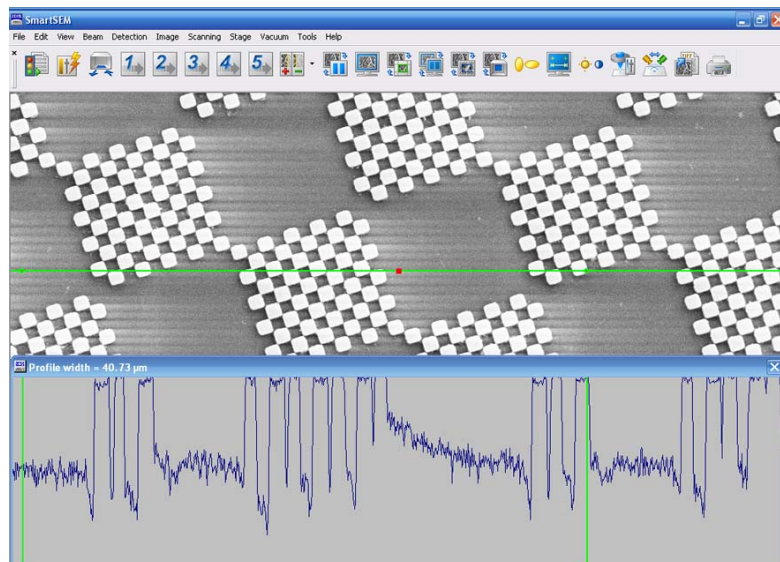
Imaging

A horizontal line is displayed together with a diagram which shows the course of the signal along this line.

The displayed graph represents the grey value distribution along the line. The grey values are represented from 0 to 255 on the ordinate. The illumination of the image can thus be adjusted at the representative spot.

- 2 To move it to the desired specimen area, click the horizontal line.
- 3 To change colour and background of the diagram:
 - a Position the mouse cursor in the diagram.
 - b Click the right mouse button.

A pop-up menu opens, where you can select the colour of the graph and a grey background.



4.4.3.5. Rotating the image (licence: SCANROT)

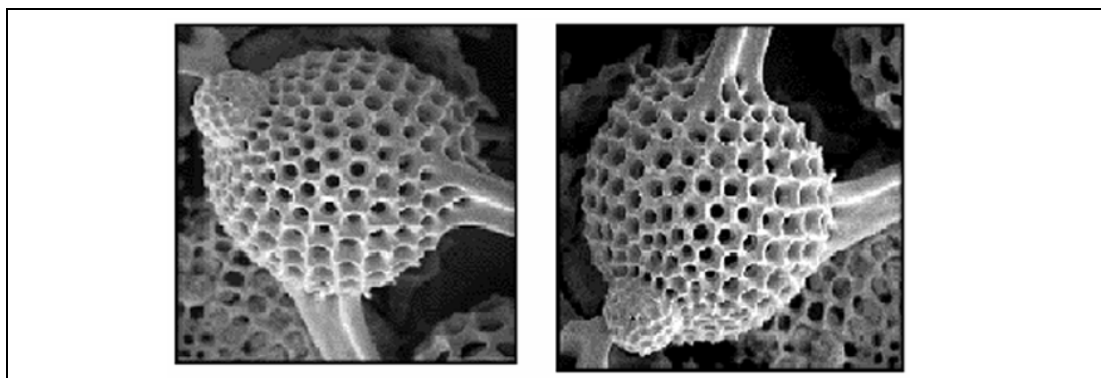
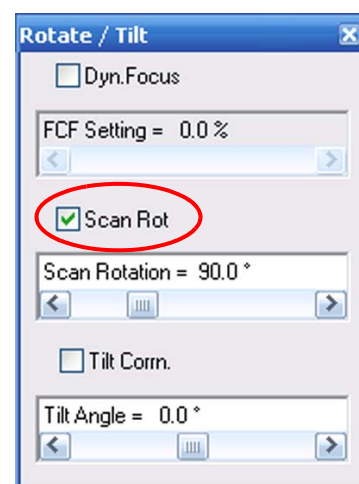
This function allows you to rotate the image electronically by rotating the scan direction.
Requires the licence SCANROT.

- 1 Select **Scanning/Rotate/Tilt**.

The **Rotate/Tilt** panel is shown.

- 2 Tick the **Scan Rot** checkbox.
- 3 Set the desired tilt angle with the **Scan Rotation** slider or by double-clicking on the **Scan Rotation** field.

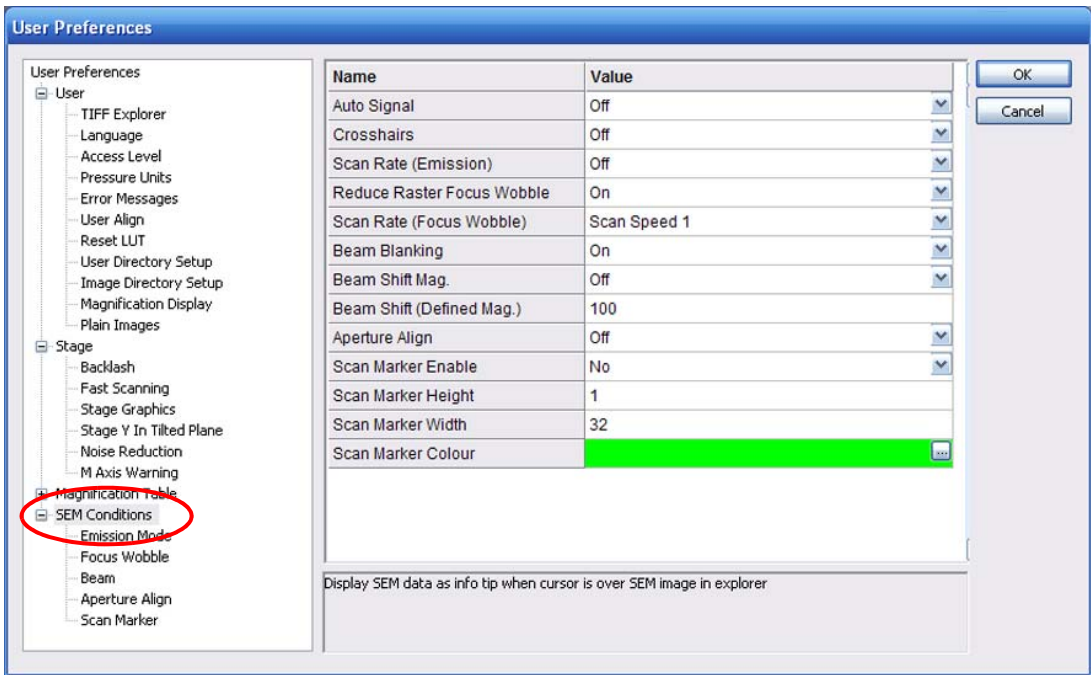
The image is rotated.



4.4.3.6. Displaying the scan marker

The scan marker is a small bar on the left side of the image area, which indicates the scanned line on the monitor. This might be helpful when using slow scan speeds because the scan marker helps to see which line is currently being scanned by the electron beam. The scan marker is not recorded on the image.

- 1 Select **Tools/User Preferences.**



- 2 In the tree structure, select **SEM Conditions.**
- 3 Select **Scan Marker Enable** Yes.
- 4 Select Height, Width and Colour of the scan marker.
- 5 Confirm by clicking on **OK.**

Name	Value
Scan Marker Enable	Yes
Scan Marker Height	1
Scan Marker Width	32
Scan Marker Colour	



IMPORTANT

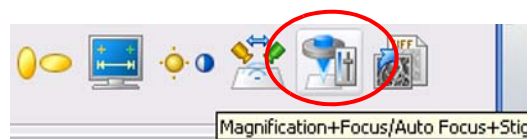
The scan marker will only be displayed when you use slow scan speeds (5 - 15). At quicker scan speeds (4 and faster) it will be deactivated automatically.

4.4.4. Setting the magnification

4.4.4.1. Selecting the magnification

- 1 In the toolbar, click **Magnification/Focus**.

- 2 Hold the left mouse button and drag the mouse to adjust the desired magnification.



The current magnification is indicated in the status bar.

4.4.4.2. Using pre-defined magnifications (Magnification Table)

Up to ten fixed magnifications can be entered in the Magnification Table for quick access during the imaging procedure. The magnifications have to be pre-defined in the **User Preference** panel (refer to section 4.9.4.4.).

To call the pre-set magnifications:

- 1 Press **<F4>**.
Anytime F4 is pressed, the next magnification value will be set.
- 2 To return to the previous magnification value, press **<Ctrl + F4>**.
- 3 To finish the use of the Magnification Table, press **<Shift + F4>**.

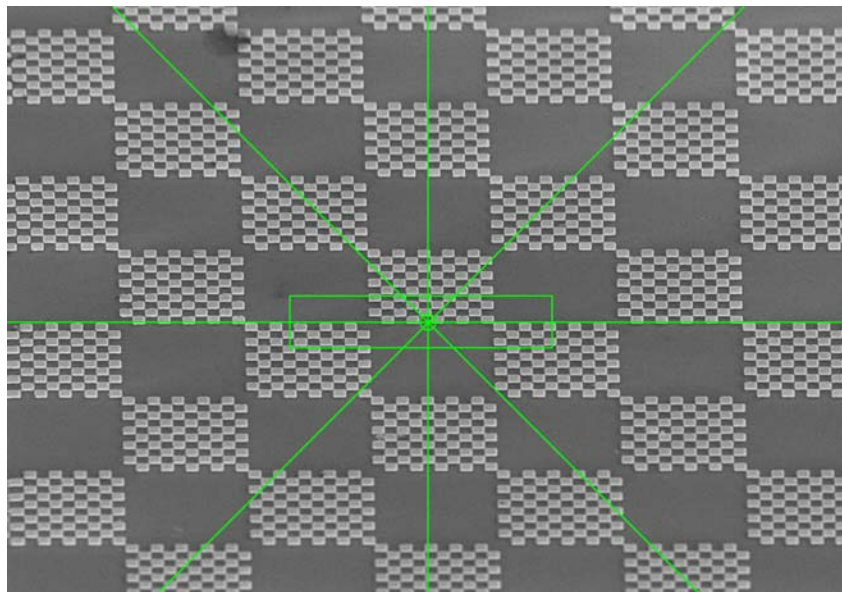
The magnification of the SEM/FESEM will be reset to the level that was active before the Magnification Table was used for the first time.

4.4.5. Imaging tilted specimen

4.4.5.1. Using Dynamic Focus (licence: DYNFOCUS)

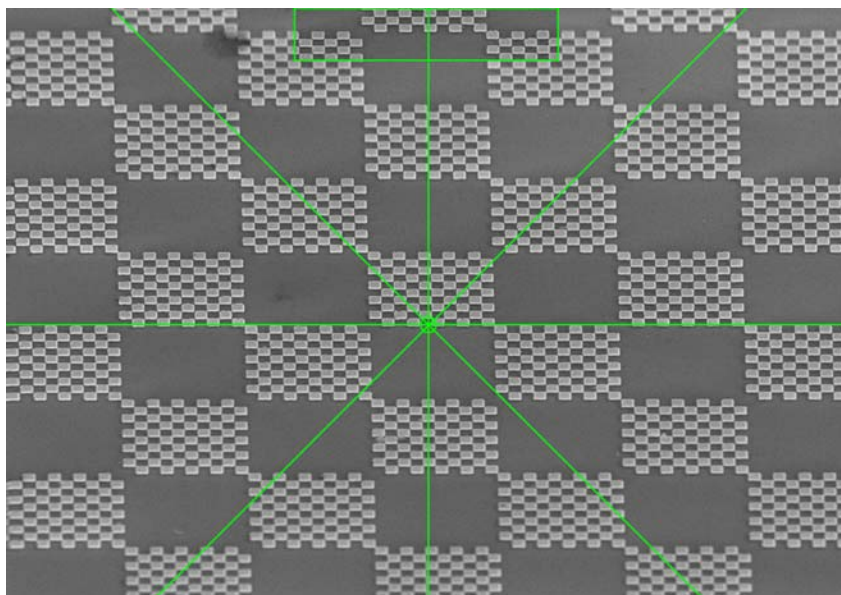
The dynamic focus allows the dynamic adaptation of the focus to tilted specimen surfaces. Requires the licence DYNFOCUS.

- 1 Show the reduced raster:
 - a Reduce the size of the raster.
 - b Place it in the centre of the image area.

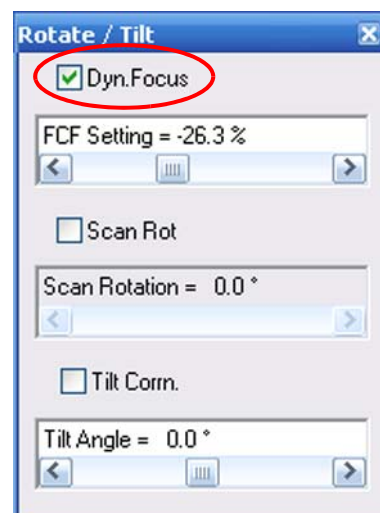


- c Adjust the best possible focus in the reduced raster.
Crosshairs may be helpful.

- 2 Displace the reduced raster to the very upper or the lower image margin.



- 3 Set a slow scan speed (9 or higher).
- 4 Select **Scanning/Dynamic Focus** from the menu.
- 5 Tick the **Dyn. Focus** checkbox.
The dynamic focus is enabled now.
- 6 Use the **FCF Setting** slider in order to adjust optimum sharpness in the reduced raster.
Do not modify the normal focus (middle mouse button).
- 7 Select **Scanning/Normal** to acquire the complete image while using a slow scan speed.
- 8 Store the image.
- 9 Untick the **Dyn. Focus** checkbox to quit the dynamic focus mode.



IMPORTANT

The best application of the dynamic focus is only possible with tilted plane specimens. If the specimen presents strong differences in height (topography) or different inclinations of slope, the depth of focus must be optimised as well.

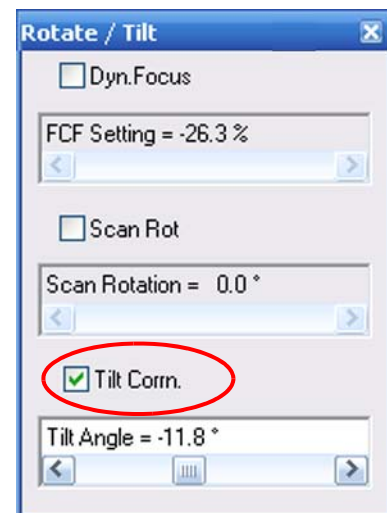
4.4.5.2. Using Tilt Correction (licence: TILTCOMP)

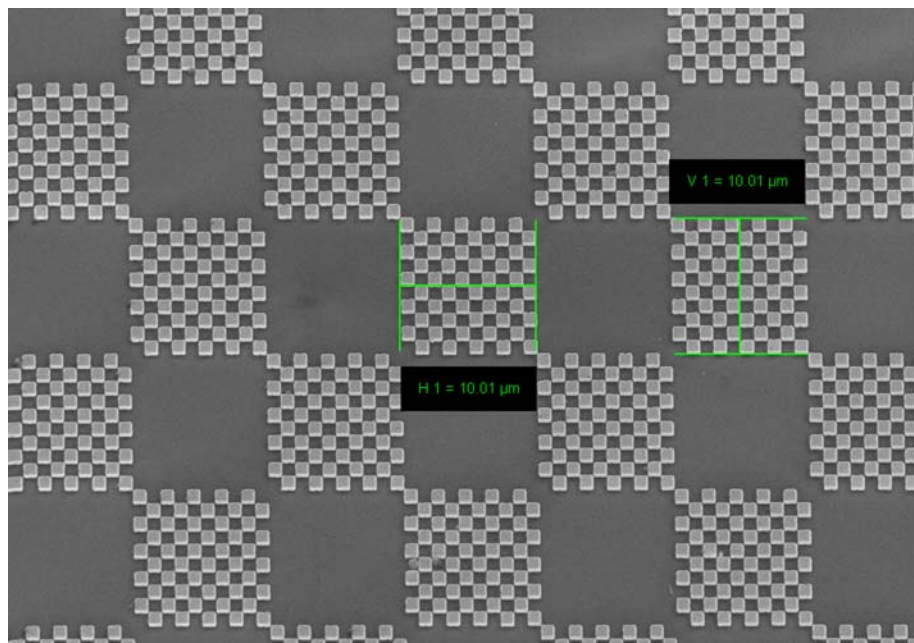
This functions allows the correction of the perspective foreshortening caused by the scan of a tilted specimen.

If a specimen presents a high tilt angle, the electron beam scans a larger part of the specimen in tilt direction so that the image is distorted.

Requires the licence TILTCOMP.

- 1 Ensure the specimen surface is tilted in Y direction respective to the monitor.
- 2 Select **Scanning/Rotate/Tilt** from the menu.
- 3 Tick the **Tilt Corr.** checkbox.
- 4 Adjust the **Tilt Angle** slider.
Alternatively, double-click in the **Tilt Angle** field and enter the angle.





IMPORTANT

When you use an extremely tilted specimen, you should adjust the dynamic focus as well.



IMPORTANT

With Cross Beam series instruments:

If you wish to measure the height, note that you have to enter '90° - tilt angle value' in the 'Tilt Angle=' field.

4.4.6. Improving the signal-to-noise ratio (noise reduction)

The signal entering the image processor is made up of two components: image and noise. Image is the signal of interest and correlates with the object being scanned, noise is random in nature. Therefore, by averaging multiple scans of the same area, the signal will be reinforced, while the noise will be reduced. This is the basis on which the noise reduction works.

The signal-to-noise ratio is an important factor for image quality. It does not only depend on the parameters EHT, aperture size and working distance, but also on the dwell time of the electron beam per image spot.

To reduce the noise level of an image, you can

- increase the dwell time of the electron beam per pixel or
- scan the respective specimen spot several times and integrate the generated signal.

The various noise reduction methods are each divided into two categories:

- **Averaging:** The image is continuously scanned. If you want to stop the scan, you have to do it manually.
- **Integration:** One image is scanned and then the image automatically freezes.

Method	Explanation	Typical application
Frame Average (Continuous Averaging)	Averaging of two or more consecutive frames: Frames are scanned continuously and the image is formed as the average of a number of successive frames. The live signal is proportionally mixed with the stored signal so that the image reflects the average of the recent frames. The proportion of live to stored can be adjusted with the parameter N which represents the number of frames to be averaged.	Frame averaging is used to reduce random noise. It can be selected with any scan speed but is generally most useful at the faster speeds where a larger amount of noise reduction can be obtained without introducing a long cycle time.
Frame Integrate	Addition of two or more consecutive frames. The image automatically freezes at the end of the integration cycle. The scan speed defines the time to complete a frame and the noise reduction parameter N defines the number of frames to integrate.	Frame integration is used to enhance contrast and reduce noise. It is useful when applied to beam sensitive materials, since the image can be obtained while the beam remains scanning quickly and not allowed to dwell too long on any point of the specimen. In this mode the image is formed as the average of a number of successive frames. Not suitable when sample drift occurs.
Line Integrate	Each line to be scanned a number of times before the scan moves on. The average line signal is stored and displayed. The noise reduction parameter N defines the number of times a line is to be averaged before moving to the next line.	

Method	Explanation	Typical application
Line Average	The image is built up by averaging a number of lines. Each line is scanned a number of times before the scan moves on. The average line signal is stored and displayed. The noise reduction parameter N defines the number of times a line is to be averaged before moving to the next line.	Use Line average when the result of the noise reduction needs to be seen without waiting for the cycle to complete. Suitable for most applications. The image will automatically freeze at the end of the frame.
Pixel Average	A single frame is scanned. The frame time is controlled by the scan speed parameter as follows ($100 \times 2^{n-1}$): Speed Max: 25 ns per pixel Speed 1: 50 ns per pixel Speed 1: 100 ns per pixel Speed 2 : 200 ns per pixel Speed 3 : 400 ns per pixel Speed 4 : 800 ns per pixel Speed 5 : 1.6 μs per pixel Speed 6 : 3.2 μs per pixel Speed 7 : 6.4 μs per pixel Speed 8 : 12.8 μs per pixel Speed 9 : 25.6 μs per pixel Speed 10 : 51.2 μs per pixel Speed 11 : 102.4 μs per pixel Speed 12 : 204.8 μs per pixel Speed 13 : 409.6 μs per pixel Speed 14 : 819.2 μs per pixel Speed 15 : 1.6384 ms per pixel	Suitable for specimens with good electric and thermal conductivity.
Continuous Average (Pixel Averaging)	Displays an image within which each pixel is measured repeatedly and the average signal displayed. Frames are scanned continuously and the image formed as the average of a number of successive frames. The pixel time is determined by the dwell time parameter, that can be selected. The number of frames is determined by the scan speed (2^n). Speed 1: Average of 2 frames Speed 2: Average of 4 frames Speed 3: Average of 8 frames Speed 4: Average of 16 frames Speed 5: Average of 32 frames Speed 6: Average of 64 frames Speed 7: Average of 128 frames Speed 8: Average of 256 frames	Most useful for stable, conductive specimens where the beam has little or no damaging effect on the specimen.

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Method	Explanation	Typical application
Drift Compensated Frame Integration	Addition of two or more consecutive frames. The image automatically freezes at the end of the integration cycle. The scan speed defines the time to complete a frame and the noise reduction parameter N defines the number of frames to integrate.	Frame integration is used to enhance contrast and reduce noise. It is useful when applied to beam sensitive materials, since the image can be obtained while the beam remains scanning quickly and not allowed to dwell too long on any point of the specimen. In this mode the image is formed as the average of a number of successive frames. The advantage of Drift Compensated Frame Integration over regular Frame Integration is the intelligent algorithm that identifies drift by comparing images. The drift is then compensated for. This method is ideal for customers with suboptimal installation sites (e.g. vibrations). You should select a high scan speed to be able to see the effect. All necessary microscope settings have to be made before using this noise reduction method. Otherwise, this mode will try to compensate for all changes that have been made afterwards.

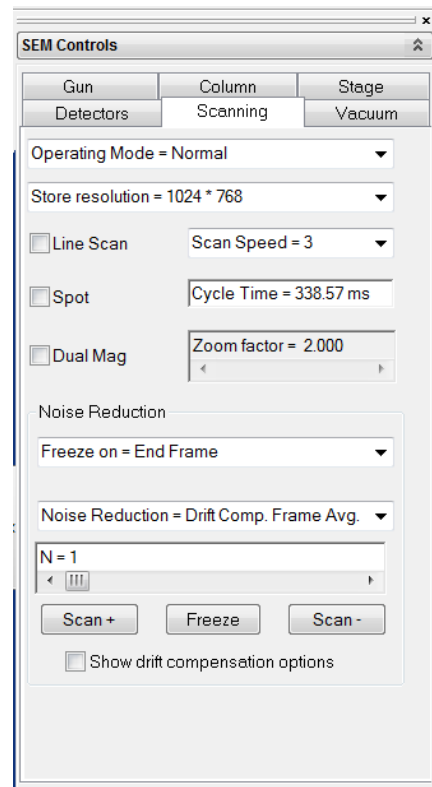
Method	Explanation	Typical application
Drift Compensated Frame Averaging	Averaging of two or more consecutive frames: Frames are scanned continuously and the image is formed as the average of a number of successive frames. The live signal is proportionally mixed with the stored signal so that the image reflects the average of the recent frames. The proportion of live to stored can be adjusted with the parameter N which represents the number of frames to be averaged. A moving average of N frames is calculated. All microscope settings (focus, beam shift etc.) can be changed. If the difference between two images is too big, all previous frames are discarded and the process begins anew.	Frame averaging is used to reduce random noise. It can be selected with any scan speed but is generally most useful at the faster speeds where a larger amount of noise reduction can be obtained without introducing a long cycle time. The advantage of Drift Compensated Frame Averaging over regular Frame Integration is the intelligent algorithm that identifies errors by comparing images. These errors are then removed. Therefore, this method is also suitably when stage drift occurs. Another benefit of this method is that it simplifies focusing of fast-charging specimens at high scan speeds. This method is ideal for customers with suboptimal installation sites (e.g. vibrations). You should select a high scan speed to be able to see the effect. All necessary microscope settings have to be made before using this noise reduction method. Otherwise, this mode will try to compensate for all changes that have been made afterwards. This noise reduction method does not work in reduced raster mode.

4.4.6.1. Selecting a noise reduction method

- 1 Select **Tools/Go To Control Panel** from the menu.
- 2 Go to the **Scanning** tab.
- 3 Select a **Freeze on** mode:
Command: Causes an immediate freeze of the current zone (the whole image in normal mode) if you click **Freeze**.
End Frame: Causes the zone to freeze at the end of the current frame.
- 4 Select a **Noise Reduction** mode.

When selecting Frame Avg:

- a Select **N=**, set a value between 1 and 256.
- b Select a **Dwell time** (Scan Speed) from the drop-down list.



4.4.6.2. Using the drift compensated noise reduction methods

- 1 Select **Tools/Go To Control Panel** from the menu.
- 2 Go to the **Scanning** tab.
- 3 To make optimal use of the drift correction, select a high scan speed (e.g. 1 or 2).
- 4 Select a **Freeze on** mode:
Command: Causes an immediate freeze of the current zone (the whole image in normal mode) if you click **Freeze**.
End Frame: Causes the zone to freeze at the end of the current frame.
- 5 Select a drift compensated **Noise Reduction** mode.

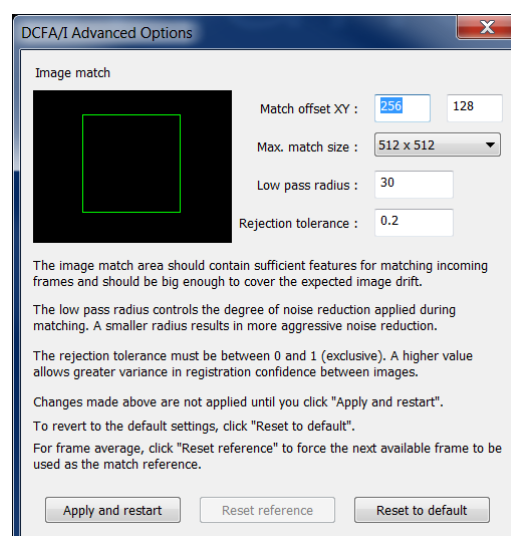
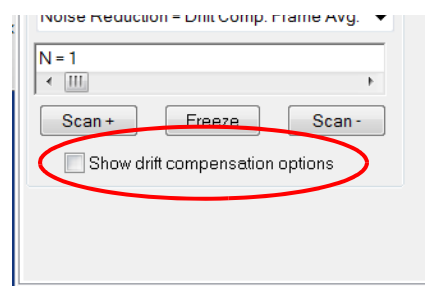
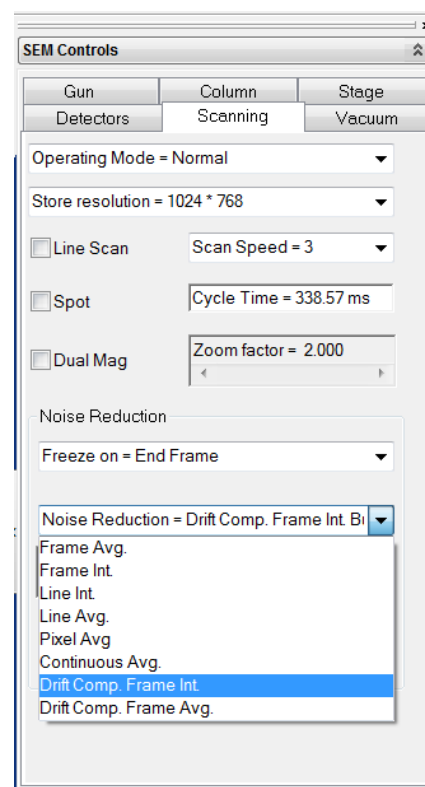
When selecting Drift Comp. Frame Avg:

- a Select **N=**, set a value between 1 and 256.
- b Select a **Dwell time** from the drop-down list.

- 6 To change the drift compensation parameters, tick the **Show drift compensation options** checkbox.

The **DCFA/I Advanced Options** dialog opens. A description for each drift correction parameter is given in the dialog.

- 7 Change the drift correction parameters according to your needs.
 To find an ideal setting, you may need to experiment.
- 8 Once you have set the parameters, click **Apply and restart**.
 The changes are applied and the drift correction now operates using the new setting.



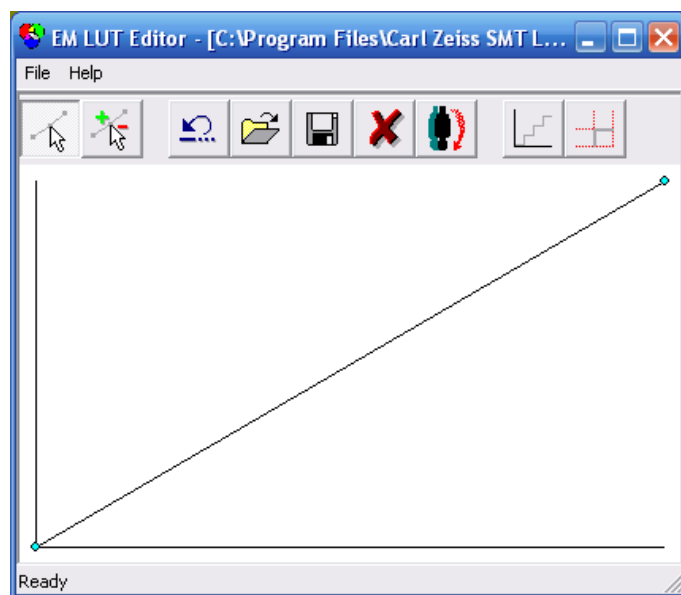
4.4.7. Improving image illumination by using Look Up Tables (LUT)

4.4.7.1. Editing a live image (Input LUT)

Using Look Up Tables (LUT) is recommended when the illumination of an image while using a linear characteristic line is very difficult or impossible. In these cases you may try to obtain better illumination of the image by adding or displacing discrete points of the characteristic line or by adding a step function. The Input LUT is used to perform a translation on the input signal as defined by the pattern loaded into the LUT. Modifications of the Input LUT effect the live image.

- 1 Select **Edit/Input LUT** from the menu.

The EM LUT Editor window opens.



The following functions are available:



Select Mode

Displaces and deletes points of the transfer characteristic.

Displace: Place the mouse cursor on the point and displace it by holding the left mouse button.

Delete: Place the mouse cursor immediately near the point and press the middle mouse button.



Add/Remove Points

Adds and deletes points in the transfer characteristics.

Add: Place the mouse cursor in the graphic field and press the left mouse button.

Delete: Place the mouse cursor immediately near the point and press the middle mouse button.



Undo Last Edit

Undoes the last change of the Input LUT.



Open LUT
Loads specific Input LUT settings and apply these settings to the current image.



Save LUT As..
Saves specific settings of the Input LUT.



Reset LUT
Returns the Input LUT to the basic condition (linear characteristic)

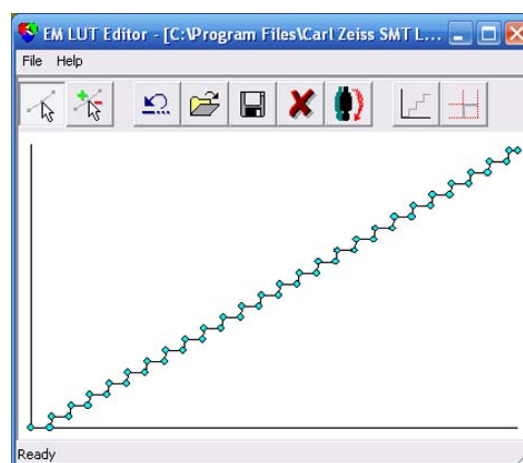


Invert LUT
Inverts the current transfer characteristic.



Step LUT
Adds a step function as a transfer characteristic to convert the transfer characteristic into a regular sequence of grey values.

The height of each step (amplitude), the position of the first step (offset) and the number of steps (period) can be separately set.
It is also possible to further modify the curve by adding or displacing different points.

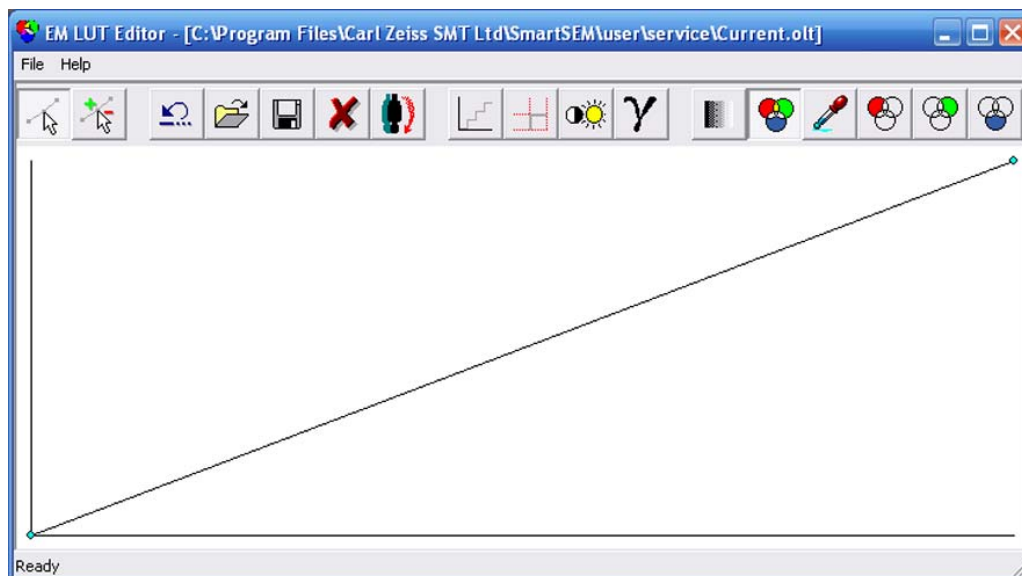


Adjust Step LUT Settings
Calls up the LUT Step Settings window to set amplitude, period, and offset of the step function.

4.4.7.2. Editing a saved image (Display LUT)

The Display LUT is used to edit a SEM image, e.g. by subsequent colouring, modification of brightness and contrast, inversion or addition of a gamma function. These settings effect the saved image as well as the live image.

- 1 Load a saved image.
- 2 Select **Edit/Display LUT** from the menu.



Select Mode

Displaces and deletes points of the transfer characteristic.

Displace: Place the mouse cursor on the point and displace it by holding the left mouse button.

Delete: Place the mouse cursor immediately near the point and press the middle mouse button.



Add/Remove Points

Adds and deletes points in the transfer characteristics.

Add: Place the mouse cursor in the graphic field and press the left mouse button.

Delete: Place the mouse cursor immediately near the point and press the middle mouse button.



Undo Last Edit

Undoes the last change of the Input LUT.



Open LUT

Loads specific Input LUT settings and applies these settings to the current image.



Save LUT As..
Saves specific settings of the Input LUT.



Reset LUT
Returns the Input LUT to the basic condition (linear characteristic)

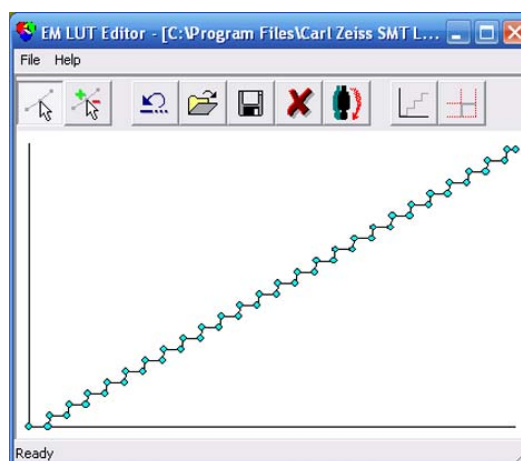


Invert LUT
Inverts the current transfer characteristic.

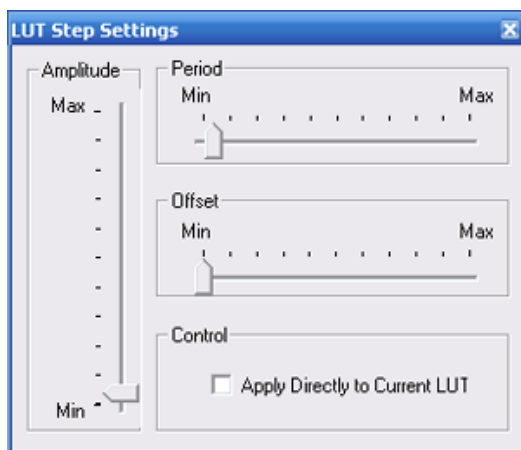


Step LUT
Adds a step function as a transfer characteristic to convert the transfer characteristic into a regular sequence of grey values.

The height of each step (amplitude), the position of the first step (offset) and the number of steps (period) can be separately set.
It is also possible to further modify the curve by adding or displacing different points.



Adjust Step LUT Settings
Calls up the **LUT Step Settings** window to set amplitude, period, and offset of the step function.



Edits brightness and contrast.



The Gamma option allows to define the transfer characteristic as a curve to enlarge lower and higher grey scales. This function can be used to improve images containing a large quantity of detailed information in few grey scales.



Inserts a grey wedge (continuous distribution of the grey scales from white to black) as current image to adjust particular output media.



Switches from RGB to grey value LUT.



Sets the level of a point in the transfer characteristic after selection of a point.



Switches from grey value LUT to RGB LUT and selects the transfer characteristic for the colour red.
Subsequent modifications of this transfer characteristic refer only to the colour red.



Switches from grey value LUT to RGB LUT and selects the transfer characteristic for the colour green.
Subsequent modifications of this transfer characteristic refer only to the colour green.



Switches from grey value LUT to RGB LUT and selects the transfer characteristic for the colour blue.
Subsequent modifications of this transfer characteristic refer only to the colour blue.

4.4.8. Processing the image (licence: IMMATH)

The functions in Image Processing offer the possibility of mathematically manipulating the image content pixel-by-pixel by using the grey value (0=black, 255=white). Different filter functions, basic mathematic operations and the detection of grey values can be used. Requires the licence IMMATH.

4.4.8.1. Grey value detection

- 1 Select **Image/Image Processing** from the menu.
- 2 Go to the **Threshold** tab.
- 3 Set the type of threshold:

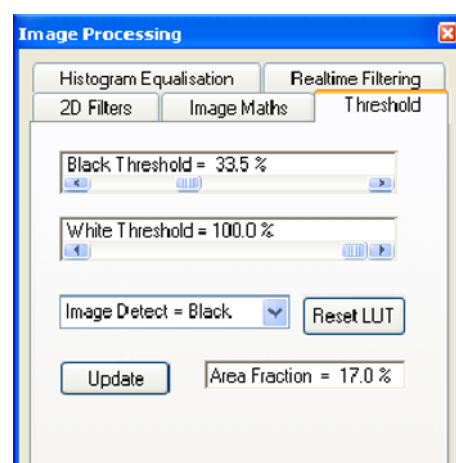
Select *Black*, *White* or *Grey* from the **Image Detect** drop-down list.

Black: Each pixel in the image storage with a value inferior to the black threshold is coloured red.

White: Each pixel in the image storage with a value inferior to the white threshold is coloured red.

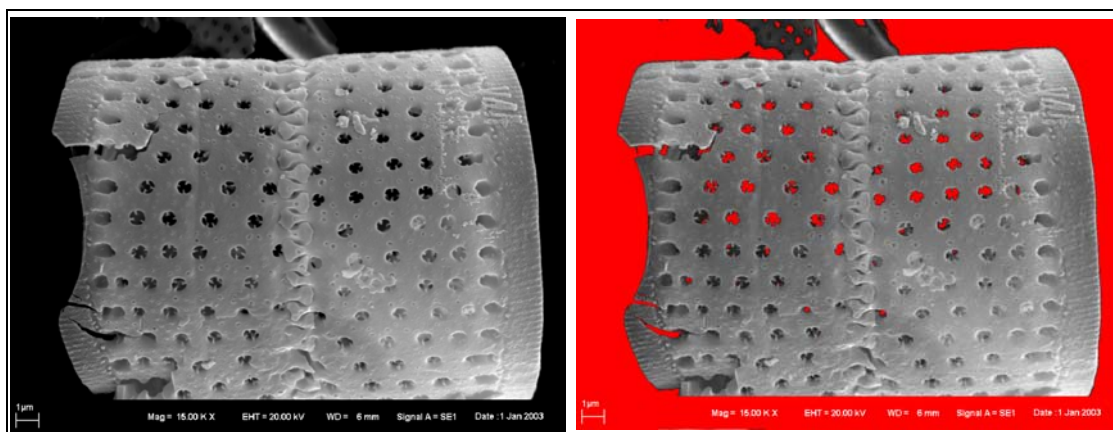
Grey: Each pixel in the image storage with a value superior to the black threshold or inferior to the white threshold is coloured red.

- 4 Select the threshold for black by using the **Black Threshold** slider.
- 5 Select the threshold for white by using the **White Threshold** slider.
- 6 To calculate the area fraction of certain grey values coloured red in the image by clicking **Update**.



IMPORTANT

If stored images contain annotations or measurements, the grey values of these annotations will be included in calculation and presentation.

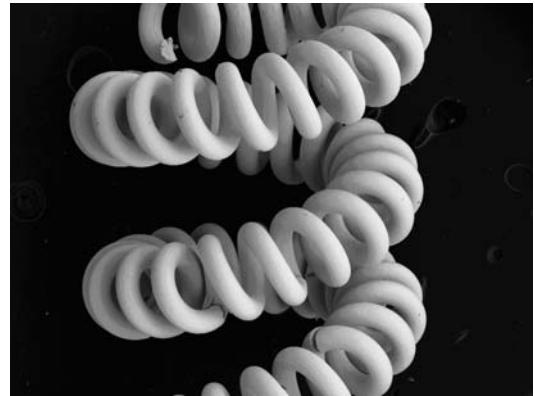


4.4.8.2. Creating a stereo image

The creation of stereo images allows you to get images showing a 3D effect.

Prerequisite is that you take two images of the same specimen at the same magnification but at a different tilt angle. Depending on magnification and topography of the specimen, the difference of the tilt angle should be 2° to 15°.

- 1 Take the first image:
 - a Display crosshairs.
 - b To ease navigation, move a striking detail to the centre of the image.
 - c Set the desired magnification.
 - d Rotate the image by 90° by means of the scan rotation function.
 - e Freeze the image.
 - f Save the image without data zone or annotations.



- 2 Take the second image under a different tilt angle:
 - a Unfreeze the image.
 - b Disable scan rotation.
 - c Display crosshairs.
 - d Tilt the stage step by step.

In most cases the tilt angle between the two images should differ by 2° to 15°.
 - e Compensate for the move of the specimen range by moving the stage in Y-direction.

Always place the striking detail back to the centre of the crosshairs.

By tilting the specimen, the focus has been changed as well.

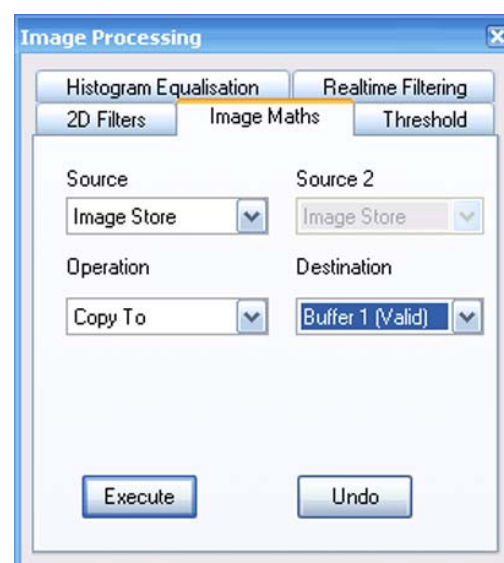
- f When reaching the required tilt angle, reset the focus by driving the stage in Z direction.

- g Rotate the image by 90° by means of the scan rotation function.
- h Freeze the image.
- i Save the image without data zone or annotations.



- 3 Select **Image/Image Processing** from the menu.
- 4 Go to the **Image Maths** tab.
- 5 Reload the first image:
 - a Under **Source** select *Image Store*, under **Operation** select *Copy To*, under **Destination** select *Buffer 1*.
 - b Click **Execute**.

The image is copied to buffer store 1.

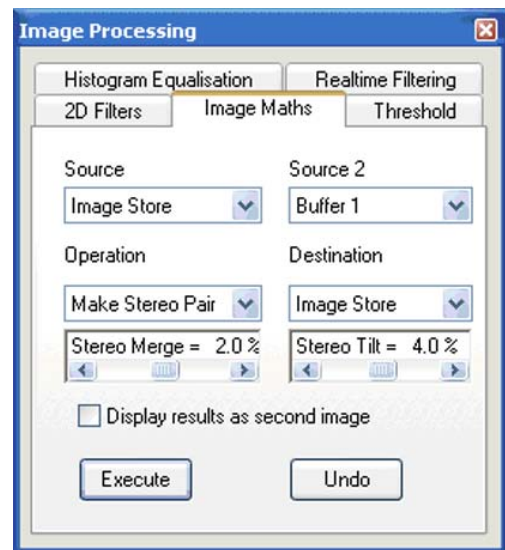


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- 6 Reload the second image:
 - a Under **Source** select *Image Store*,
under **Operation** select *Make Stereo Pair*,
under **Source 2** select *Buffer 1*,
under **Destination** select *Image Store*.
 - b Click **Execute**.

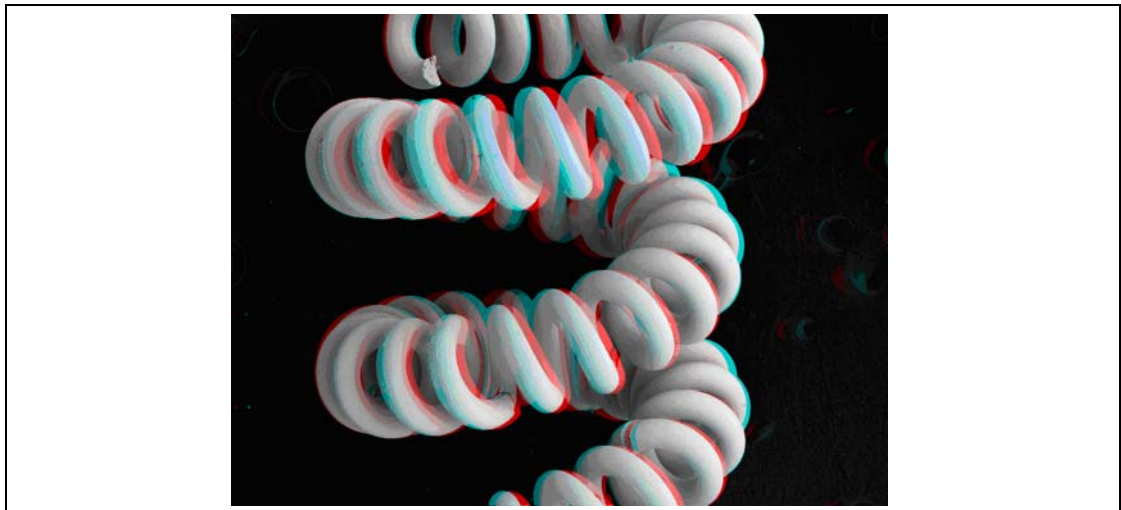
Both images are combined with a colour code and displayed on the monitor.

- 7 If the images are not exactly congruent, use the sliders **Stereo Merge** and **Stereo Tilt** to adjust X- and Y-directions.



IMPORTANT

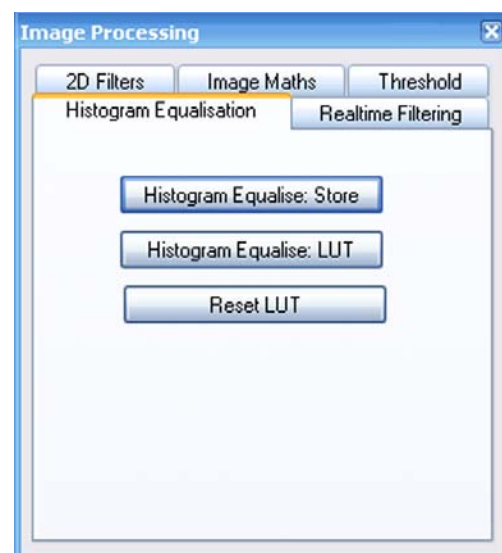
Stereo glasses are required to be able to recognise the 3D effect in the colour image.



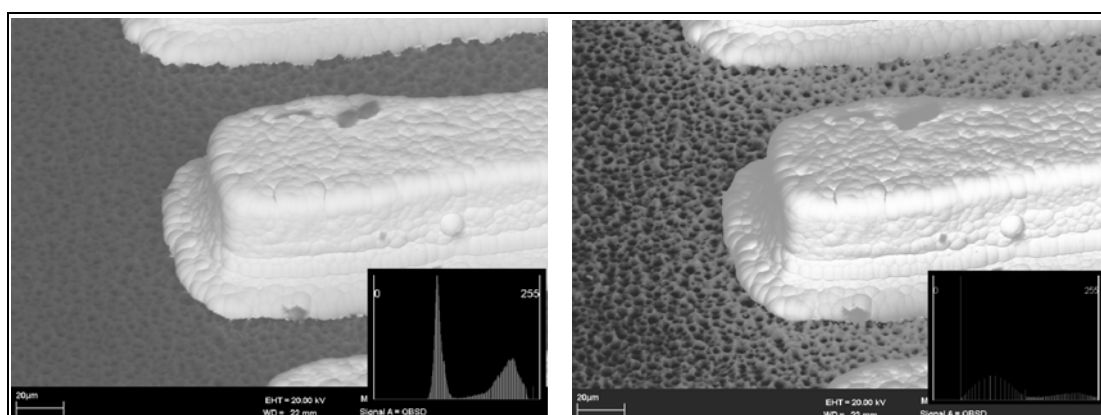
4.4.8.3. Histogram equalisation

This function allows a non-linear contrast optimization of the image. Ranges with frequent grey values are enlarged while ranges with rare grey values are compressed. Certain image structures can thus be accentuated whereas other structures are reduced so that the total impression of the image is modified.

- 1 Select **Image/Image Processing** from the menu.
- 2 Go to the **Histogram Equalisation** tab.
- 3 To improve the contrast by calculating the grey scale distribution, click **Histogram Equalise: Store**.
The image is frozen.
- 4 To generate an image transformation by using a Display-LUT click **Histogram Equalise:LUT**.
To undo the calculated Display LUT, click **Reset LUT**.



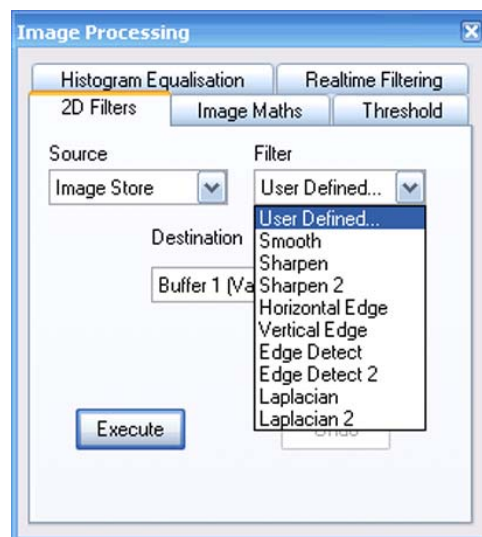
Examples for histogram equalisation:



4.4.8.4. 2D filtering

The 2D Filters function enables selection of a kernel to be applied to the image in the source image store.

- 1 Select **Image/Image Processing** from the menu.
- 2 Go to the **2D Filters** tab.
- 3 Under **Source**, select the storage to which the transformation should be applied to.
- 4 Select a **Filter**.
Nine pre-defined filters are available:

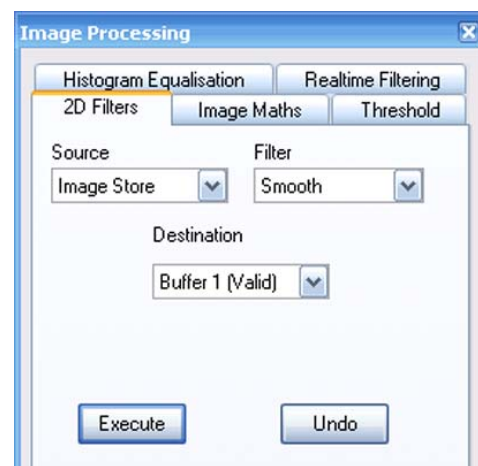


Filter	Process
<i>User Defined</i>	Applies user-specific filters, according to definition below
<i>Smooth</i>	Smooths the image
<i>Sharpen</i>	Sharpens the image
<i>Sharpen 2</i>	Sharpens the image
<i>Horizontal edge</i>	Detects horizontal edges in the image
<i>Vertical edge</i>	Detects vertical edges in the image
<i>Edge Detect</i>	Performs irregular edge detection by using a combined detection of horizontal and vertical edges in the image
<i>Edge Detect 2</i>	Performs irregular edge detection by using a combined detection of horizontal and vertical edges in the image
<i>Laplacian</i>	Detects edges in the image by realising a Laplace transformation using the four neighbouring pixels.
<i>Laplacian 2</i>	Detects edges in the image by realising a Laplace transformation using the eight neighbouring pixels.

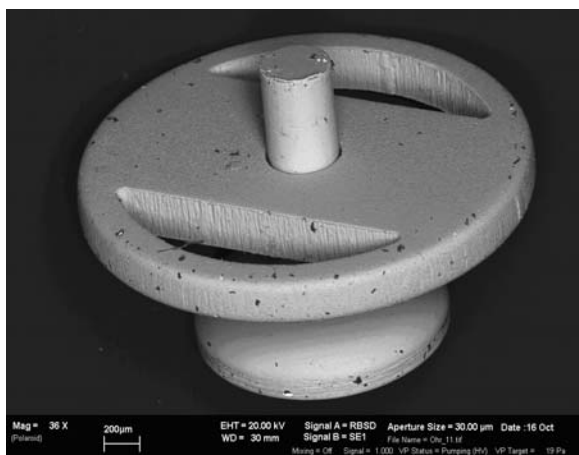
5 Select a **Destination**.

6 To start the image processing, click **Execute**.

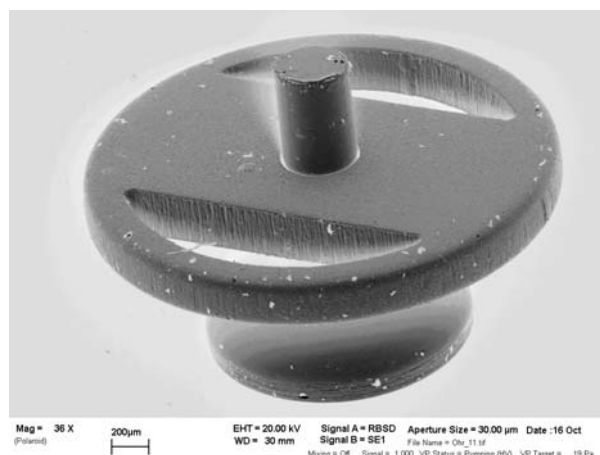
If you want to cancel the last calculation, click **Undo**.



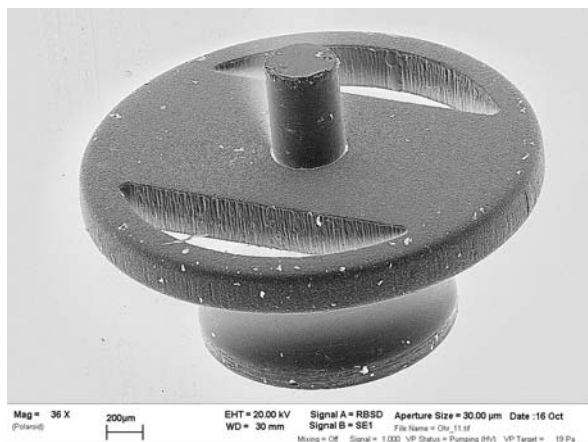
Examples for 2D filtering:



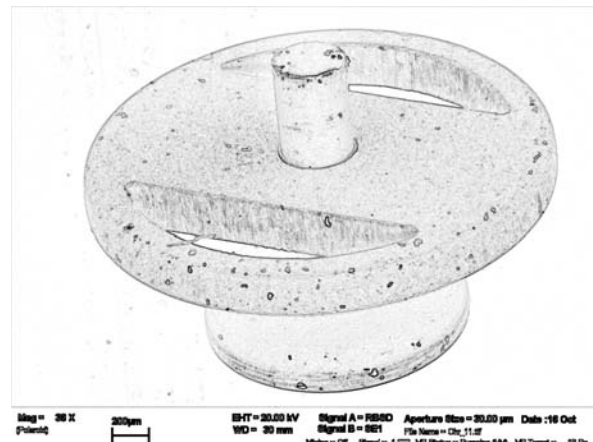
Original image



Inverted image



After application of Sharpen filter

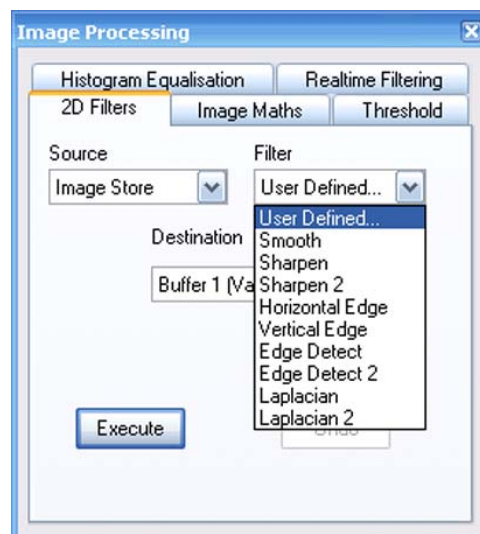


After application of Edge Detect filter

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- Defining user-specific filters
- 1 Under **Filter**, select *User Defined*.
 - 2 Click **Execute**.



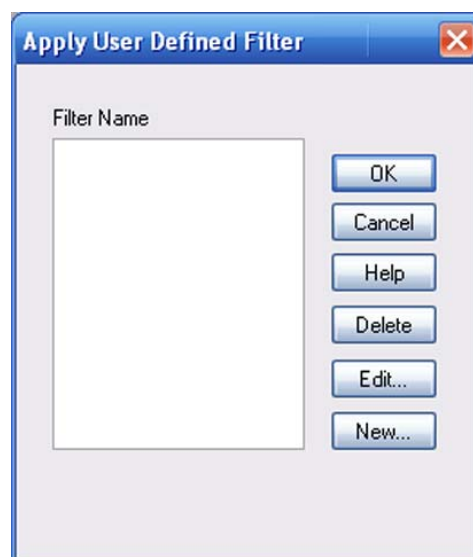
If no user-specific filters are defined, a warning message pops up.

- 3 Confirm this message by clicking on **OK**.



The **Apply User Defined Filter** window opens.

- 4 Select **New**.



The **Edit User Defines Filter** window opens.

- 5 Create a new filter by means of the **Filter Kernel Matrix**, enter a file name and confirm.

Edit User Defined Filter

Filter Name

Filter Kernel Matrix

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

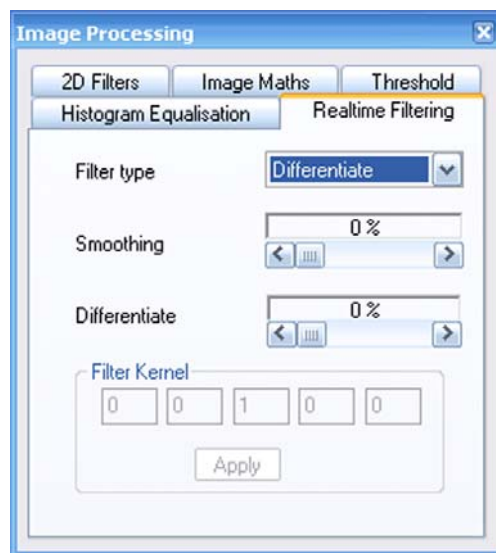
Division Factor

OK Cancel Help

4.4.8.5. Realtime filtering

The function **Realtime Filtering** offers the possibility of mathematically manipulating the image during recording. This feature is based on the evaluation of the grey value of a pixel, under consideration of the grey value of the neighbouring pixels.

- 1 Select **Image/Image Processing** from the menu.
- 2 Go to the **Realtime Filtering** tab.
- 3 Select the **Filter type**.



Filter	Process	Remarks
<i>Smooth</i>	Smooths the image. Set the degree of smoothing by using the Smoothing slider.	Recommended for live images with a high noise ratio.
<i>Differentiate</i>	Differentiates the image. Set the degree of smoothing by using the Differentiate slider.	Increases the grey value differences of the individual pixels. Accentuates fine structures and increases the focus of the image. Being prone to interferences, this filter should not be used for very noisy images.
<i>User Defined</i>	Applies a user-specific filter, which can be set by means of the Filter Kernel field.	

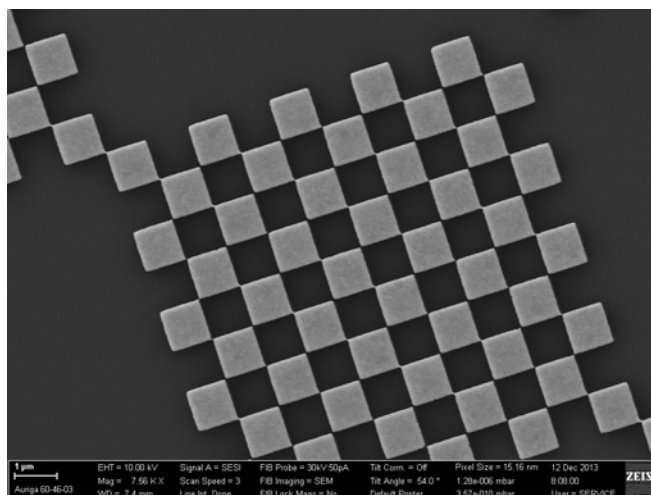
4.4.9. Using the Histogram dialog

While the **Histogram Equalisation** tab in the **Image Processing** dialog (see section 4.4.8.3.) offers an ordinary adaptive histogram equalisation, the **Histogram** dialog described here uses the Contrast Limited Adaptive Histogram Equalisation (CLAHE) algorithm.

CLAHE is a computer image processing technique used to improve contrast in images. It differs from ordinary histogram equalisation in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast of an image and bringing out more detail.

By limiting the amplification, CLAHE prevents overamplifying noise in relatively homogeneous regions of an image.

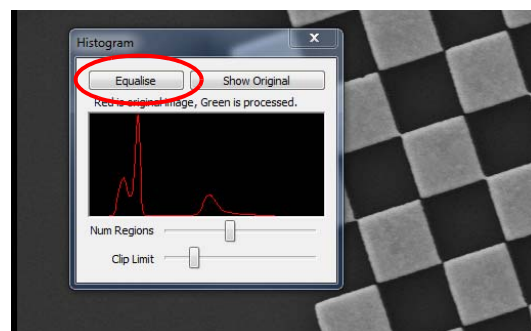
- 1 Obtain an image.
- 2 Stop the scan.



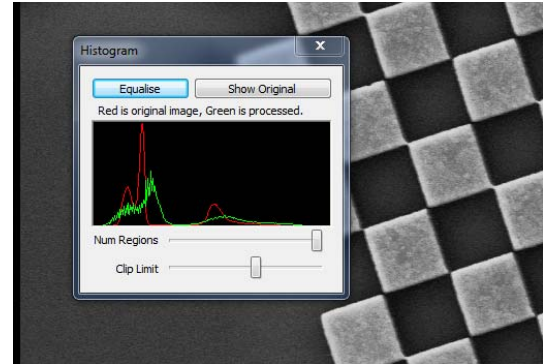
- 3 From the Panel Configuration Bar, select **Histogram**.

The **Histogram** dialog opens.
A red graph shows the original image histogram.

- 4 Click **Equalise**.



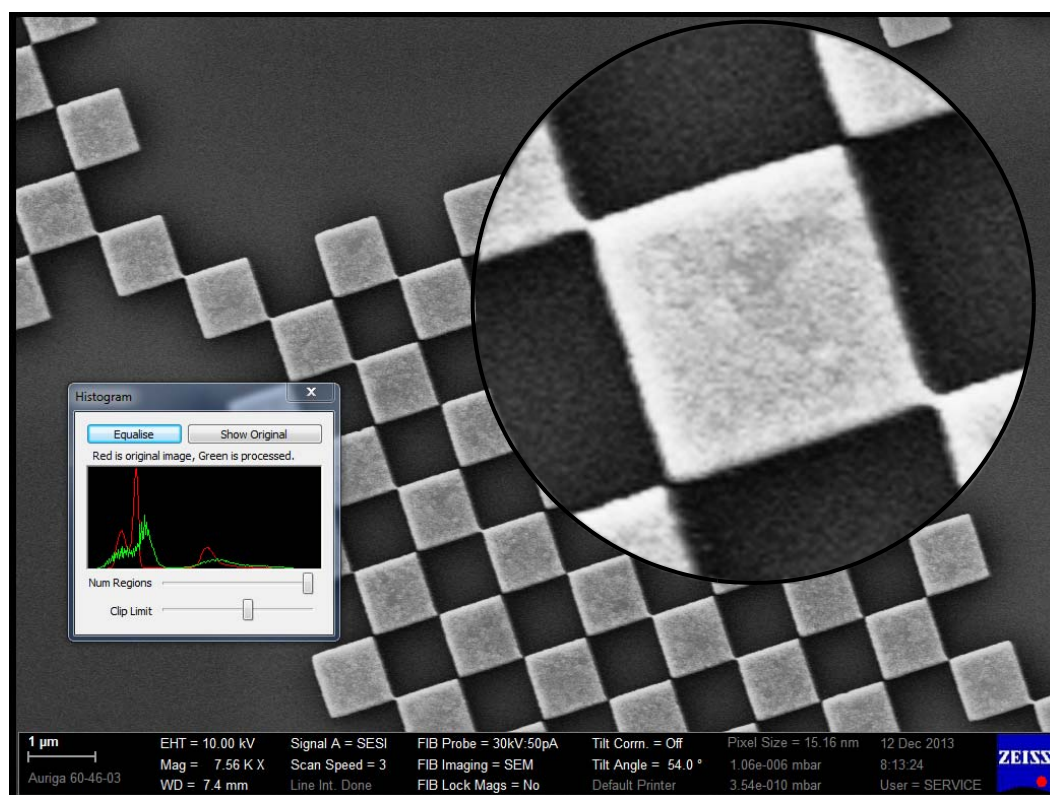
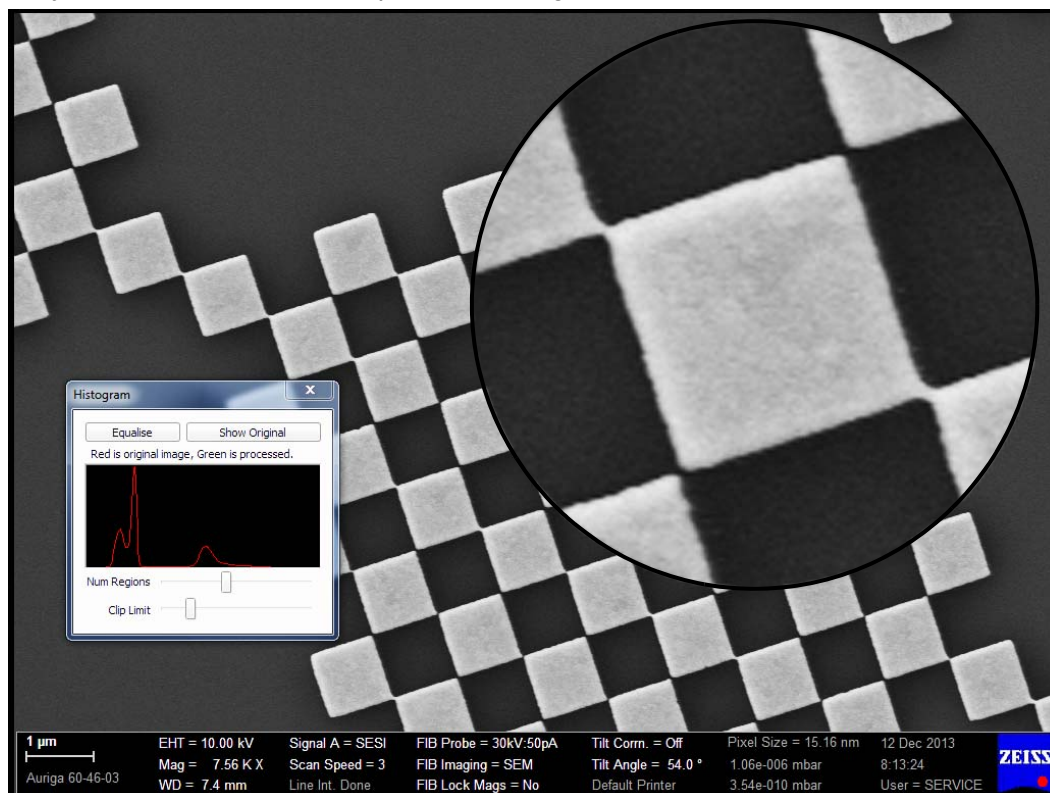
The processed image is displayed.
A green graph shows the processed image histogram.



- 5 To further optimise the image, perform the following steps.
Several iterations may be necessary to achieve the best result.
 - a Adjust the **Num Regions** slider.
CLAHE optimises the contrast in subdivisions of the total image first and then computes an average from these regions. The **Num Regions** slider indirectly defines the size of these regions. To find the optimal value, consider the size of relevant structures on the specimen.
 - b Adjust the **Clip Limit** slider:
This slider sets the limit value for the clipping of image content.
All information above this limit value is clipped and therefore not visible in the equalised image.
 - c Click **Equalise**.

You can switch between the original and the processed image by clicking **Equalise / Show Original**.

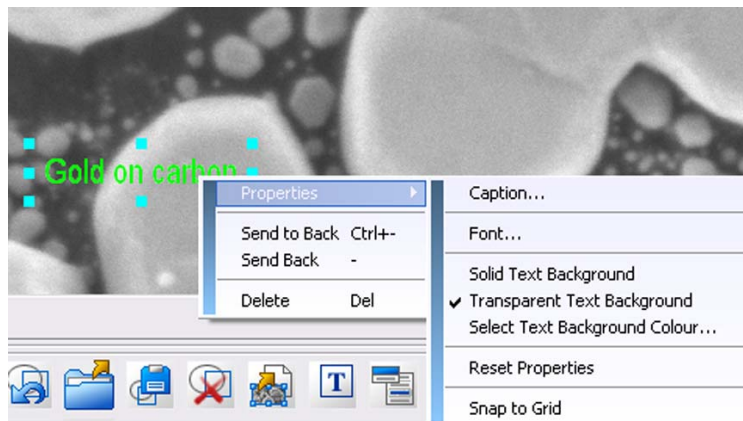
The following example shows the benefit of the CLAHE algorithm: The white sections of the chessy reveal more details in the processed image.



4.5.1.1. Modifying text properties

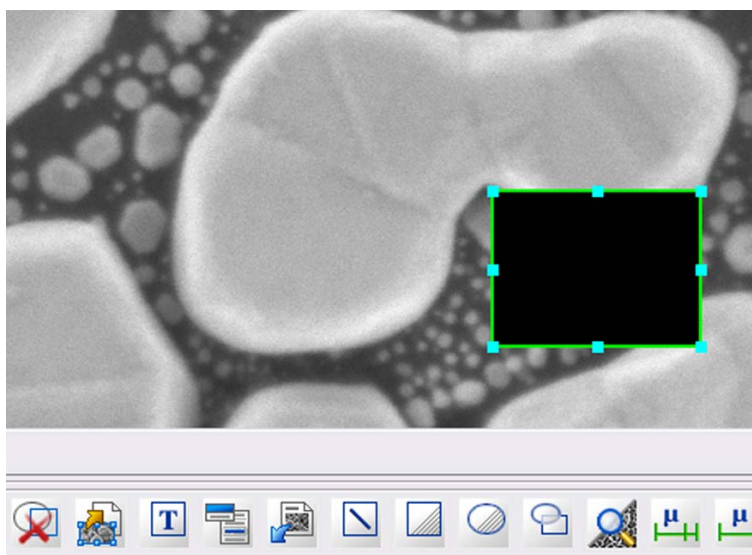
- 1 Click the annotation text box to mark it.
- 2 Select **Properties** from the drop down list.

You can change e.g. font, font style, background style, and background colour.



4.5.2. Adding geometrical objects

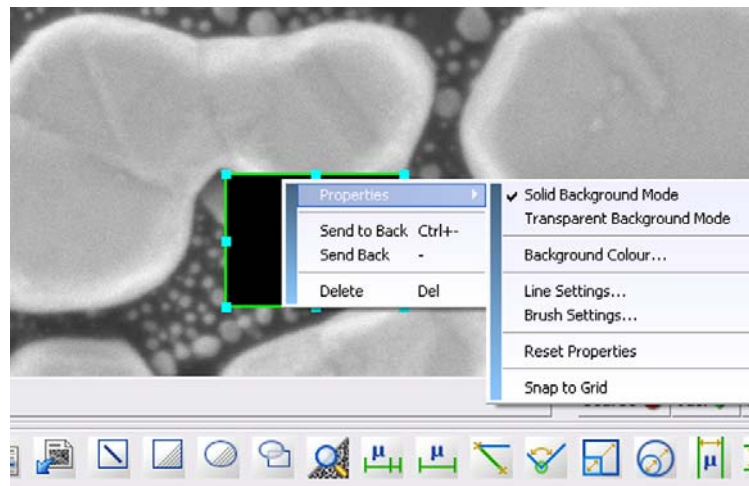
- 1 Select the desired annotation icon such as **Annotation Line**, **Annotation Rectangle** or **Annotation Ellipse**.
- 2 Click the image where you wish to place the object.



4.5.2.1. Modifying object properties

- 1 Click the annotation text box to mark it.
- 2 Select **Properties** from the drop-down list.

You can e.g. display a direction arrow at a line, change line settings, background style, and background colour.



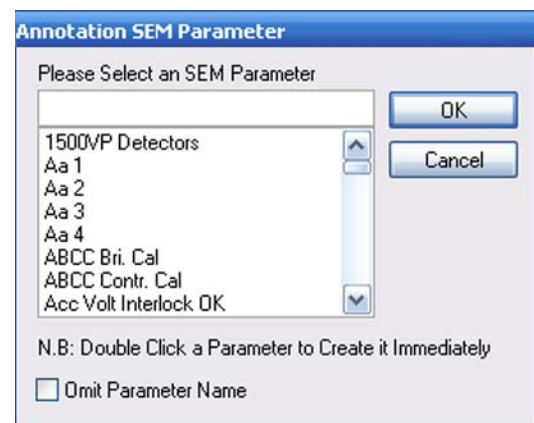
4.5.3. Adding EM parameters

- 1 Click the **EM Parameter** icon.

The **Annotation SEM Parameter** panel opens.



- 2 Select the parameters to be inserted.
- 3 If you wish that the value will be displayed without parameter, tick the **Omit Parameter Name** checkbox.
- 4 Confirm by clicking on **OK**.



4.5.4. Adding a bitmap or metafile

- 1 Click the **Insert User Bitmap** icon.
- 2 Click the image where you wish to place the object.
- 3 Select the bitmap or metafile.
- 4 Click **Open**.



4.5.5. Zone magnification

Zone magnification allows you to show the magnification of a selected zone which might be helpful when the magnifications of different zones are not the same.

- 1 Click the **Zone Magnification** icon.
- 2 Click the zone of interest.

The magnification of this zone is displayed.



4.5.6. Adding micron markers

A micron marker is a horizontal bar which indicates the size of an object in the image. Above the bar its length is displayed.

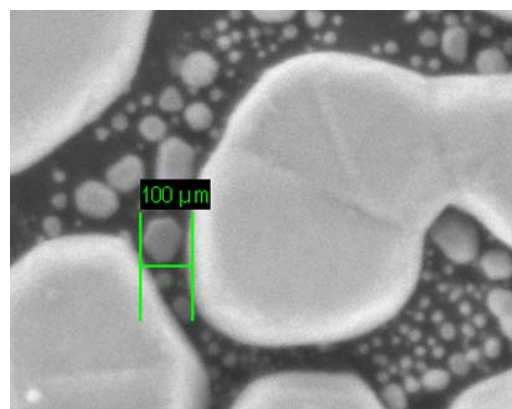
4.5.6.1. Micron marker

The micron marker is self-sizing as the bar has minimum and maximum lengths. If the magnification is changed such that these limits would be exceeded the length represented by the bar is changed to a whole number which would permit the bar to be within limits.

- 1 Click the **Micron Marker** icon.
- 2 Click where you wish to place the micron marker.



The micron marker annotation can be picked up and dragged into the required position. Ensure to place the annotation not over another zone.

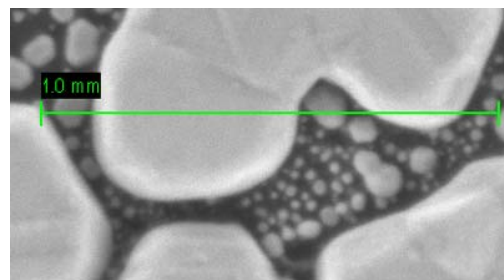


4.5.6.2. Fixed micron marker

- 1 Click the **Fixed Micron Marker** icon.
- 2 Click where you wish to place the micron marker.
- 3 Enter the desired value.
- 4 Confirm.



The micron marker represents a fixed dimension, and may therefore extend off the screen if the magnification is too large or may shrink to a single pixel length if the magnification is too low. Editing the fixed micron marker allows you to change the size.



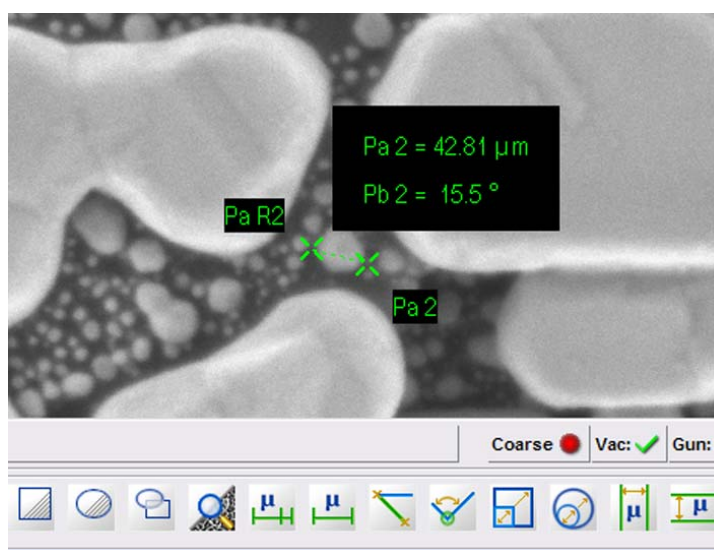
4.5.7. Measuring

4.5.7.1. Measuring a size

- 1 To measure the size of a certain feature, select the **Point To Point Measure** icon.
- 2 Click the image and keep the left mouse button pressed while drawing a line across the feature you wish to measure.
- 3 Release the left mouse button.



The measurement is displayed as a text adjacent to the object.



If you do not wish to display any of the parameters:

- 1 Double-click the line.

A dialog box opens.

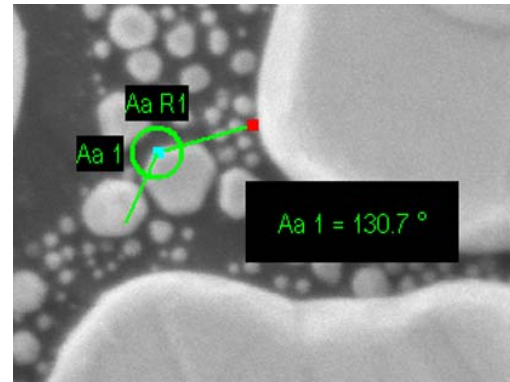
- 2 Remove any items you do not want to be shown.
- 3 Confirm with **OK**.

4. Operation

Annotating images

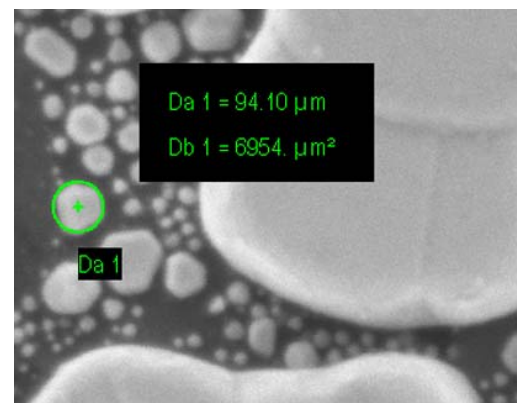
4.5.7.2. Measuring an angle

- 1 Click the **Angular Measurement** icon.
- 2 Click the image where you wish to measure the angle.
The measuring angle is shown.
- 3 Click the side of the angle to move its position.



4.5.7.3. Measuring a length or an area

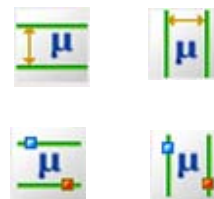
- 1 Select the desired annotation icon: **Linewidth Measure** or **Radial Measure**.
- 2 Click the image where you wish to measure an object.



4.5.7.4. Measuring distances

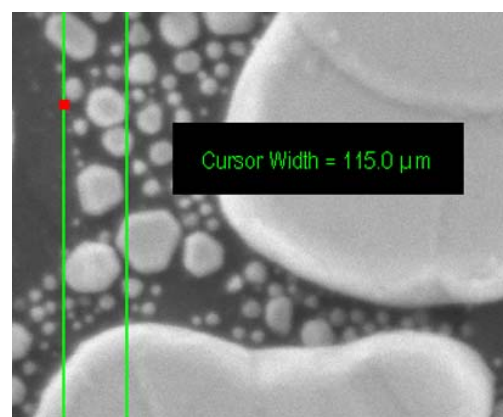
1 Select the desired annotation icon such as:

- **Width Measurement Cursors:** fixed width
- **Height Measurement Cursors:** fixed height
- **Moveable Width Cursors:** variable width
- **Movable Height Cursors:** variable height



The cursors are displayed.

2 To move the cursor, click the cursor line and hold the left mouse button.



4.5.7.5. Applying extended measuring capabilities (licence: MEASA)

The expanded measuring capabilities refer to adjustable width and height measuring cursors and the rectangle measuring.

This licence offers four cycle measurements instead of only two without this licence. The point-to-point measurement can be called up to ten times (without licence: twice). The adjustable measuring lines also can be called up to ten times (without licence: twice).

Requires the licence MESASA.

4.5.8. Editing Annotations

4.5.8.1. Moving an annotation

- 1 To move the annotation text to a different position, use drag & drop.

4.5.8.2. Undoing the last edit

- 1 Click the **Undo last Edit** icon.



4.5.8.3. Hiding/Unhiding annotations

You can show or hide annotations.

- 1 To hide annotations:
 - a Select **View/Hide Annotations** from the menu.
 - b From the submenu select which kind of annotation you wish to hide.
- 2 To show annotations:
 - a Select **View/Hide Annotations** from the menu.
 - b From the submenu select which kind of annotation you wish to show.

4.5.8.4. Deleting an individual annotation

- 1 Click the annotation object or text.
- 2 Right-click the annotation object or text.
- 3 Select **Delete** from the drop-down list.

4.5.8.5. Deleting all annotations

- 1 Click the **Delete All Visible Objects** icon.
- 2 Confirm by clicking on **OK**.



4.5.8.6. Saving annotations

- 1 Click the **Save Annotation** icon.
- 2 Enter an annotation name.
- 3 Confirm.



4.5.8.7. Loading annotations

- 1 Click the **Load Annotation** icon.
- 2 Select an annotation.
- 3 Confirm.

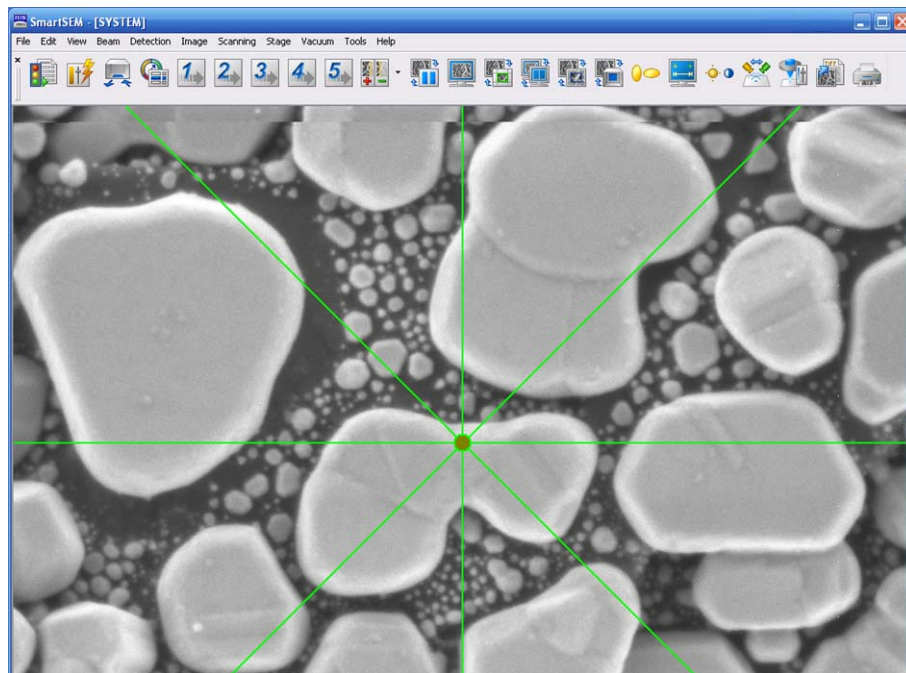


4.5.9. Displaying crosshairs or graticules (licence: GRATICULE)

4.5.9.1. Crosshairs

- 1 Select **View/Crosshairs** from the menu.

Crosshairs are displayed in the image area. In the drop-down menu, **Crosshairs** is ticked.



In order to remove the crosshairs, select **View/Crosshairs** again.

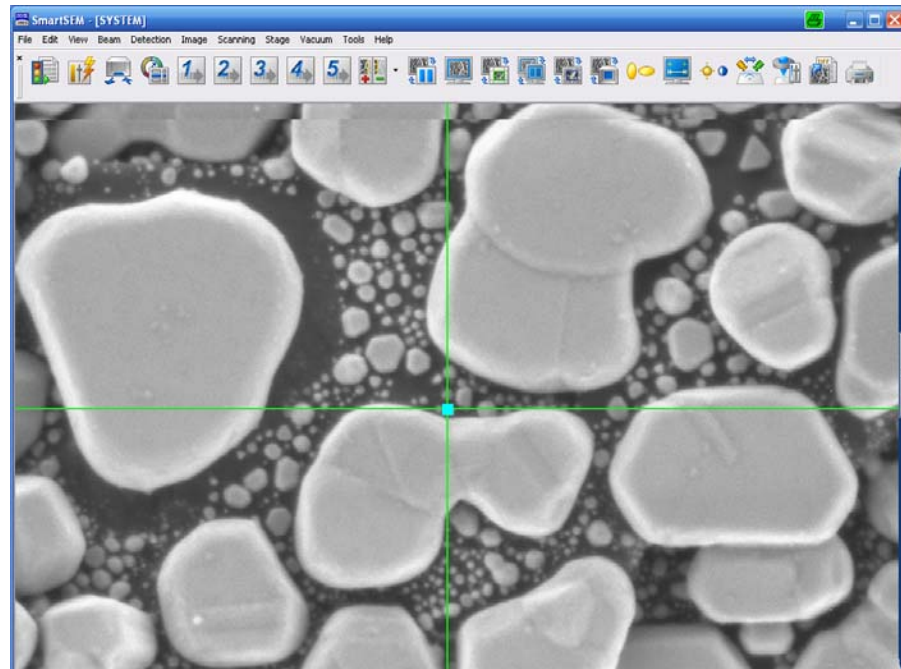
4.5.9.2. Movable Crosshairs

- 1 Select **View/Movable Crosshairs** from the menu.

Crosshairs are displayed in the image area.

In the drop-down menu **Movable Crosshairs** is ticked.

- 2 To move the crosshairs, click the square in the centre and drag.

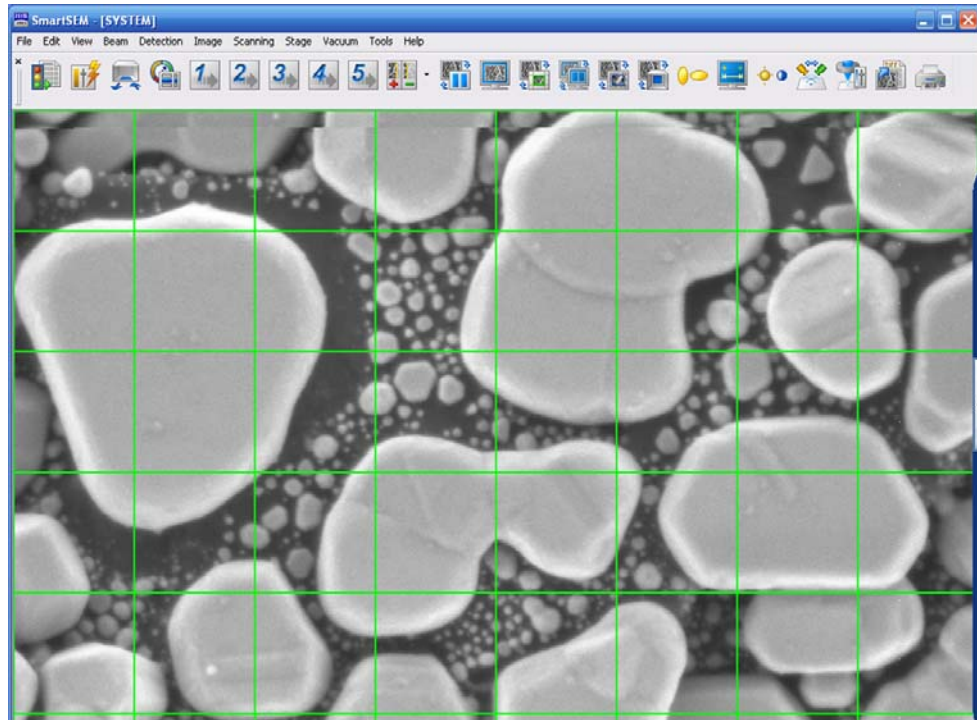


In order to remove the crosshairs, select **View/Movable Crosshairs** again.

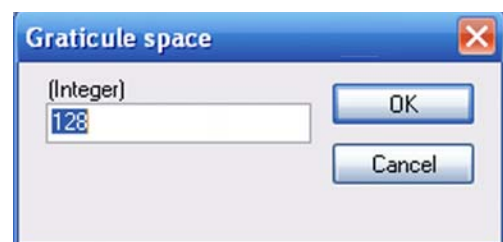
4.5.9.3. Graticules

- 1 Select **View/Graticules** from the menu.

Graticules are displayed in the image area. In the drop-down menu, **Graticules** is ticked.



- 2 To change the spacing between the graticule lines, select **View/Graticule Spacing**.
- 3 Enter a value and confirm.



In order to remove the graticules, select **View/Graticules** again.

4.6. Working with recipes

Recipes are used to save a set of SEM parameters which are ideal for a certain type of specimen. When this type of specimen needs to be re-analysed in the future, the SEM parameters can be recalled by opening the saved recipe. Only fine adjustments should then be required.

An Expert user (supervisor privilege) may set the SEM parameters for a range of applications and save them as a common recipe that is available to all users. This enables *Novice* users to recall such recipes.

4.6.1. Saving a user-specific recipe

A recipe is a file defining the specific set of parameters of the SEM/FESEM. A default ingredient list defines the parameters to be saved in the recipe.

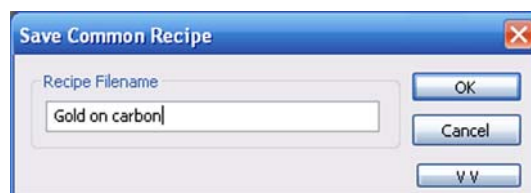
- 1 Select **File/Save Recipe** from the menu.
- 2 Enter a file name and confirm.
It is recommended selecting a file name which allows you to clearly identify the very type of specimen.



4.6.2. Saving a common recipe

Common recipes are available to all users. Saving a common recipe requires the supervisor privilege.

- 1 Select **File/Recipe Management/Save Common Recipe** from the menu.
- 2 Enter a file name and confirm.
It is recommended selecting a file name which allows you to clearly identify the very type of specimen.



4.6.3. Viewing a recipe

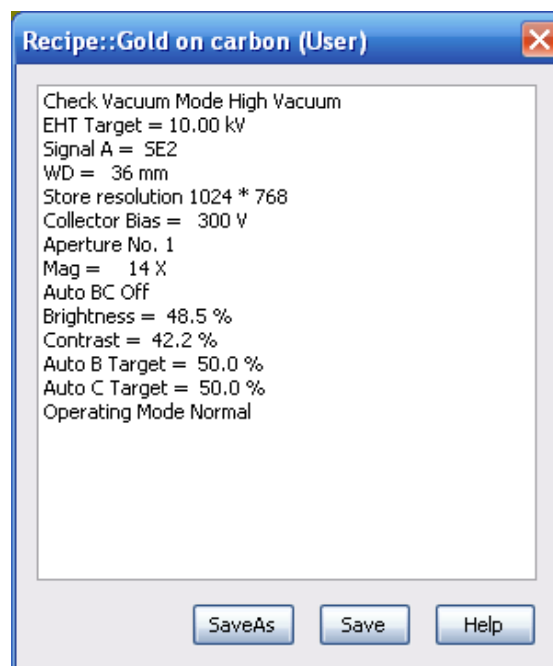
In order to check the content of a recipe you can display a list of saved parameters.

- 1 Select **File/View/Edit Recipe** from the menu.

A list is displayed.

- 2 Mark the recipe you wish to view and confirm.

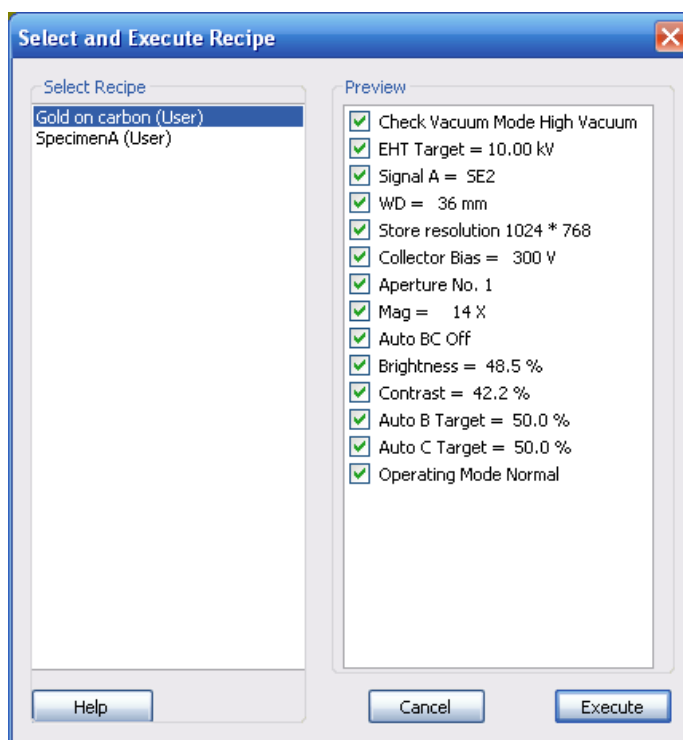
The content of the recipe is displayed.



Double-clicking on a parameter allows you to edit the parameter setting.

4.6.4. Executing a recipe

- 1 Select **File/Execute** from the menu.
- 2 Mark the recipe you wish to run.



- 3 If you wish to omit a particular parameter on the list, remove the respective tick.
- 4 Click **Execute**.

Only one recipe may be run at a time.

4.6.5. Deleting a recipe

- 1 Select **File/Recipe Management/Delete** from the menu.
- 2 Mark the recipe you wish to delete.
- 3 Confirm.

4.6.6. Creating an ingredient list

The ingredient list defines the contents of the recipe, i.e. the combination of saved parameters. Parameters can be added and deleted.

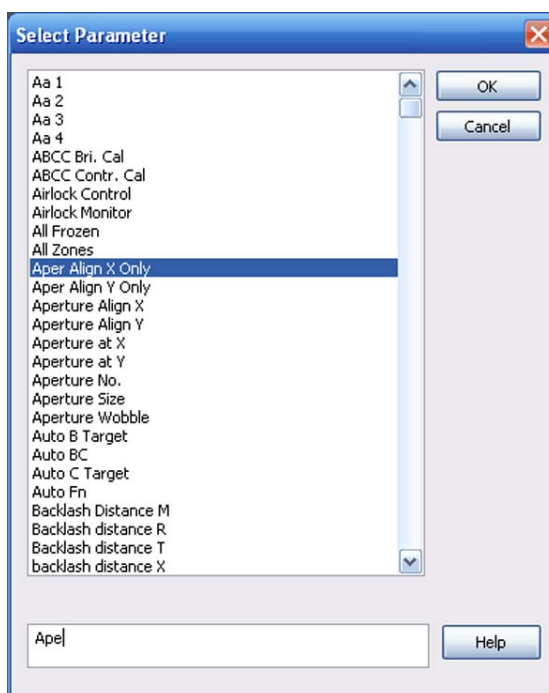
- 1 Select **File/Recipe Management/Ingredient File Editor** from the menu.

The **Recipe Ingredient List Editor** opens.



- 2 Click **Load File**.
- 3 Select a recipe file and confirm.
- 4 Click **Insert Parameter**.

An alphabetical list of parameters is displayed.

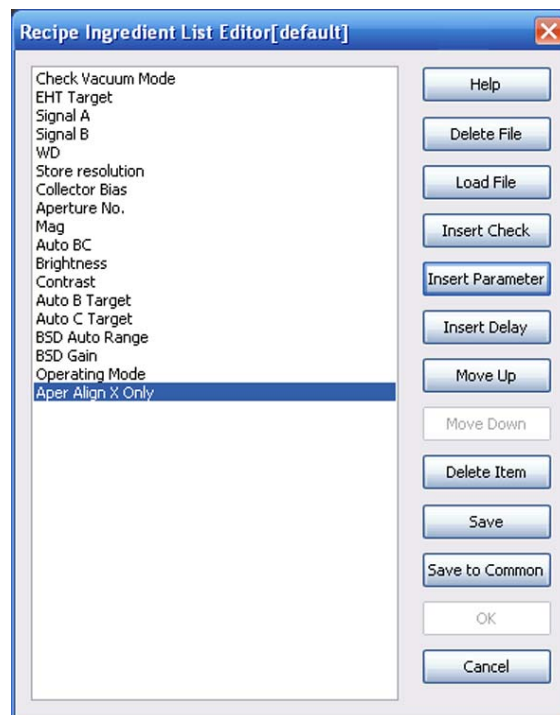


- 5 Select the parameter you wish to add.
 - a To simplify the search, enter a key word in the field at the bottom.
 - b Select the parameter and confirm by clicking on **OK**.

4. Operation

Working with recipes

The parameter is added to the list.



- 6 To change the order of the parameters, use the **Move Up** and **Move Down** buttons.
- 7 To insert a delay: Click **Insert Delay**.
- 8 Enter a time and confirm.
- 9 Save the ingredient list:
 - a To save it as a user-specific ingredient list: Click **Save**.
 - b To save it as a common ingredient list: Click **Save To Common**.

4.6.7. Using the MiniBar to work with recipes

Saving user-defined recipes, editing, and executing is also possible via MiniBar.

- 1 Click the **Recipes** icon on the Mini Bar.



- 2 To save the current SEM/FESEM settings as a user-specific recipe, select **Save Recipe**.
- 3 To view, edit or run a recipe, select **Recent** for the latest recipes or **All Available** for all recipes.
- 4 To run a recipe, click the recipe name.
- 5 To view or edit, click the ... button after the respective recipe name.



A preview list is shown, where you can omit individual parameters.

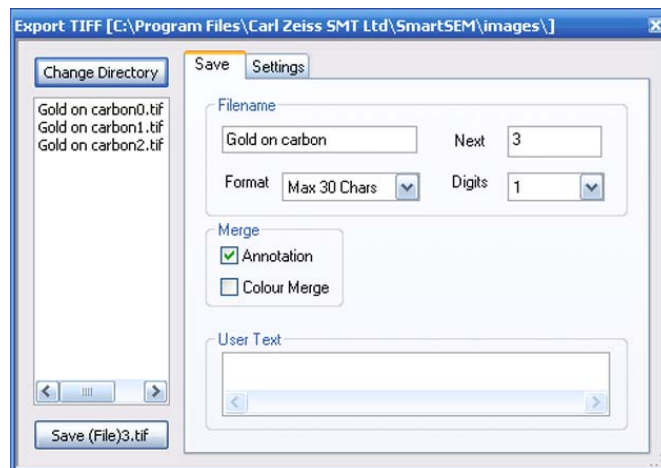


4.7. Saving and managing images

4.7.1. Saving images

After optimising and freezing the image, it can be saved as a TIF (Tagged Image Format) file.

- 1 Select **File/Save Image** from the menu.

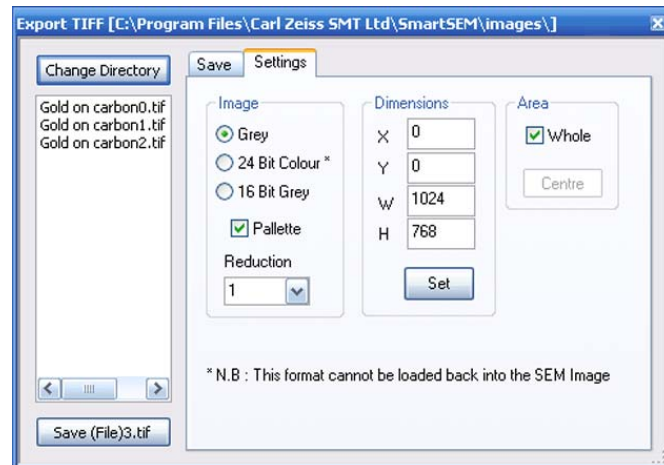


- 2 Enter a file name.
- 3 Select a file name format from the drop-down menu **Format**.
- 4 Select the numbering of the image file.
- 5 Select the store resolution from the drop-down menu **Store Resolution**.
- 6 You can also add text in the field **User Text**.
This text will be displayed when selecting a file in the **Load Image** dialog.
- 7 Click **Save 'file name'**.

4.7.1.1. Selecting TIF image modes and image dimensions

It is possible to save an image in several formats depending on your requirements. In general, Grey is recommended.

- 1 Select **File/Save Image** from the menu.
- 2 Go to the **Settings** tab.



- 3 Select the Image mode:
 - *Grey*
(8 bit, 256 grey scales)
Coloured SEM images which may possibly need to be modified later within the SmartSEM[®] user interface, should be saved as grey images together with the respective colour pallet.
 - *24 Bit Colour*
(16 millions of colours)



IMPORTANT

Images saved as colour images (24 Bit Colour) cannot be reloaded to the SmartSEM[®] user interface, but they can be implemented to most Windows[®] user programs.

- *16 Bit Grey*
(65536 grey scales)
Exclusively reserved for later image modification by means of commercial programs.



IMPORTANT

When selecting 16 Bit Grey, no annotations, measurements or data zones will be saved.

- 4 Set the image dimensions.
- 5 Click **Save 'file name'**.

4. Operation

Saving and managing images

4.7.1.2. Saving images as BMP or JPEG

It is also possible to save SEM images as BMP or JPEG. When using these formats, the SEM images are always saved as grey images with the respective pallet. You cannot save the image in colour.

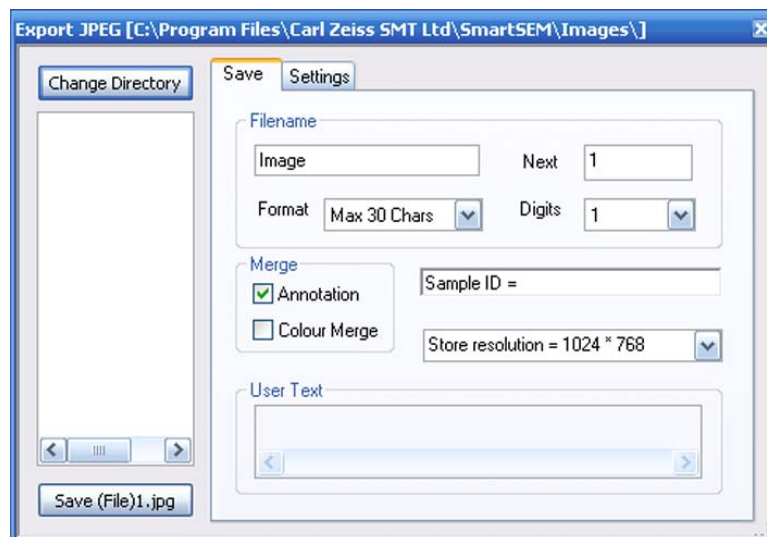


IMPORTANT

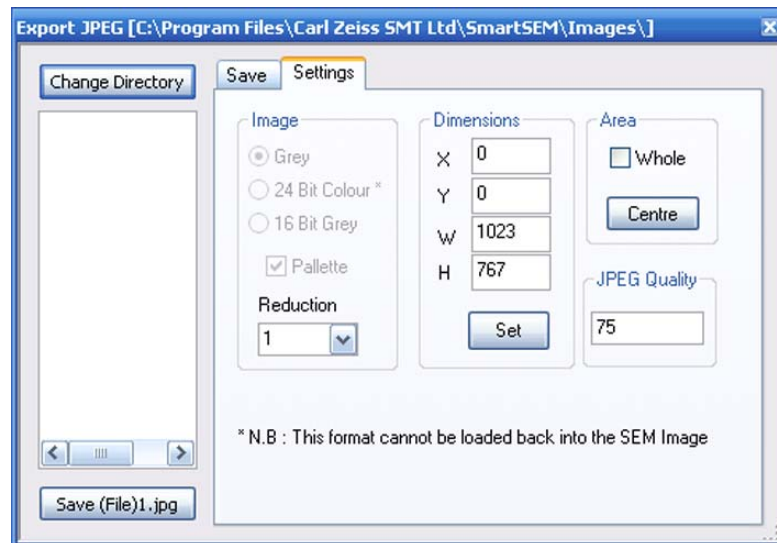
Images in BMP and JPEG format cannot be reloaded to the SmartSEM® user interface. Besides, it is not possible to save additional information with the image.

- 1 Place the cursor into the image area.
- 2 Right-click.
- 3 Select **Send to/BMP file** or **JPEG file**.

A dialog opens.



- 4 Go to the **Settings** tab.



- 5 Define the image dimensions.
- 6 When saving the image as JPEG:
 - a Enter a value for **JPEG Quality**.

The value can be between 5 and 95. The smaller the value, the higher the compression (reduced storage place) and the worse the quality of the image when printed.

A default value of 75 is set for **JPEG Quality**. In most cases, this value represents a good compromise between compression of the storage place and quality of the image.



IMPORTANT

Depending on the image content of the respective image, quality and information may be lost even when saving images at high level of JPEG Quality (75-95).

- 7 Return to the **Save** tab.
- 8 Enter a file name.
- 9 Click **Save 'file name'**.

4.7.1.3. Saving images together with the Windows[®] overlay (Image Capture Mode)

Actually, the image displayed on the monitor consists of the SEM image itself and a Windows[®] overlay. The overlay contains status bar, toolbar etc., while the centre (scan range) is set to transparent.

When you take a screenshot by using the <PRINT> key on the keyboard, the saved image shows only the Windows[®] overlay, whereas the SEM image range is displayed as a green or orange section.

Image Capture Mode should be used to avoid this effect.

- 1 Select **Tools/Image Capture Mode** from the menu.

The submenu **Image Capture Mode** is ticked.
The **Capture Now** submenu becomes available.

- 2 To activate the function one single time:

- a Select **Tools/Capture Now**.

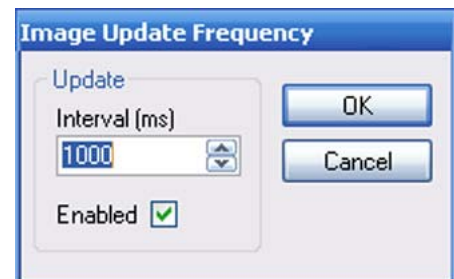
The live image is frozen and saved together with the Windows[®] overlay.

A red triangle is displayed in the lower right corner indicating the saved image.



- 3 To activate the function for continuous application:

- a Select **Tools/Image Update Frequency**.
- b In the **Image Update Frequency** panel tick the **Enabled** checkbox.
- c Enter an interval.
- d Confirm.



The live image is frozen and saved together with the Windows[®] overlay.

A red triangle is displayed in the lower right corner indicating the saved image.



To quit Image Capture Mode, select **Tools/Image Capture Mode** again.

4.7.2. Taking videos (licence: AVI capture)

The function AVI Capture Mode allows taking video sequences in order to show dynamic processes. The video can be played using the SmartSEM® user interface or another Windows® application.

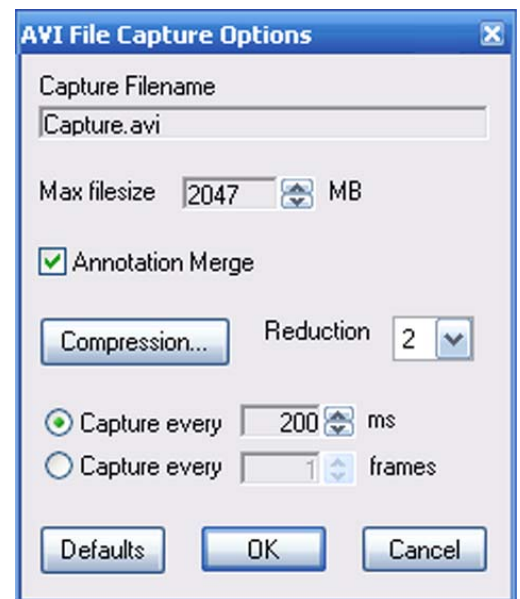
Requires the licence AVI Capture.

4.7.2.1. Setting parameters

- 1 Select **Tools/AVI Options** from the menu.

As a standard, the created video is saved as a Capture.avi file in the user's current image directory.

- 2 To change the file name or to select another directory, click in the **Capture Filename** and enter the data.
- 3 Set the maximum file size (max. 2047 MB).
- 4 In order to save annotations or measurements together with the video, tick the **Annotation Merge** checkbox.
- 5 If specific compression routines have been installed under the operating system, these routines can be selected by clicking on **Compression**.
- 6 To set the number of images to be saved, enter a value at **Capture every**.
- 7 Click **OK** to confirm.
To reset the default values, click **Defaults**.



4.7.2.2. Starting the record

- 1 Select **Tools/AVI Capture**.
The AVI Capture toolbar is shown.
- 2 To start recording, click the **Start AVI Capture** icon.



4. Operation

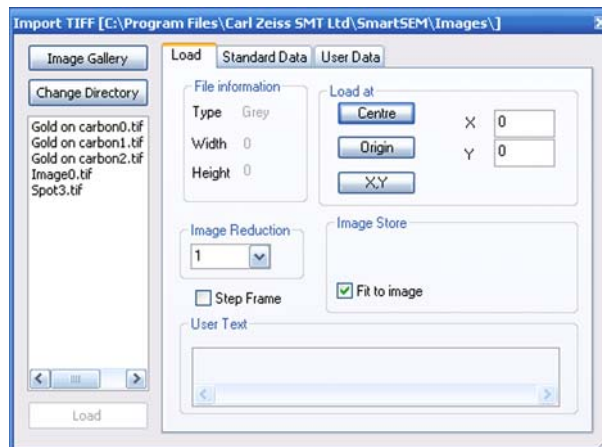
Saving and managing images

4.7.3. Loading images

- 1 Select **File/Load Image** from the menu.

Alternatively, type **<Ctrl + O>**.

The Import TIFF dialog opens.



- 2 Select the directory by clicking on **Change Directory**.
Confirm by clicking on **OK**.
- 3 Select an image by double-clicking on it.

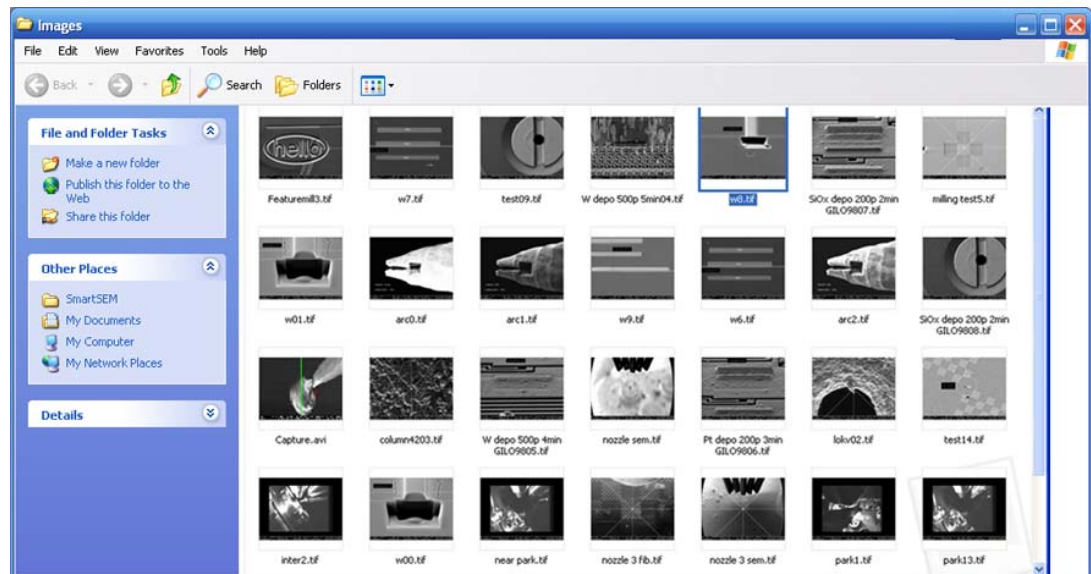
To return to the live image, select **Scanning/Normal** from the menu.

4.7.4. Using the Image Gallery

The images of a directory can be displayed as an image gallery. The images are shown as thumbnails together with the respective file name.

- 1 Select **Image/Image Gallery** from the menu.

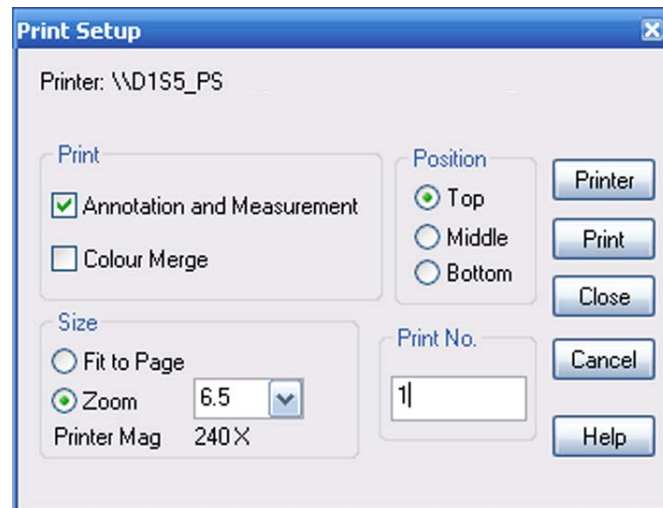
The gallery is displayed.



- 2 To select an image, double-click it.

4.7.5. Printing images

- 1 Select **File/Print Image**.
Alternatively, type <Ctrl + P>.



- 2 If you wish to print annotations and measurements together with the image, tick the respective checkbox.
To print colour annotations or measurements, the **Colour Merge** checkbox must be ticked as well.
- 3 In the **Size** section, select the size of the printed image.
If you tick **Zoom**, you should also enter a zoom factor and select the position on the sheet (*Top, Middle or Bottom*).
- 4 To select the printer, click **Printer**.
- 5 To start the printing process, click **Print**.

4.7.6. Copying images to the Windows® buffer (licence: CLIP)

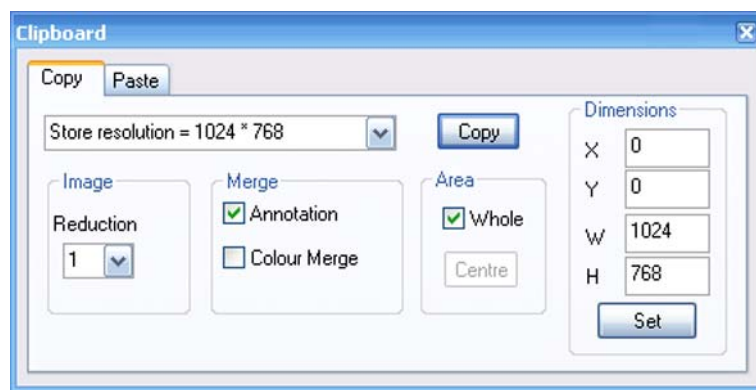
The clipboard functions may be used to copy images to the Windows® buffer. As the image is not saved to a storage device such as hard disk or floppy disk but to the central memory of the computer, it can be used for other Windows® applications with access to the buffer store.

SEM images or sections of images can thus be copied to other programs without prior storage. On the other hand, SEM images in the clipboard can be added to the stored image.

4.7.6.1. Storing images

- 1 Select **Edit/Clipboard** from the menu.

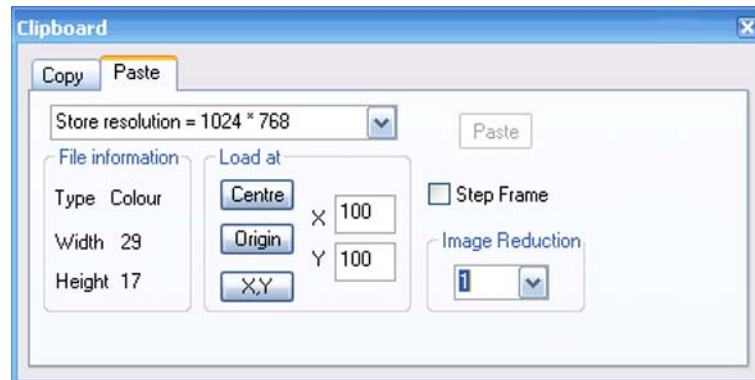
The **Clipboard Copy** tab opens.



- 2 Set the storage resolution by using the drop-down menu.
- 3 Select a reduction factor between 1 (original size) and 8.
- 4 To save data zone, annotations and measurement together with the image, tick the **Annotation** checkbox.
- 5 To save colour annotations or measurements together with the image, tick the **Colour Merge** checkbox.
However, the number of grey values (256) of the image is reduced to 20 as this storage space is required for the annotation.
- 6 Set the desired dimensions of the image and click **Set**.

4.7.6.2. Inserting images

- 1 Go to the **Paste** tab.



The field **File information** lists size and type of the image in the buffer.

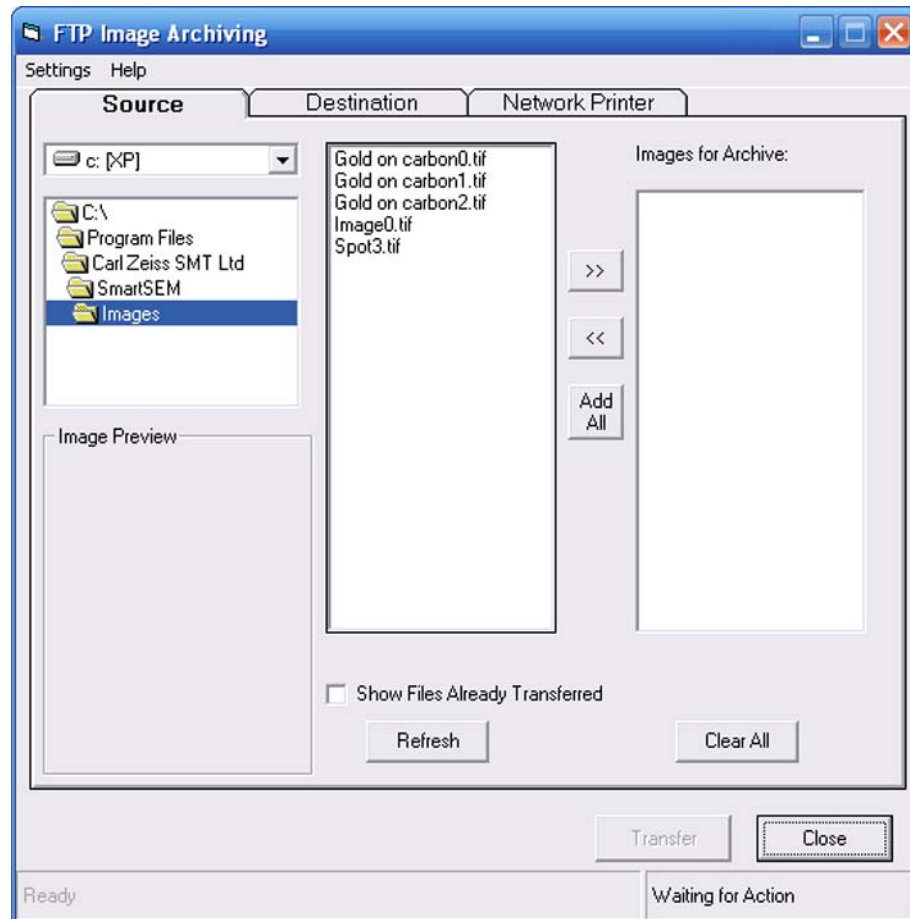
- 2 Select the **Image Reduction** factor.
Depending on the reduction factor, the size of the graticule is displayed on the screen. This graticule shows position and format of the loaded image.
- 3 To change the position of the graticule, use the **Centre**, **Origin**, and **XY** buttons.
Selecting **YX** allows you to freely position the graticule by means of the mouse.
- 4 To compose one image out of four images:
 - a Click **Origin**.
 - b Tick the **Step Frame** checkbox.
- 5 To insert the image, click **Paste**.

4.7.7. Transmitting data to a FTP server or a network printer (licence: REMARCH)

The FTP Remote Archiving program offers the possibility of transmitting images to a FTP server or a network printer by using a network (TCP/IP).

Requires the licence REMARCH.

- 1 Select **Start/Programs/SmartSEM/ImageArchiving**.

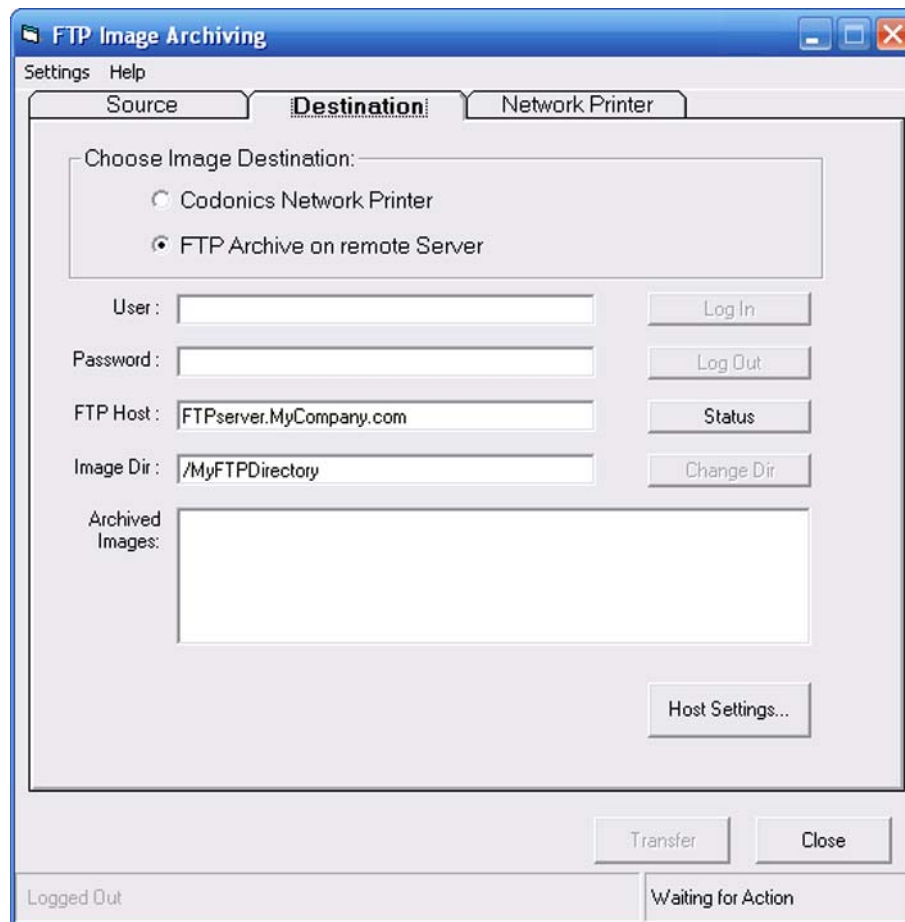


- 2 In the middle field of the **Source** tab, select the files to be sent.
To select several files at the same time, hold the **CTRL** key and click the files.
- 3 Click the >> button to copy the selected files to the **Image for Archive** field.
To copy all files at the same time, click **Add All**.

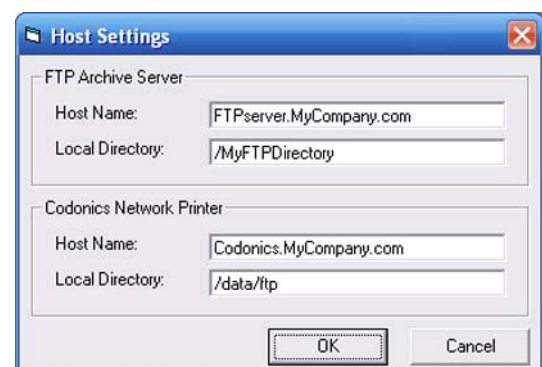
4. Operation

Saving and managing images

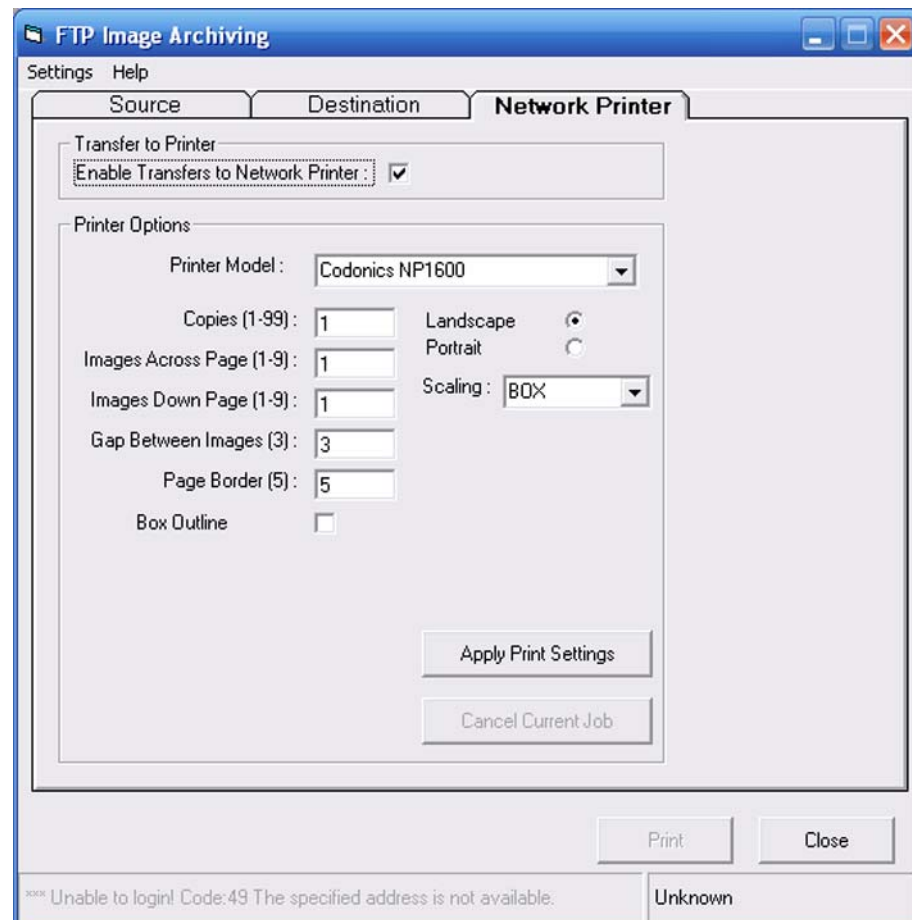
- Go to the **Destination** tab.



- Use the radio buttons to select the destination of the image (*Codonics Network Printer* or *FTP Archive*).
- Click **Host Settings**.
- Enter the required settings.
- Confirm.



- 9 If you wish to sent the data to the network printer, go to the **Network Printer** tab.
- 10 Tick the **Enable Transfers to Network Printer** checkbox.



- 11 Set the required **Printer Options**.
- 12 Confirm the settings by clicking on **Apply Print Settings**.
- 13 To start the printing process, click **Print**.
The print job can be interrupted by clicking on **Cancel Current Job**.

4.7.8. Using the Large Image Store Wizard

The Large Image Store Wizard guides you through a process with three main steps to obtain images with high pixel resolution.



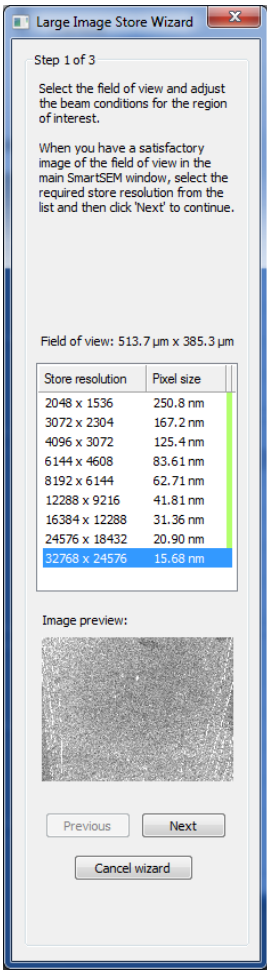
IMPORTANT
No annotations can be saved when using the Large Image Store Wizard.

- 1 From the **Panel Configuration Bar**, select **Large Image Store Wizard**.

Step 1 of 3 is displayed with a list of possible store resolutions and a preview image.

In the SmartSEM[®] main window an image with the resolution of 1024x768 is continuously scanned and displayed.

The image in the main window equals the field of view (FOV) that the final image will cover.



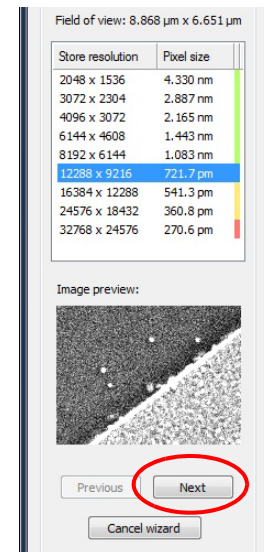
- 2 Optimise the image as described in section 3.4.7. Changing the magnification will also change the FOV for the final image.

The size of the FOV and the pixel sizes for each store resolution are shown in the wizard.

The coloured bar to the right helps you to select a suitable store resolution. Resolutions marked in red and yellow can also be selected, but these resolutions will not provide an optimal image quality.

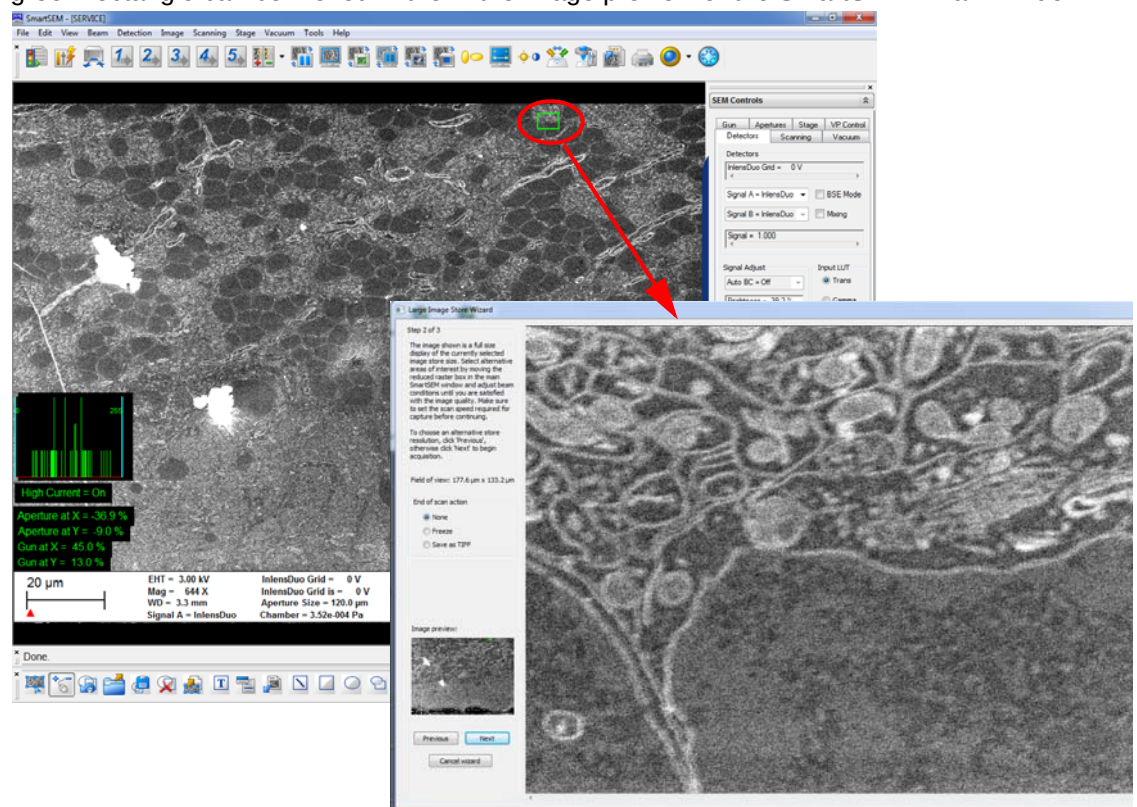
The store resolution can still be selected according to your requirements, as the coloured bar can only give you a hint on the technical possibilities to exclude resolutions that are too high for the selected area.

- 3 To continue, select a store resolution from the list and then click **Next**.



Step 2 of 3 is displayed.

An image preview is displayed at the bottom left of the window. A green rectangle shows the area of interest displayed in the large image. The field of view and the rectangle represent the image displayed in the SmartSEM® main window. To change the detail displayed in the large image, the green rectangle can be moved in the image preview or the SmartSEM® main window.



- 4 To check the alignment, move the green rectangle to different areas. If necessary, optimise the alignment. If you have problems to obtain satisfactory results, restart the procedure by clicking **Previous**.

4. Operation

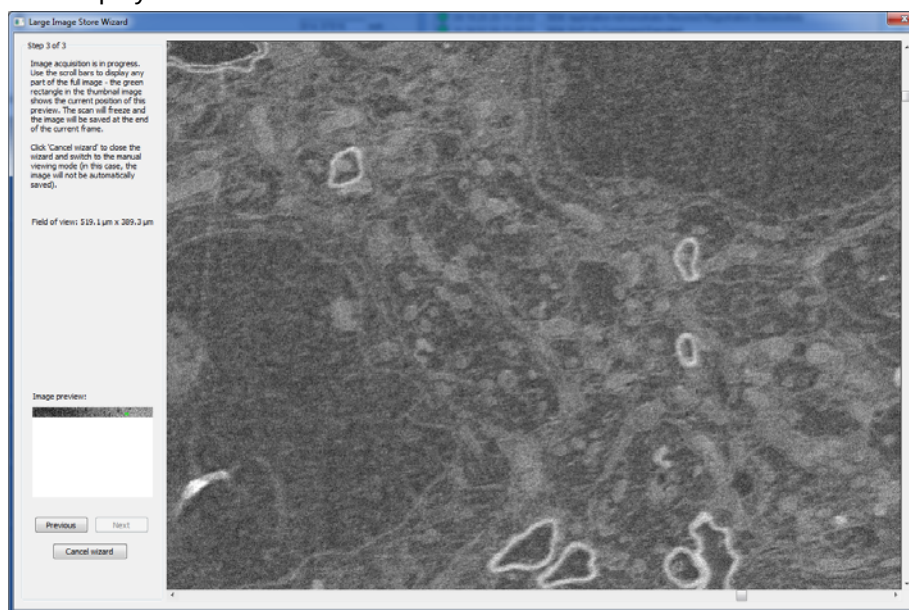
Saving and managing images

5 Select an **End of scan action**:

- **None**: after the scan is complete, it will restart at the beginning
- **Freeze**: after the scan is complete, the scan will be stopped
- **Save as TIFF**: after the scan is complete, the image will automatically be saved to the user's image directory with the last used **Export TIFF** settings.

6 Click **Next**.

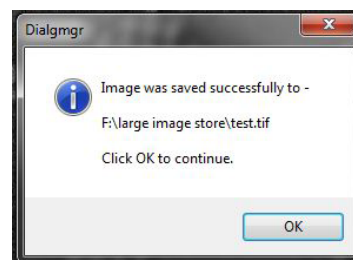
Step 3 of 3 is displayed.



Depending on the selected store resolution, the acquisition might take several minutes. You can observe the process by moving the green square in the Image preview to a region that is already displayed. If you need to stop the scan to change any settings, you can go back to step 2 by clicking **Previous**.

The selected **End of scan action** will be performed.

If you have selected **Save as TIFF**, a message appears to confirm that the image has been successfully saved.



4.8. Managing users

The SmartSEM® software uses the SmartSEM® Administrator for user management. By means of the SmartSEM® Administrator you can create new users and assign them with certain privileges.

The Administrator creates the various user directories and edits existing folders and user configurations. A user directory is a closed data path which saves frequently modified configuration parameters of the SmartSEM® user interface and system software files for the various users.

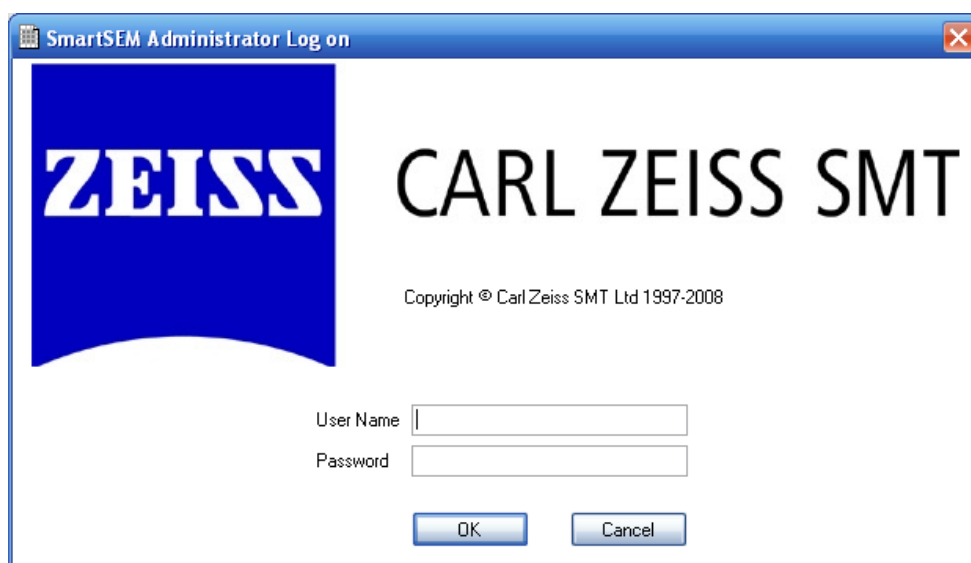
If each user has their own directory for configuration parameters, the software can be configured in such a way that toolbar, menus, data zones, etc. meet the specific requirements of each user. Thus there is no need to reconfigure the user interface each time SmartSEM® is started.

4.8.1. Managing user profiles

4.8.1.1. Starting the SmartSEM® Administrator

- 1 Select **Start/Programs/SmartSEM/SmartSEMAdmin**.

The **Administrator Log on** window is shown.



- 2 Log on as follows:

Logging on for the first time

On initial installation of the SmartSEM® software:

- a The person responsible for the SEM/FESEM should log on as SYSTEM with a blank password.

The user list is shown.

4. Operation

Managing users

- b Change the password to a suitable string:
Mark *System* in the user list. Select the menu **Users/Edit**.
- c Click **Change Password**.
Change the password. It will take effect on the next log on.
- d Confirm by clicking on **OK** twice.



IMPORTANT
Record the System password in a safe place. If you lose the password a chargeable service visit will be required.

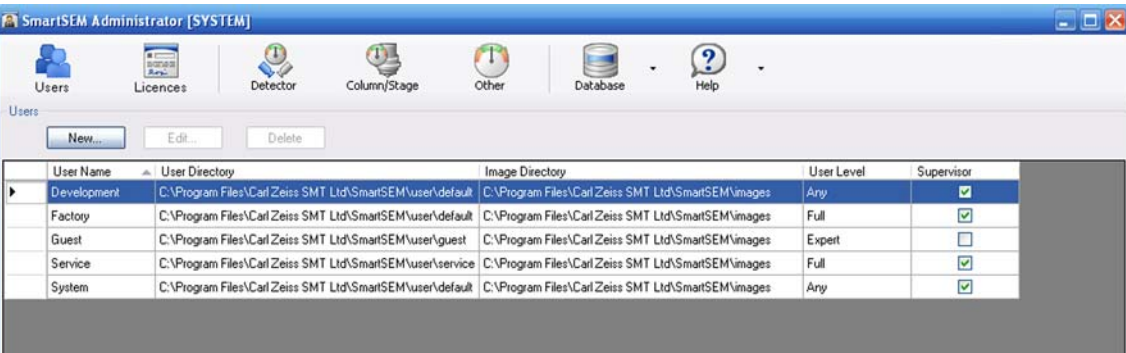
Logging on
regularly

- On regular log on:
- a Enter username and password.
 - b Confirm by clicking on **OK**.



IMPORTANT
Logging on requires Supervisor privileges.

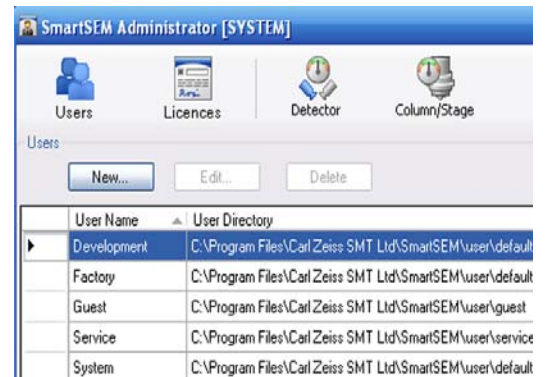
The SmartSEM Administrator window opens showing the user list.



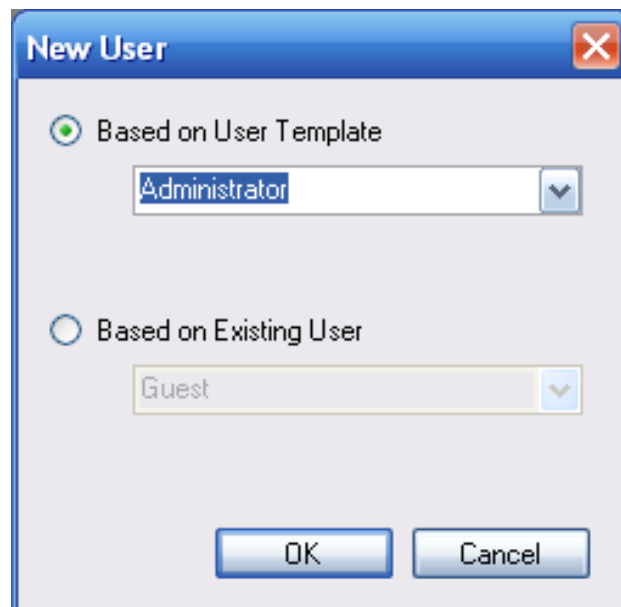
User Name	User Directory	Image Directory	User Level	Supervisor
Development	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\user\default	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\images	Any	☒
Factory	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\user\default	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\images	Full	☒
Guest	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\user\guest	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\images	Expert	☐
Service	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\user\service	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\images	Full	☒
System	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\user\default	C:\Program Files\Carl Zeiss SMT Ltd\SmartSEM\images	Any	☒

4.8.1.2. Creating a new user profile

- 1 Click **New**.



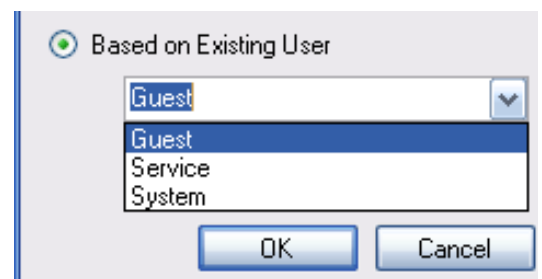
The **New User** window opens.



IMPORTANT

New user profiles are based on user templates or on existing users. This reduces the workload when allocating rights for new users, while still being able to refine the profiles later on.

- 2 To create a new user based on a user template or on an existing user, tick one of the radio buttons.
- 3 Select a profile or an existing user from the drop down list.
- 4 Click **OK**.



The **Creating new User Profile** window opens.

Creating new User Profile

User Name Change Password

User Directory ...

Image Directory ...

Current

User Level Permissions

☐ Any level To Maximum -> Expert

User Privileges

Name	Granted
Calibration	☐
Change Image Directory	☐
Change Toolbar	☒
Change User Directory	☐
Extractor	☒
Gun Align	☐
Gun Off	☐
Stage Initialise	☐
Supervisor	☐
Vent	☐

Calibration Privileges

Name	Category	Granted
------	----------	---------

Temporary Calibration Privilege

Action ☐ Enabled Expires

OK Cancel

- 5 Enter a **User Name**.

The user name must consist of at least three but not more than 20 characters.

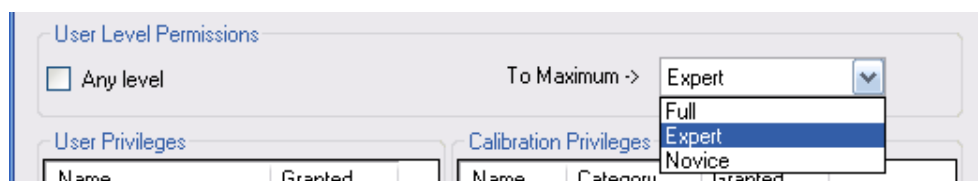
- 6 Select a **User Directory**:
- Click the ... button to browse the folders.
 - Select a user directory and confirm.

In the user directory, all user specific parameters and configurations such as appearance of toolbar, data zone, and coordinates are stored and can be loaded again.

- 7 Select an **Image Directory**:
 - a Click the ... button to browse the folders.
 - b Select an image directory and confirm.

In the image directory, all images of the user will be saved.

- 8 Set the **User Level Permissions**.
Any Level gives access to all available para-meters.
Full, Expert and *Novice* only enable access to a certain number of privileges and permissions.



Select the **User Privileges**.

If ticked, the user is allowed to modify parameters as explained in the following table:

User Privileges	
Name	Granted
Calibration	☐
Change Image Directory	☐
Change Toolbar	☒
Change User Directory	☐
Extractor	☒
Gun Align	☐
Gun Off	☐
Stage Initialise	☐
Supervisor	☐
Vent	☐

Checkbox	Privilege
<i>Calibration</i>	Enables the user to perform instrument calibration operations.
<i>Change Image Directory</i>	Enables the user to change the location, where all images will be saved.
<i>Change Toolbar</i>	Enables the user to change the toolbar.
<i>Change User Directory</i>	Enables the user to change the location, where all user specific parameters and configurations are saved.
<i>Extractor</i>	Enables the user to change the extractor voltage.
<i>Gun Align</i>	Enables the user to modify the alignment of the electron beam.
<i>Gun Off</i>	Enables the user to switch off the FE filament
<i>Stage Initialise</i>	Enables the user to initialise the motorised stage.
<i>Supervisor</i>	Enables the user to - start the Administrator, create and edit users - set User Max EHT - modify the filament current - set-up, edit and delete global stage coordinates - save common macros and toolbars - save common recipes - activate Partial Vent on Standby, Z Move on vent, Protect Z, Go to HV@Shutdown, EHT Off & Log Off and Leave Gun ON at Shutdown. - use the bakeout function - start the FIB filament heating.
<i>Vent</i>	Enables the user to ventilate the specimen chamber.



IMPORTANT

Assign SUPERVISOR privileges only to a restricted number of authorised users. The SUPERVISOR privilege permits the user to start the Administrator and to edit or create user directories.

9 Confirm by clicking on **OK**.



IMPORTANT

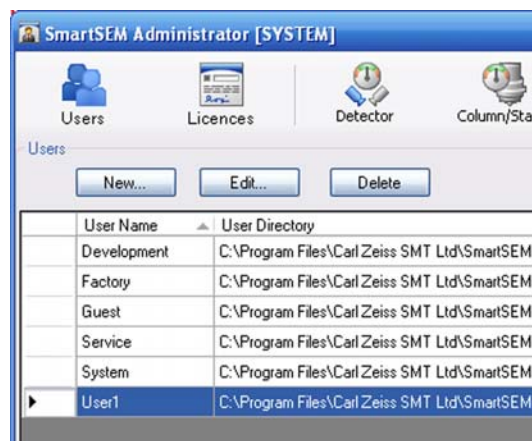
The default password for a new user is the user name.

Continue with assigning a personal password as described in the next section.

4.8.1.3. Assigning or changing a password

- 1 Mark the user whose password is to be assigned/changed.

- 2 Click **Edit**.



- 3 Click **Change Password**.

The **Change password for..** window opens.

- 4 Enter the password.
It must consist of at least three but not more than 20 characters.
- 5 Confirm by clicking on **OK**.

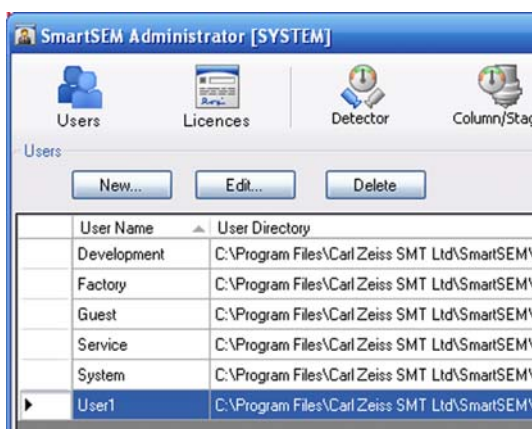


4.8.1.4. Modifying a user profile

- 1 Mark the user whose user profile is to be changed.

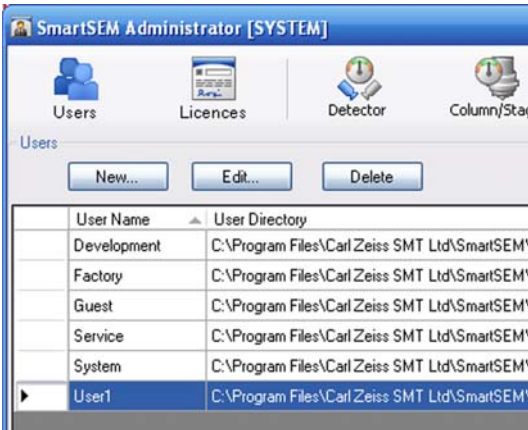
- 2 Click **Edit**.

- 3 Change the **Preferences** as desired.
- 4 Confirm.



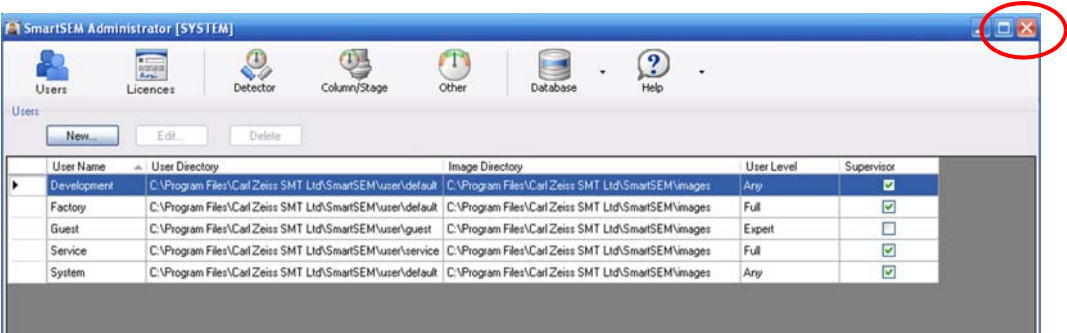
4.8.1.5. Deleting a user profile

- 1 Mark the user whose user profile is to be deleted.
- 2 Click **Delete**.
- 3 Confirm.



4.8.1.6. Closing the SmartSEM® Administrator

- 1 Click the cross to close the Administrator software.



4.8.2. Managing user accounts (licence: ACCOUNT)

The utility *SmartSEM User Accounting* allows recording of important information during individual working sessions on the SEM/FESEM. The information is stored in a separate database file. The *SmartSEM User Accounting* is part of the SmartSEM® program suite. Requires the licence ACCOUNT.



IMPORTANT

Only Supervisor level users and higher are supposed to manage user accounts and use the SmartSEM Administrator.

4.8.2.1. Starting the SmartSEM User Accounting

- 1 Select **Start/Programs/SmartSEM/SmartSEM User Accounting**.

The **SmartSEM Accounting Log On** window is shown.

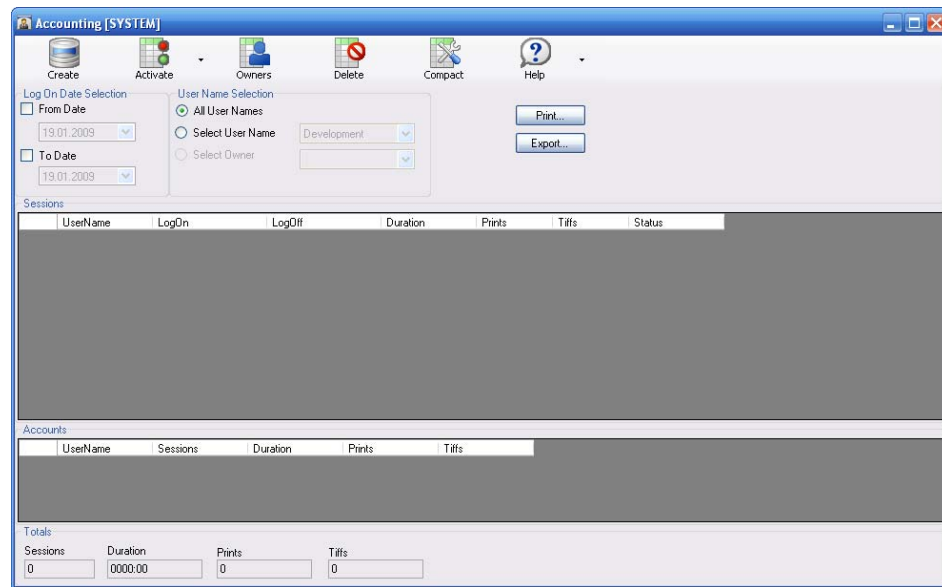


- 2 Enter user name and password.
- 3 Confirm by clicking on **OK**.

The User Accounting window opens.

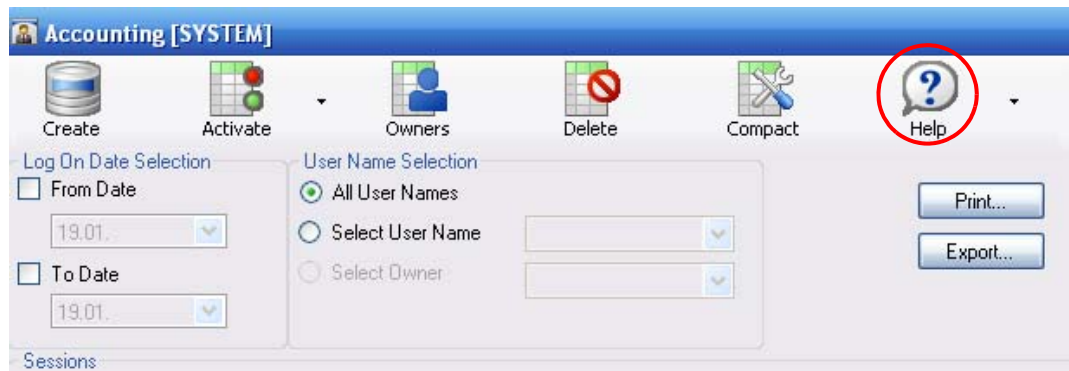
4. Operation

Managing users



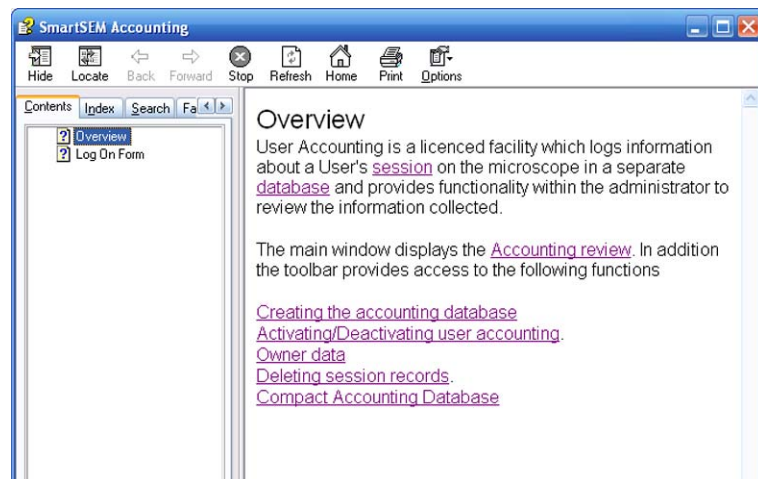
4.8.2.2. Using the help functions

- 1 Click **Help**.



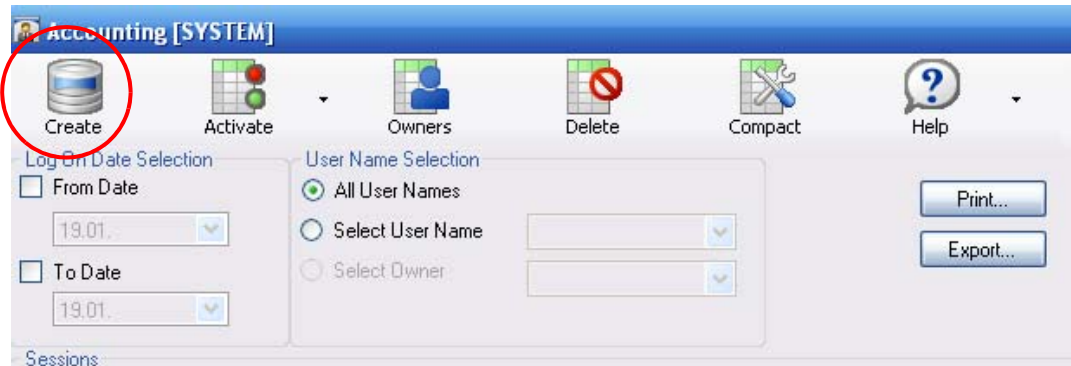
- 2 Select **Help Contents** from the drop-down menu.

The **SmartSEM Accounting Help** opens.



4.8.2.3. Creating a new database file

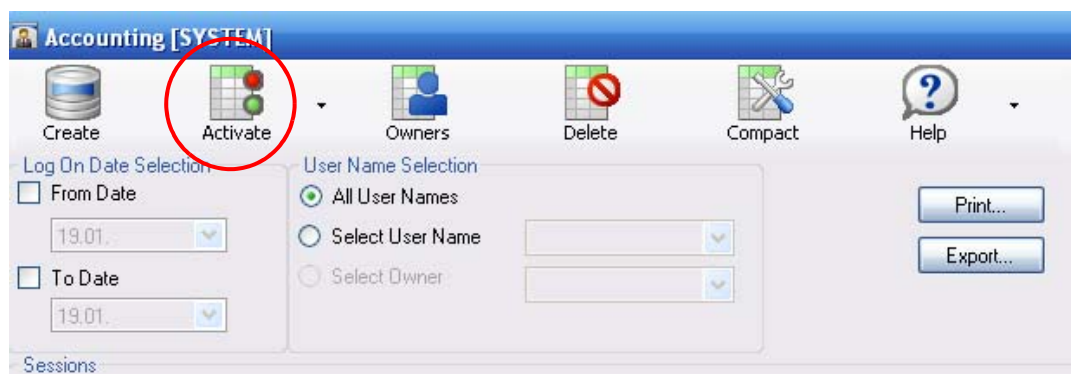
- 1 Click **Create**.



An empty file ('Account.accdb') is created in the directory C:\Program Files\Carl Zeiss Microscopy Ltd\SmartSEM\system.
If a file has already been created, a warning message will pop up.

4.8.2.4. Activating/deactivating user accounting

- 1 To start recording, click **Activate/Activate**.

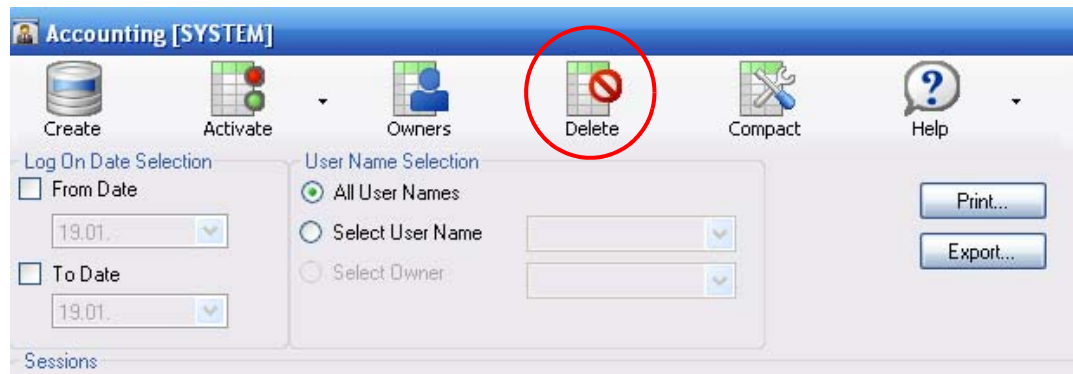


- 2 To stop recording, click **Active/Deactivate**.

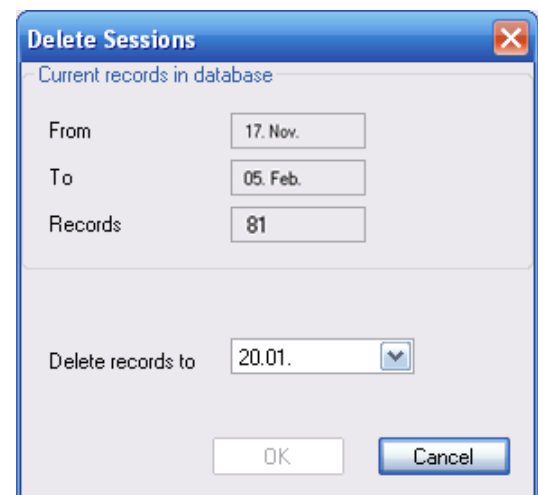
4.8.2.5. Deleting session records

This function offers the possibility to delete data in the database as from a specific date.

- 1 Click **Delete**.



- 1 Under **Delete Records To** enter the date.
- 2 Confirm by clicking on **OK**.



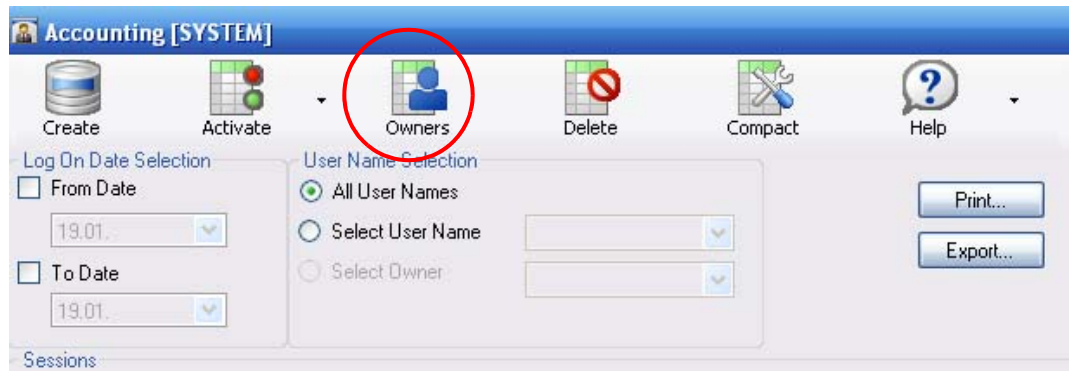
A pop-up message appears.

- 3 Confirm.

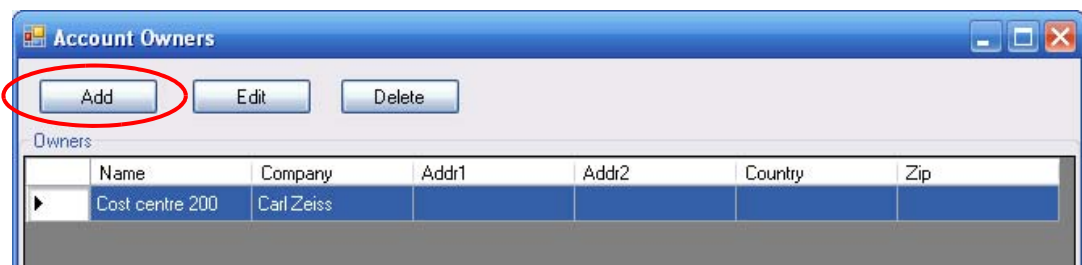
4.8.2.6. Grouping users

In order to group users together by the same institute or cost centre you can assign a user to a so-called owner.

- 1 Click **Owners**.



- 2 Click **Add**.

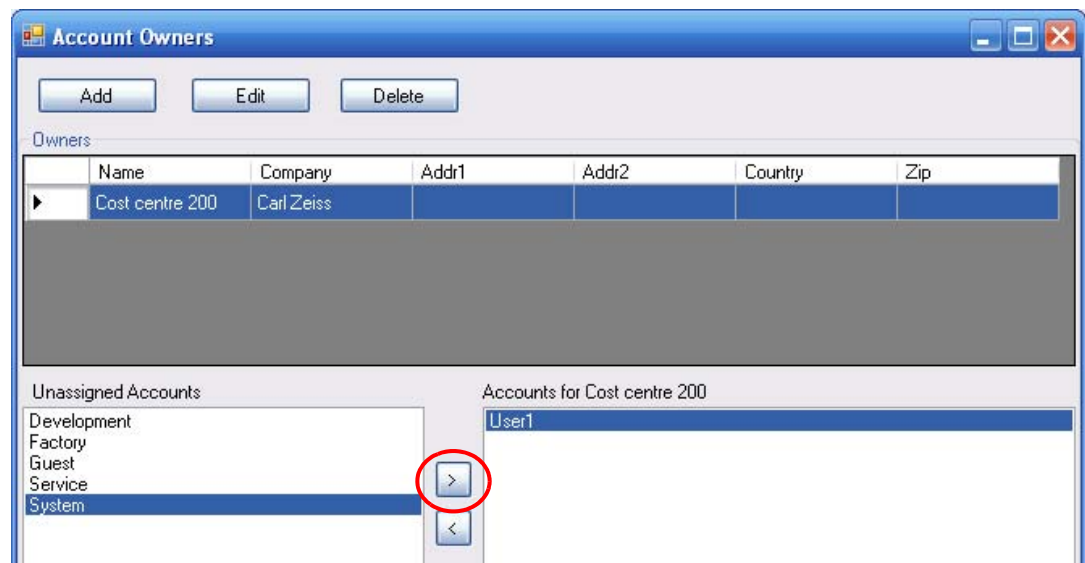


The **Creating new Owner** window is shown.

- 3 Complete the fields.
The fields **Name** and **Company** are compulsory.

The screenshot shows the 'Creating new Owner' window. It contains the following fields: 'Owner Reference' (set to 3), 'Name' (filled with 'Cost centre 200'), 'Company' (filled with 'Carl Zeiss NTS'), 'Address' (filled with 'Carl-Zeiss-Str. 56' and '73447 Oberkochen'), 'Zip/Post Code' (empty), and 'Country' (filled with 'Germany'). At the bottom, there are 'Cancel' and 'OK' buttons.

- 4 Confirm by clicking on **OK**.

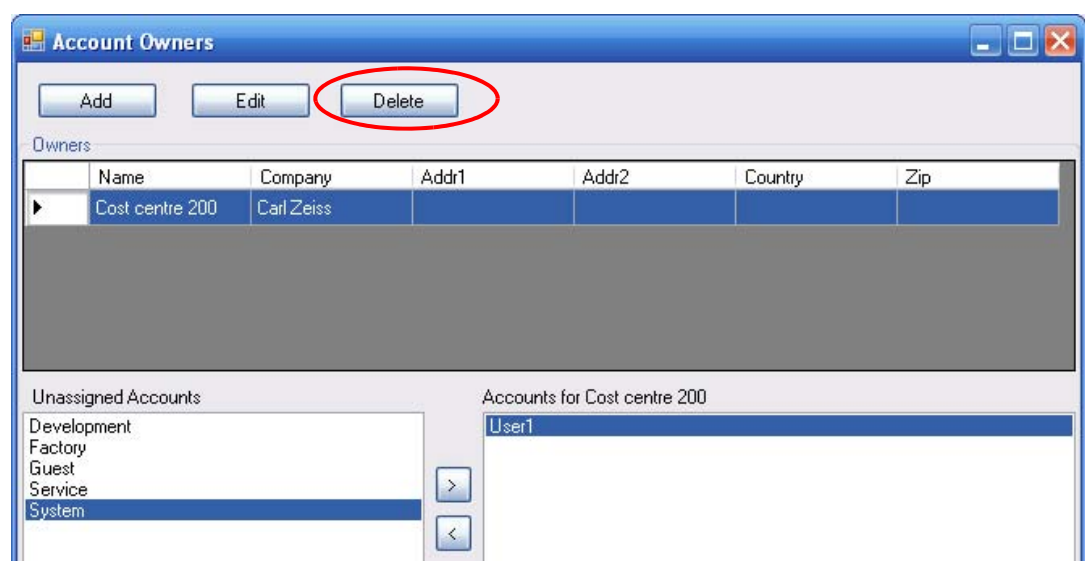


To assign a user to an existing owner:

- 1 Mark the owner in the list.
- 2 Mark an entry in the field **Unassigned Accounts**.
- 3 Click the **arrow** button.
- 4 Close the window by clicking on the cross.

To delete an owner:

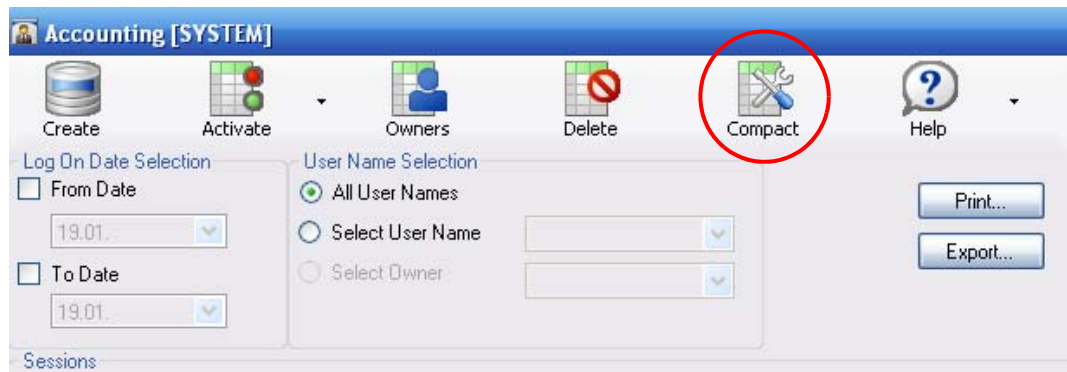
- 1 Mark the owner.
- 2 Click **Delete**.
- 3 Confirm.



4.8.2.7. Compressing the database

When the data within the database is modified the file will include unused sections inflating the size of the database file on disk. To remove unused sections and remove errors:

- 1 Click **Compact**.



A back-up copy (account.bak) will be created in the directory
C:\Program Files\Carl Zeiss Microscopy Ltd\SmartSEM\system.

The database file will be compacted.

If errors occur during compaction, reset the original state by deleting the file 'Account.accdb' and
renaming the file 'account.bak' to 'Account.accdb'.

4.9. Customising the SmartSEM[®] software

4.9.1. Customising joystick and control panel settings

You can change the settings for joystick speed, stigmator sensitivity and the sensitivity of the control panel encoders such as the *Focus* encoder.

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **User Settings**.

The **User Settings** panel opens.

- 3 Use the respective slider to adjust joystick speed, stigmator sensitivity and panel sensitivity.
- 4 Confirm by clicking on **OK**.



4.9.2. Setting mouse adjustment preferences

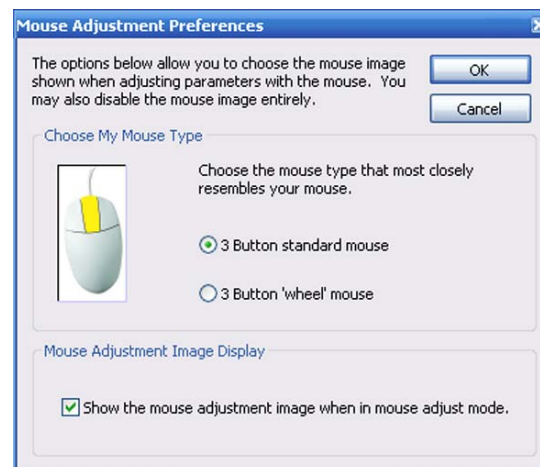
This option allows you to use the right mouse button for parameter adjustment when selecting '3 Button wheel mouse'.

You may also show or hide the mouse adjustment image.

- 1 Select **Tools/Configure Mouse Adjust** from the menu.

The **Mouse Adjustment Preferences** dialog opens.

- 2 Make the desired settings.
- 3 Confirm by clicking on **OK**.

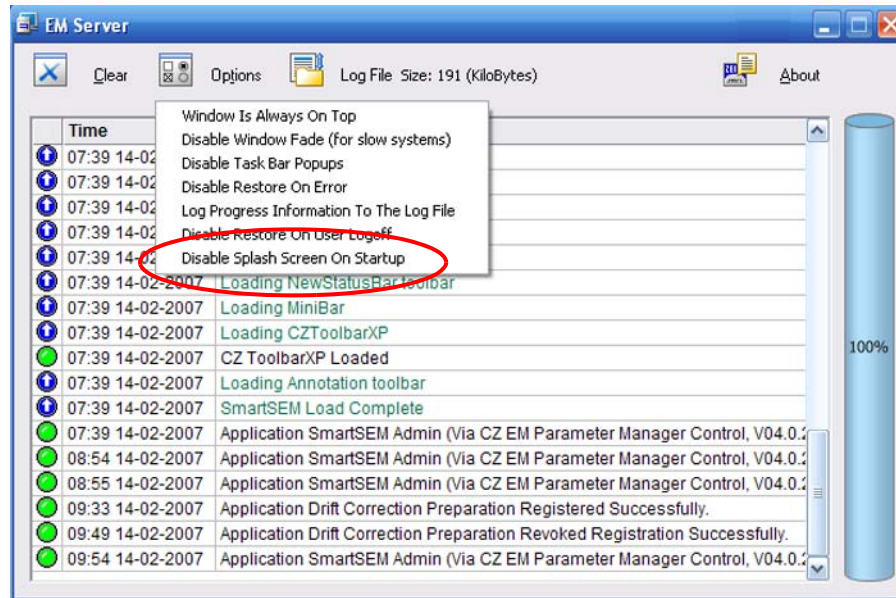


4. Operation

Customising the SmartSEM® software

4.9.3. Disabling the splash screen on startup

- 1 Go to the **EM Server** window.
- 2 Select **Options** from the menu.
A drop-down menu opens.



- 3 Click **Disable Splash Screen On Setup**.
The function is ticked in order to indicate that it is activated.

4.9.4. Personalising the user interface (User Preferences)

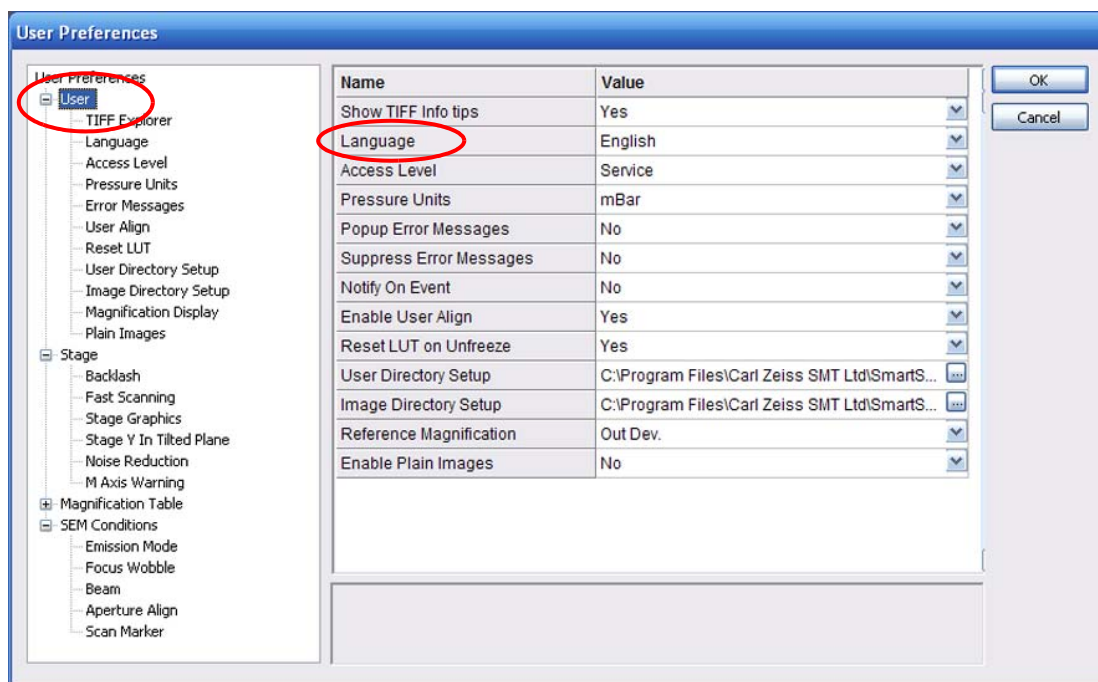
The user preferences offer the possibility to define user-specific pre-settings in the SmartSEM® user interface.

4.9.4.1. Selecting the language

- 1 Select **Tools/User Preferences**.
- 2 Under **User/Language** select *English*, *French* or *German*.

At present, switching to German or French is only possible within certain limits.

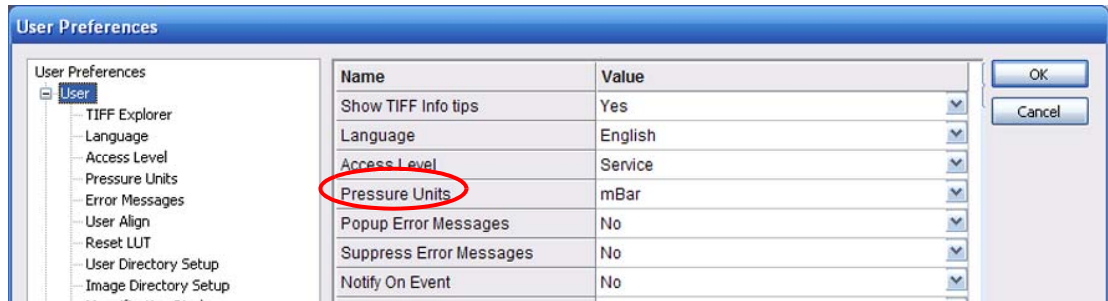
Help texts are available in English only.



- 3 Confirm by clicking on **OK**.

4.9.4.2. Selecting the indicated pressure unit

- 1 Select **Tools/User Preferences**.
- 2 Under **User/Pressure Units** select *Torr*, *mbar* or *Pascal*.



- 3 Confirm by clicking on **OK**.

4.9.4.3. Selecting the User Access Level

The setting in **User Access Level** refers to parameters and commands to be selected e.g. in the SEM Status window.

- 1 Select **Tools/User Preferences**.
- 2 Under **User/Access Level** select *Novice*, *Expert* or *Service*.

Novice: Enables frequently used parameters and commands

Expert: Enables parameters and commands which may be helpful for an advanced user

Service: Activates all available parameters and commands

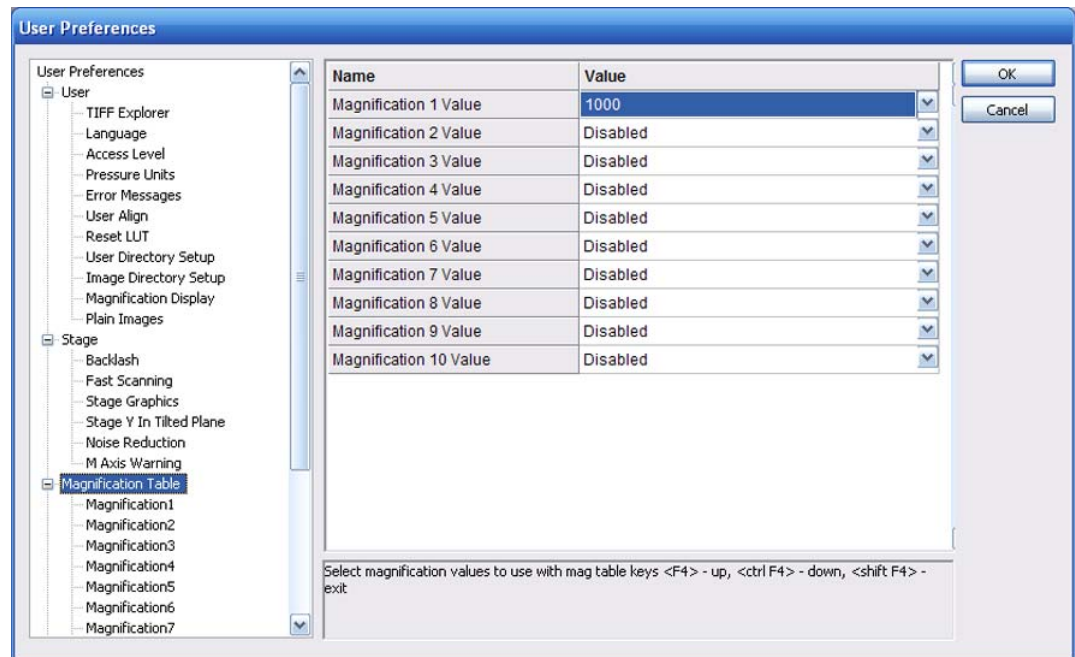


- 3 Confirm by clicking on **OK**.

4.9.4.4. Entering pre-defined magnifications

Up to ten fixed magnifications can be entered in the Magnification table for quick access the during imaging procedure.

- 1 Select **Tools/User Preferences**.
- 2 In the tree structure, click **Magnification Table**.



- 3 Click into the **Value** field of Magnification 1 Value.
- 4 Enter the desired magnification.
- 5 Enter the desired magnification values for the other entries.
- 6 Confirm by clicking on **OK**.

To use the Magnification Table while obtaining an image:

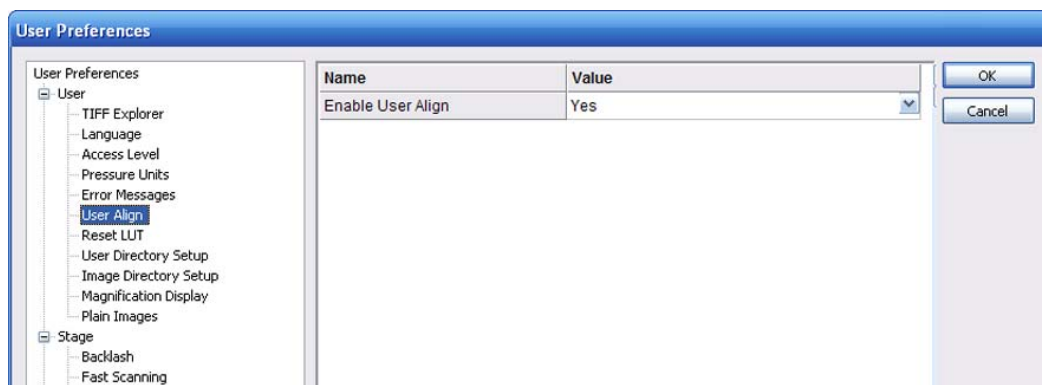
- a Press **<F4>**.
Anytime **<F4>** is pressed, the next magnification value will be set.
- b To return to the previous magnification value, press **<Ctrl + F4>**.
- c To finish the use of the Magnification Table, press **<Shift + F4>**.
The magnification of the SEM/FESEM will be reset to the level that was active before the Magnification Table was first used.

4.9.4.5. Tracking the user alignments (licence: USERALIGN)

The user align function tracks the alignment values each user has utilised for different operating conditions. When these conditions are used the next time, the previous alignment values will be reloaded.

Values are stored in an indexed table, where the index is generated from a combination of the parameters making up the operating conditions.

- 1 To activate the function, select **Tools/User Preferences**.
- 2 In the tree structure, select **User/User Align**.
- 3 Select **Enable User Align** Yes.

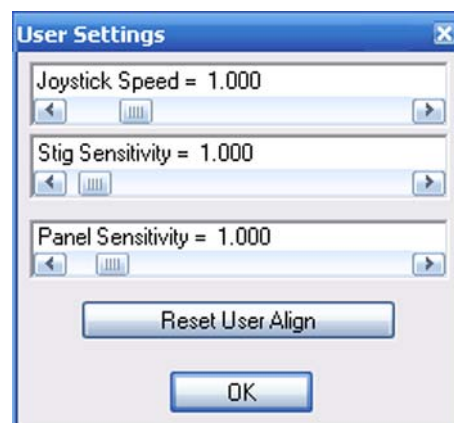


Resetting the table

The indexed table is automatically reset every time the cathode is changed.

In addition, each user can reset his/her table individually:

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **User Settings**.
- 3 Click **Reset User Align**.



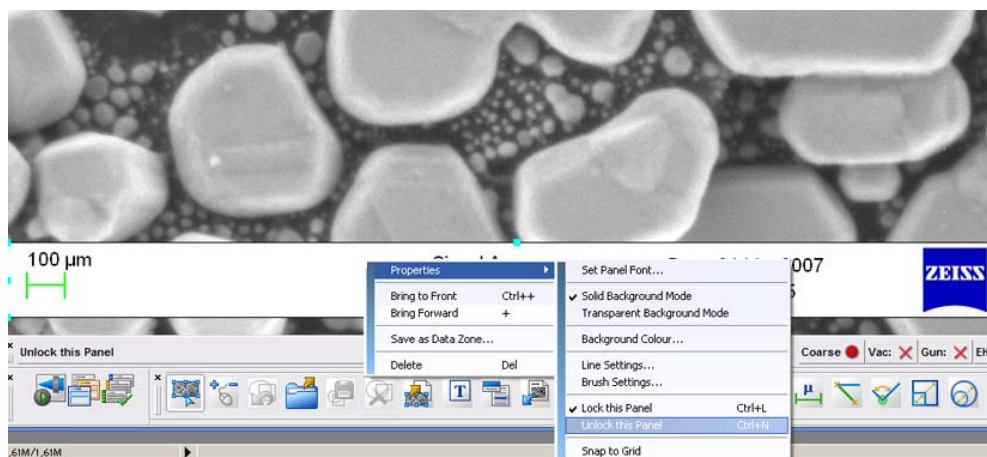
4.9.5. Customising the data zone

The data zone displays a special group of annotation objects which are used to show current parameters, such as SEM parameters, username, time or date.

4.9.5.1. Unlocking the data zone

By default, the data zone is locked, so that the parameters stay within the data zone. Before you can make any modifications, you have to unlock the data zone.

- 1 Click the **Select Annotation Object(s)** icon in the annotation bar.
- 2 Click anywhere in the data zone to mark it.
- 3 Right-click the data zone.
- 4 Select **Properties/Unlock this Panel** from the pop-up menu.



4.9.5.2. Inserting a parameter

- 1 Unlock the data zone.
- 2 Select the **EM parameter** icon in the annotation bar.
- 3 Click in the data zone, where you wish to insert the new parameter.
- 4 Select the parameter from the drop-down list.
- 5 Confirm by clicking on **OK**.
- 6 Drag the new parameter to the required position.
- 7 To change font, size or colour:
 - a Right-click the parameter.
 - b Select **Properties/Font**.
 - c Make your selection and confirm.



4.9.5.3. Inserting a logo

Logos or other images to be inserted have to be in bitmap (bmp) or metafile (wmf, emf) format.

- 1 Unlock the data zone.
- 2 On the **Insert User Bitmap or Metafile** icon in the annotation bar.
- 3 Click the data zone.
- 4 Select a bitmap or metafile and confirm.
- 5 Arrange size and position of the inserted logo.



4.9.5.4. Displaying a value without parameter name

- 1 Unlock the data zone.
- 2 Click the parameter you wish to edit.
- 3 Right-click the parameter.
- 4 Select **Properties/SEM Parameter**.
- 5 Tick the **Omit Parameter Name** checkbox.

4.9.5.5. Modifying data zone features

You can change background colour, background mode (solid or transparent), select section lines, style of frame, as well as fonts, colour and size of fonts.

- 1 Unlock the data zone.
- 2 Click anywhere in the data zone.
- 3 Right-click.
- 4 Select Properties
 - a To modify fonts, font style, font colour, and size: Select **Set Panel Font**.
 - b To change background mode: Select **Solid Background Mode/Transparent Background Mode**.
 - c To change colour of background: Select **Background Colour**.

4.9.5.6. Deleting a parameter

- 1 Unlock the data zone.
- 2 Click the parameter to be deleted.
- 3 Type ****.
Alternatively, right-click and select **Delete**.

4.9.5.7. Saving the customised data zone

- 1 Click the data zone to mark it.
- 2 Right-click in the data zone. Select **Properties/Lock this Panel**.
- 3 Right-click and select **Save as Data Zone**.
- 4 Enter a file name and save.

4.9.5.8. Loading a saved data zone

- 1 Select **View/Data Zone/Load User Data Zone** from the menu.
- 2 Select a file and confirm.

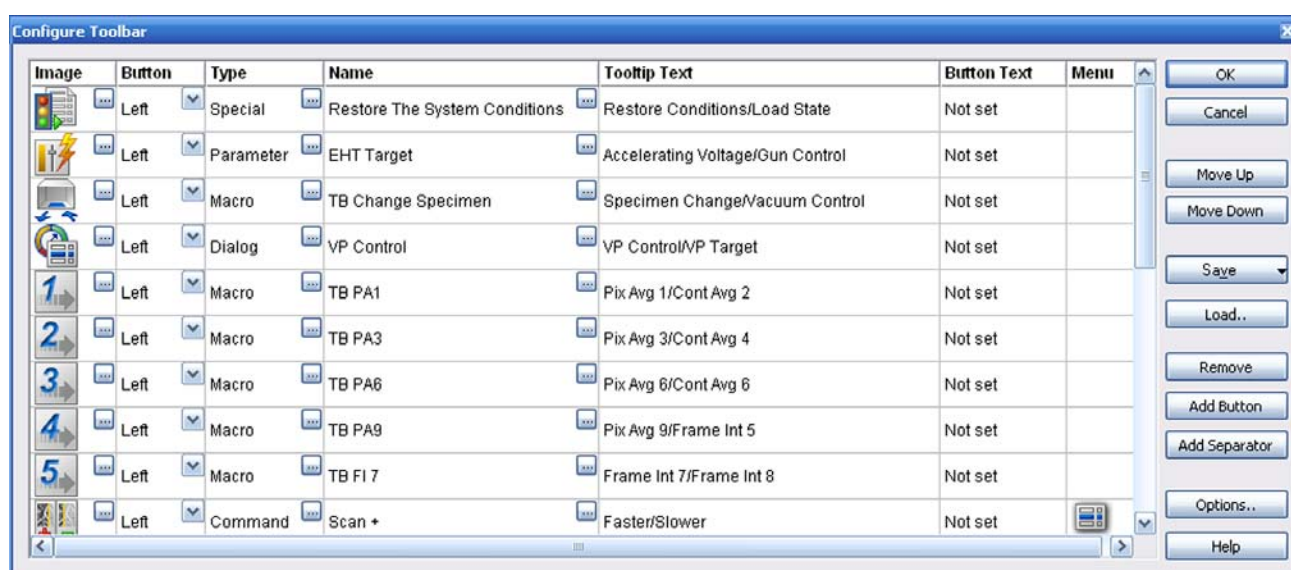
4.9.6. Customising the toolbar

The toolbar is fully customisable and can be altered to fit the needs of each individual user.

**IMPORTANT**

If 'Use Common Toolbar' has been assigned to a user in the user profile, the functions Move Up, Move Down, Save, Load, Remove, Add Button, Add Separator are NOT available.

- 1 Select **Edit/Toolbar** from the menu.
The **Configure Toolbar** window opens.



The toolbar editor is divided into several columns.

- The column **Image** shows the icon.
Each icon can have a double assignment activated by means of the left or the middle mouse button.
- The column **Button** shows the assignment. You can toggle between left and middle mouse assignment.
- The column **Type** shows the type of function (*Special, Command, Macro, Dialog, Parameter-Toggle, No Function*) to be executed, when clicking on the toolbar icon.
- The column **Name** shows the name of the function.
- The column **Tooltip Text** shows the text to be displayed when moving the mouse cursor over the icon.
- The column **Button Text** shows the text to be displayed below the icon.
To show the button text, click **Options** and tick the **Enable the text below buttons** checkbox.
- The column **Menu** shows the definition of a submenu, that can be assigned to each icon regardless of the assigned functions.

4.9.6.1. Changing the order of the icons

- 1 Select an icon in the **Configure Toolbar** window.
- 2 Click **Move Up**, respectively on **Move Down**.
- 3 To insert a space between two toolbar icons, click **Add Separator**.

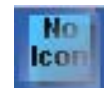
4.9.6.2. Deleting an icon

- 1 Select an icon in the **Configure Toolbar** window.
- 2 Click **Remove**.

4.9.6.3. Adding a new icon

- 1 Select the row in the **Configure Toolbar** window where you wish to insert the new icon.
- 2 Click **Add Button**.
- 3 Insert an icon:

- a Double-click the **No Icon** symbol.



- b Select an icon and confirm.

- 4 Assign a function:
 - a Double-click in the **Type** column.
 - b Select a function from the drop-down list:

Commands: Lists different commands such as 'EHT on'.

Dialogs: Lists the commands to call up menus and windows.

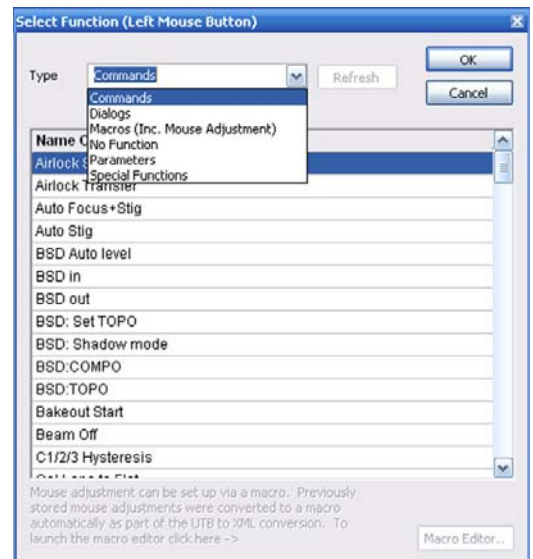
Macros: Lists all macros of the standard macro library as well as individual macros which have been implemented to this library.

Parameters: Lists different commands to read or set important parameters of the SEM/FESEM.

Special Functions: Lists the Restore System Conditions and Save System Conditions routines.

Toggle: Lists digital parameters which can be used as a switch.

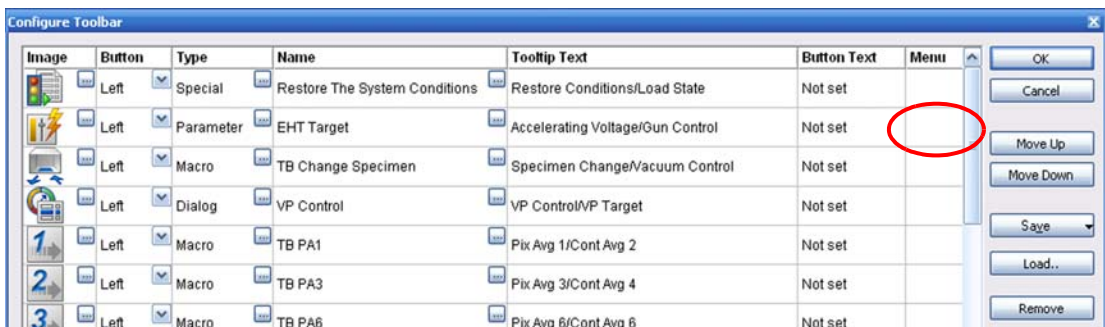
- c Confirm.



- 5 Select *Mid* in the **Button** column.
- 6 Assign a function to the middle mouse button as described in step 4.
- 7 For both assignments, double-click the **Tooltip Text** field and enter a help text.

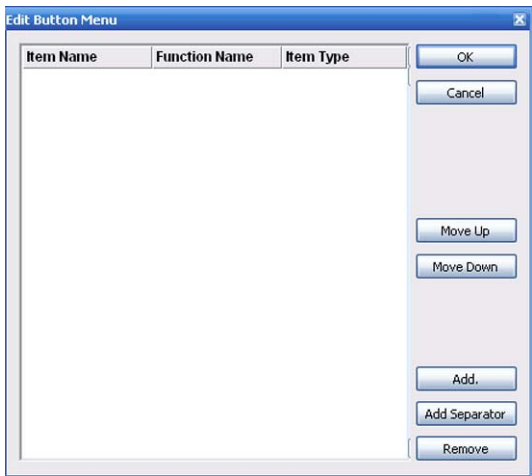
4.9.6.4. Assigning a menu to an icon

- 1 Double-click in the **Menu** field of the row you wish to edit.

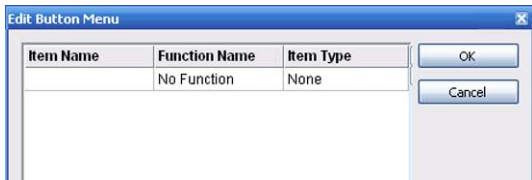


The **Edit Button Menu** window opens.

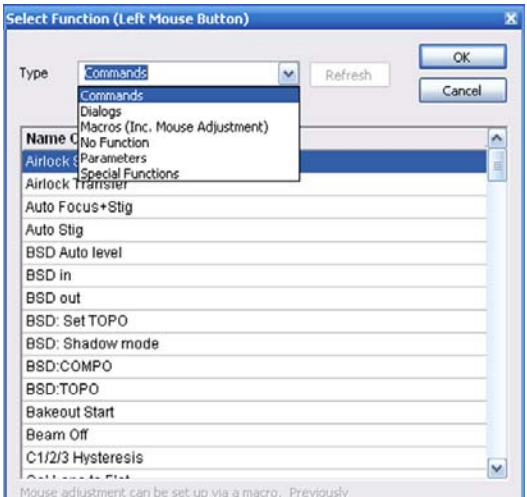
- 2 Click **Add**.



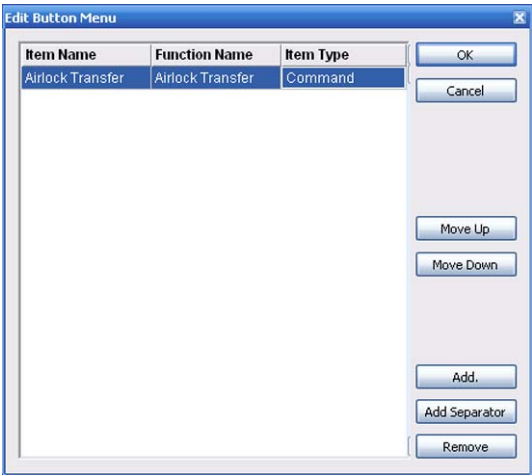
- 3 Double-click *No Function* in the **Function Name** column.



- The **Select Function** window opens.
- 4 Select a type of function from the drop-down list.
 - 5 Select one of the functions shown.
 - 6 Confirm.

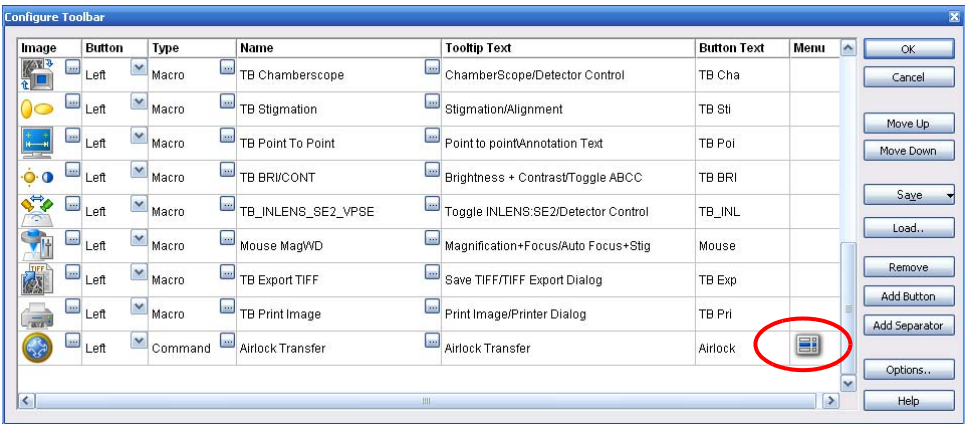


- The new menu is shown in the list.
- 7 Confirm.



The toolbar editor shows a small icon in the **Menu** column.

By double-clicking on this icon, you can directly open the **Edit Button Menu** window.



4.9.6.5. Saving the toolbar

Edited toolbars have to be saved with their own names.

- 1 Click **Save**.

- 2 Select **Save As**.

If you wish to make the toolbar available to all users, select **Save As Common Toolbar**.

- 3 Enter a name.

- 4 Confirm.

4.9.7. Customising the magnification display

4.9.7.1. Calibrating a user-specific magnification

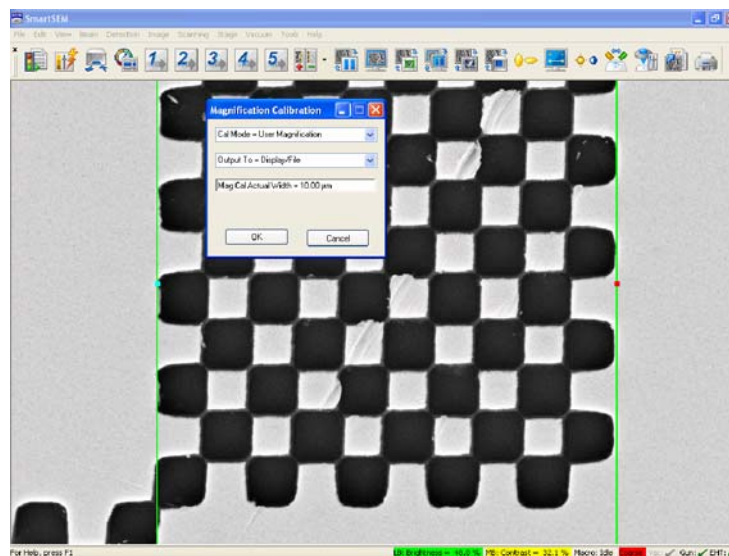
In the factory, certified magnification standards are used for the calibration of magnification. However, it is possible to carry out a user-specific calibration of the magnification. This will allow the comparison with other instruments or the use of specific application settings.

- 1 Load a calibration standard as specimen.
- 2 Select the User preferences *Expert* or *Service*.
- 3 Set acceleration voltage, working distance, and aperture size typically used for your application.
- 4 Adjust the best possible focus and stigmation.
- 5 Open the **Panel Configuration Bar**.
- 6 Double-click **Magnification Calibration**.
- 7 Select **Cal User Magnification** from the upper drop-down list.



Two vertical lines are displayed on the screen.

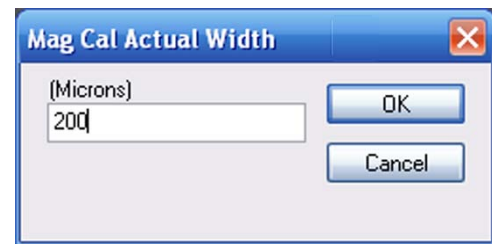
- 8 Click the vertical lines and use them to mark an exactly defined distance on the image. Refer to the documents delivered with the calibration standard.



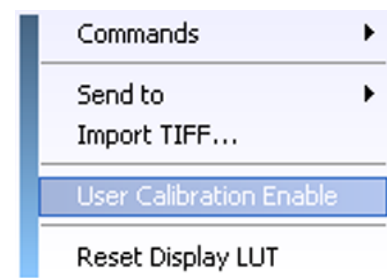
4. Operation

Customising the SmartSEM® software

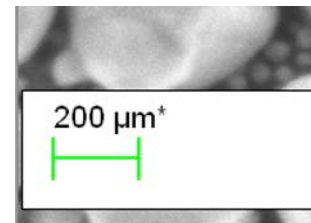
- 9 Click into the **Mag Cal Actual Width** field.
- 10 Enter the value (μm) of the distance between the two vertical lines.
- 11 Confirm by clicking on **OK** twice.
- 12 Close the **Magnification Calibration** window.



- 13 Place the cursor into the image area and right-click.
- 14 Select **User Calibration Enable**.



Now, the calculation and setting of the magnification is based on the user-specific calibration. This is symbolised by an asterisk next to the micron marker in the data zone.



To disable the user-specific calibration:

- a Place the cursor into the image area.
- b Right-click.
- c Select **User Calibration Enable** so that the tick is being removed.

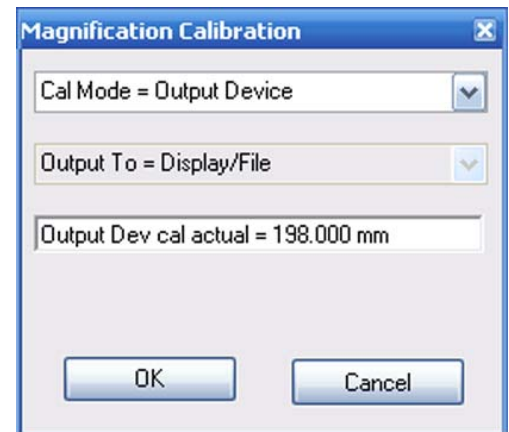
4.9.7.2. Calibrating an output device

The magnification is the ratio between the edge length of the image displayed on an output device and the edge length of the scanned range on the sample. This means that it depends on the selected output device.

If a defined range of the specimen is scanned and imaged on the monitor, the magnification will correspond to the value X_1 . If the same specimen range is scanned and imaged in a Polaroid, the magnification will correspond to the value X_2 . The value X_2 is 3-4 times inferior to the value X_1 (depending on the monitor size), a Polaroid being 3-4 times smaller than the image range on the screen.

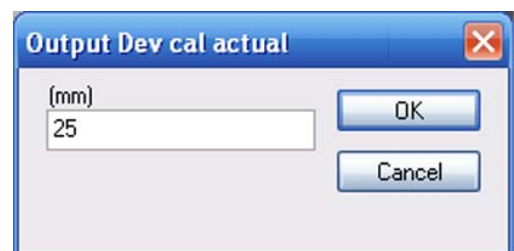
When exchanging or installing an output media on a SEM/FESEM, a re-calibration is necessary if the size of the presentation or print image has been changed.

- 1 Select the User preferences *Expert* or *Service*.
- 2 Open the **Panel Configuration Bar**.
- 3 Double-click **Magnification Calibration**.
- 4 Select **Cal Output Device** from the upper drop-down list.



Two vertical lines are displayed on the screen.

- 5 Click the vertical lines and use them to mark an exactly defined distance on the image.
- 6 Click into the **Output Dev cal actual** field.
- 7 Enter the value (*mm*) of the distance between the two vertical lines.
- 8 Confirm by clicking on **OK** twice.
- 9 Close the **Magnification Calibration** window.



4.9.8. Showing the installed licences

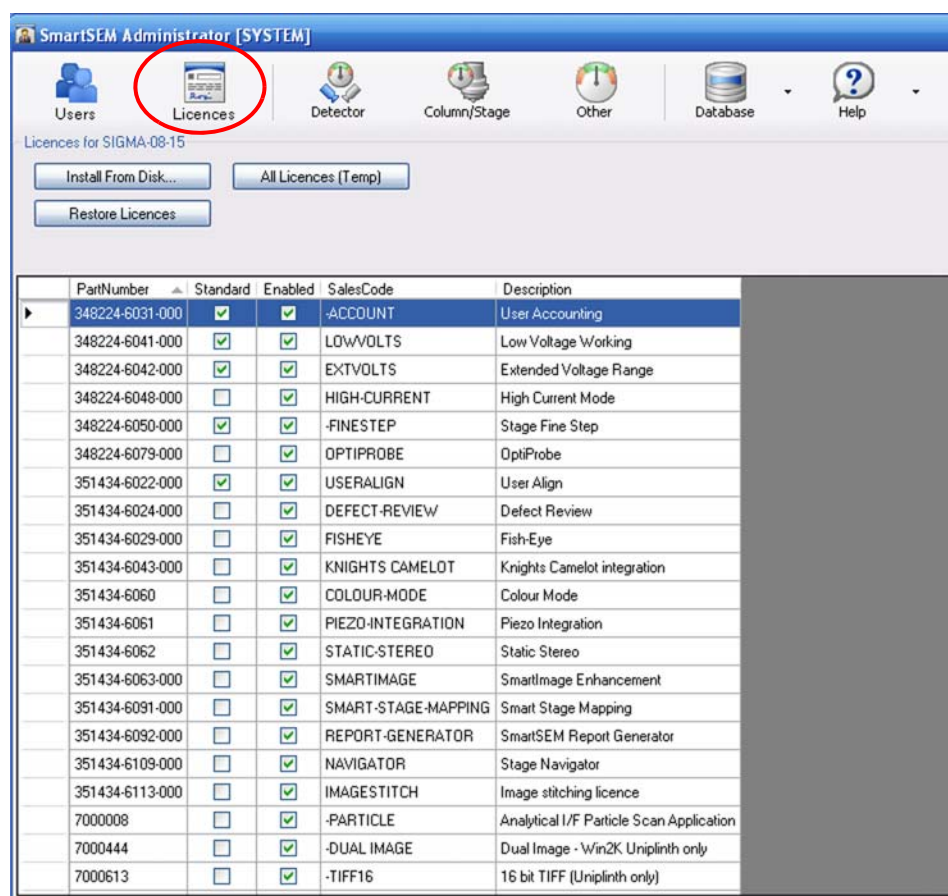
The licences installed on your SEM/FESEM can be shown from the SmartSEM® Administrator.

- 1 Open the SmartSEM® Administrator.
- 2 Click **Licences**.

A window with all installed software licences is displayed.

The checkboxes in the **Standard** column indicate the standard licences.

The checkboxes in the **Enabled** column indicate which licences are active.



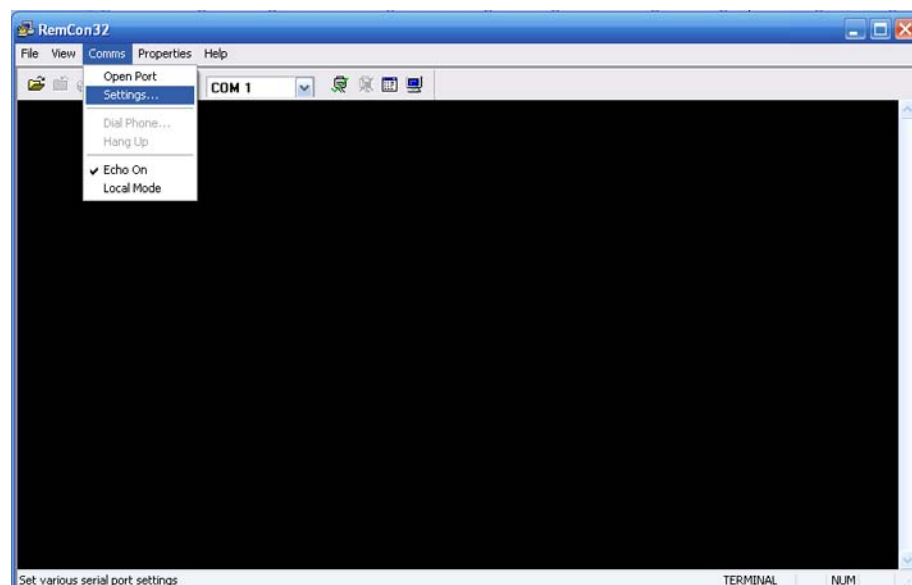
You can sort the list according to part numbers, sales codes or descriptions. To do so, click into the respective column title.

4.10. Remotely controlling the SEM/FESEM

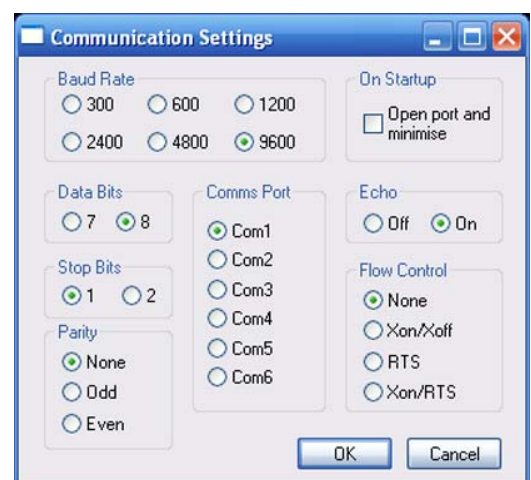
4.10.1. Using RS232 (licence: REMCON)

The program RemCon32 offers the possibility of remotely controlling the SEM/FESEM by using the serial interface (RS232). Thus, it is possible to read or control specific parameters of the SEM/FESEM. This option is especially useful if an EDX/WDX system is attached to the SEM/FESEM as it enables communication between both systems by means of the serial interface.

- 1 Start the SmartSEM[®] user interface.
- 2 Select **Start/Programs/SmartSEM/RemCon32**.
- 3 Enter your username and password.
The RemCon32 window opens.



- 4 Select **Comms/Settings** from the menu.
- 5 Enter the port settings.
- 6 If you wish that the port automatically starts after starting RemCon32, while the window is reduced, tick the **Open port and minimise** checkbox.
- 7 Confirm by clicking on **OK**.



4. Operation

Remotely controlling the SEM/FESEM

- 8 To display the transmitted commands and replies, select **Comms/Echo On**.
- 9 For test purposes it might be helpful to use RemCon 32 in local mode:
 - a Select **Comms/Local Mode** from the menu.
 - b Enter commands and queries manually.

If correct communication is possible, the respective reply is displayed in the window and the command is executed in the SmartSEM[®] user interface.

4.10.2. Using Windows XP Remote Desktop Connection (licence: Remote SEM)

Remote operation of the SEM/FESEM is possible using the Windows XP Remote Desktop Connection feature.

See the Window help on Using Remote Desktop Connection or contact your network administrator for information on configuring Windows XP Remote Desktop Connection to operate over your network.

To see the live microscope image over a remote connection, Image Capture Mode must be turned on.

Image Capture Update Frequency should be set to the minimum value of 100 ms, which is only available if the Remote SEM licence is present.

Remote SEM requires a minimum of 10 Mbps network bandwidth for useable operation, but a 100 Mbps LAN connection is recommended for true real time remote operation. If bandwidth is limited, fast scan rates should be avoided and reduced raster should be used when possible to minimise network traffic.

4.11. Communication with additional software

4.11.1. Communicating with Camelot software (licence: KNIGHTS CAMELOT)

Knights Camelot software is a CAD navigation tool for locating specific features on a semiconductor die. It works by registering the specimen with the design of the die to allow the CAD image and SEM images to be synchronized to the same field of view. It is also possible to overlay the image with parts of the design.

Requires the licence KNIGHTS CAMELOT.

- 1 Select **Tools/Camelot Interface** from the menu bar.
The **Camelot Properties** panel opens.
- 2 Click **Start Listening**.
The indicated state changes from *Waiting* to *Listening*.



4. Operation

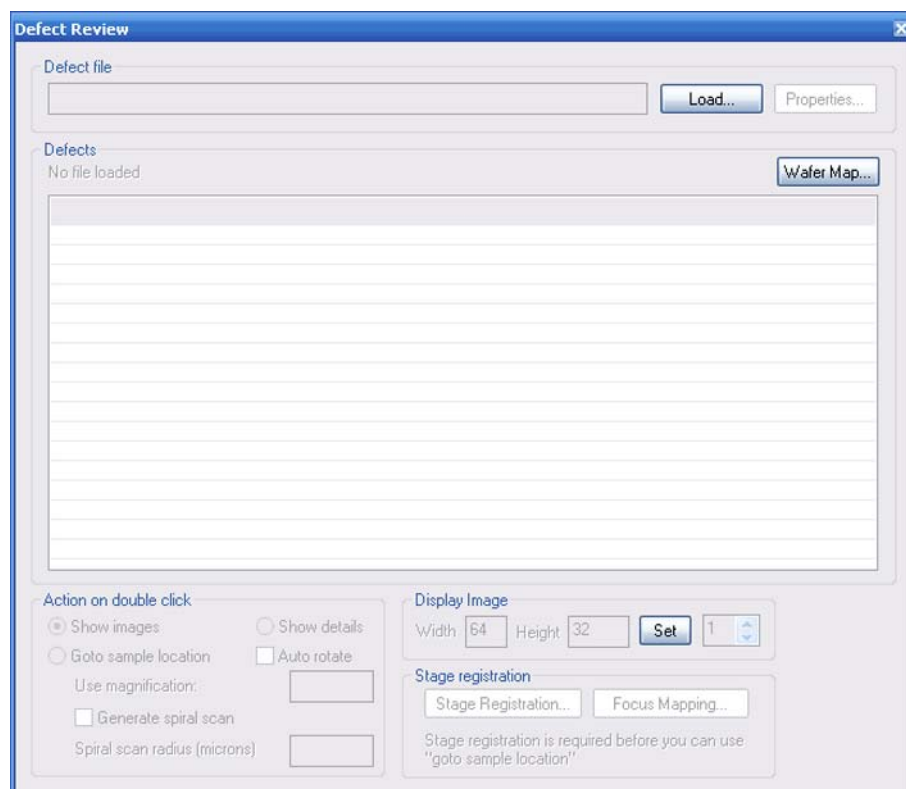
Communication with additional software

4.11.2. Reading wafer defect files (licence: DEFECT REVIEW)

Defect review is used to find defects on a wafer or mask based on the results from KLA Tencor results file.

Requires DEFECT REVIEW licence as well as STAGEREG and CENTRE licences.
Requires the KLA Tencor Resultsfile Specification V1.7

- 1 Select **Tools/Go To Panel** from the menu bar.
- 2 Double-click **Defect Review**.



- 3 Click **Load** and select a defect file (*.rff).

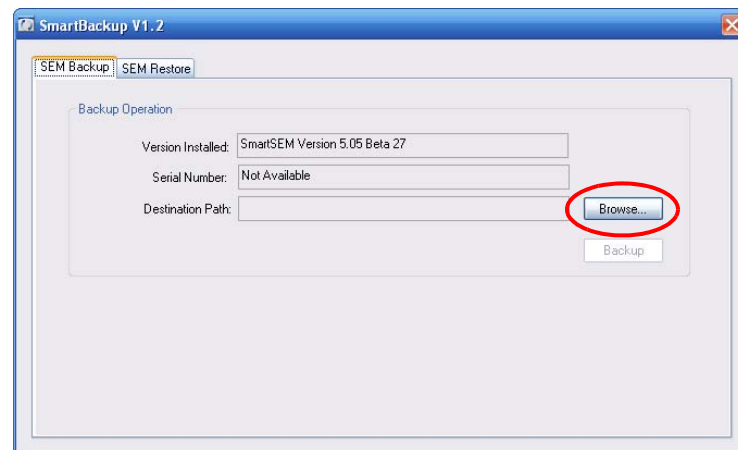
4.12. Backing up / restoring data

When upgrading to a new PC or when reinstalling Windows on the PC, SmartSEM® configuration and calibration data is lost. SmartBackup allows you to keep the data without having to recalibrate the workstation.

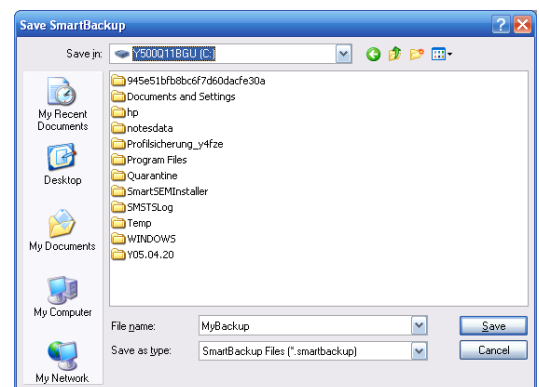
4.12.1. Creating a backup

- 1 Close the EM Server.
- 2 Select **Start/Programs/SmartSEM Service/SmartBackup Tool**.

The **SmartBackup** window opens.



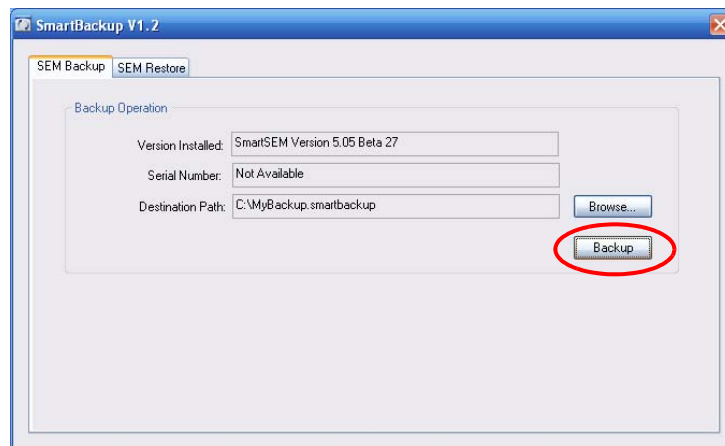
- 3 To select a backup directory, click **Browse**.
- 4 Enter a file name.
- 5 Click **Save**.



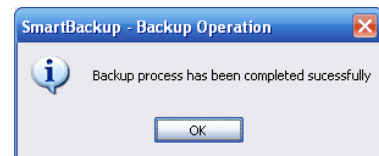
4. Operation

Backing up / restoring data

- 6 To backup the data to the selected directory, click **Backup**.



- 7 A message shows that the backup was successful.
- 8 Confirm with **OK**.

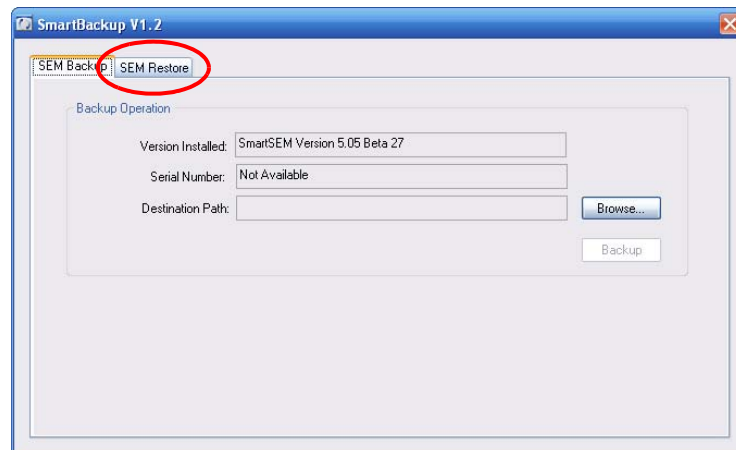


4.12.2. Restoring data

Once a backup has been made, it can be restored to regain the configuration and calibration data on a new PC or new Windows installation.

- 1 Close the EM Server.
- 2 Select **Start/Programs/SmartSEM Service/SmartBackup Tool**.

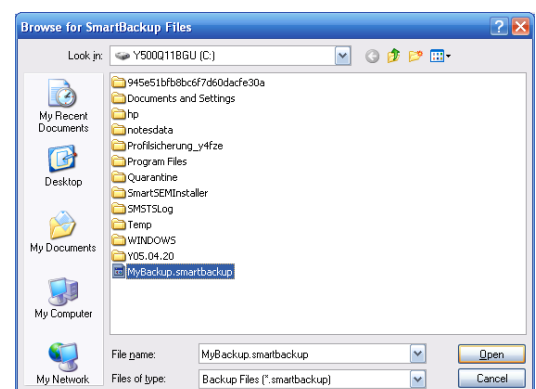
The **SmartBackup** window opens.



- 3 Go to the **SEM Restore** tab.
- 4 To select a previously saved backup, click **Browse**.



- 5 Select the backup file.
- 6 Click **Open**.

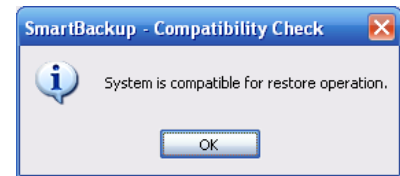


4. Operation

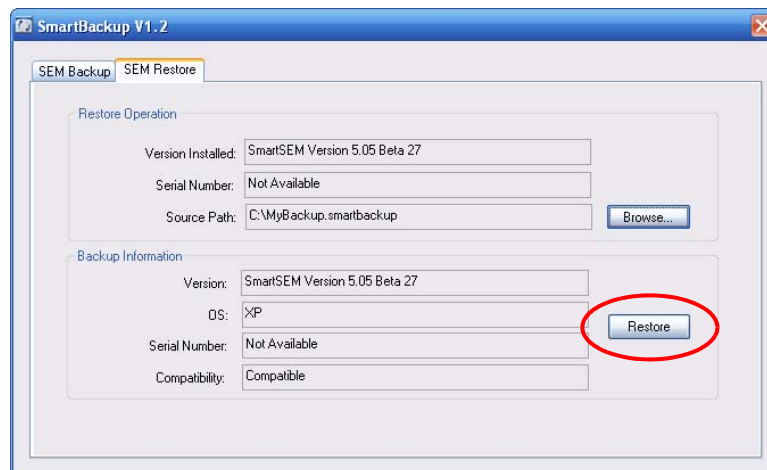
Backing up / restoring data

A message shows that the system is compatible.

7 Confirm with **OK**.

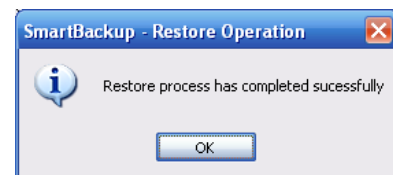


8 Click **Restore**.



A message shows that the restore process has completed successfully.

9 Confirm with **OK**.



4.13. Working with optional accessories

4.13.1. Using the Laser Finder

The Laser Finder is an accessory option that is designed to ease finding the area of interest on the specimen surface. It consists of a chamber mounted laser, which is only illuminated in TV mode. The laser spot is visible in the image of the CCD camera. It is used to make specimen navigation easier.

For details on operation refer to the Instruction Manual Laser Finder.

4.13.2. Using the Quiet Mode

The automatically controlled **Quiet Mode** is optionally available. It allows switching off the pre-vacuum pump after specimen exchange when the vacuum threshold is achieved. This will provide a more comfortable noise level for operator and SEM/FESEM while reducing power consumption of the pre-vacuum pump.

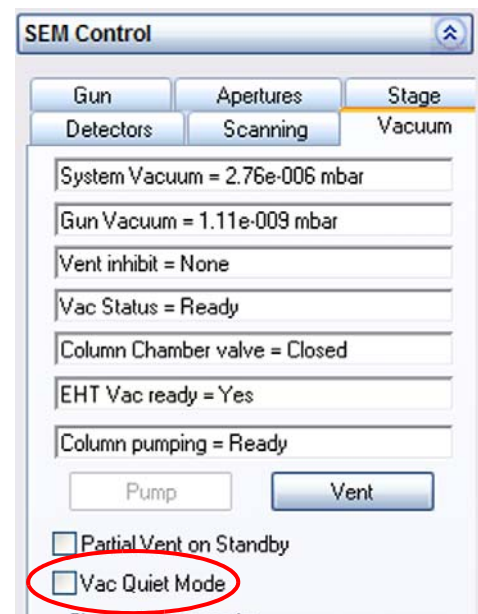
Requires particular hardware.

- 1 Go to the **Vacuum** tab of the **SEM Controlss** panel.

- 2 Tick the **Vac Quiet Mode** checkbox.

The Quiet Mode is activated: The pre-vacuum pump will be switched off when the vacuum threshold is achieved.

To deactivate Quiet Mode, untick the checkbox.



4.13.3. Measuring the specimen current

The specimen current is the current flowing through the specimen. It corresponds to the total number of electrons that hit the specimen.

A specimen current monitor can be attached to the SEM/FESEM as an optional accessory.

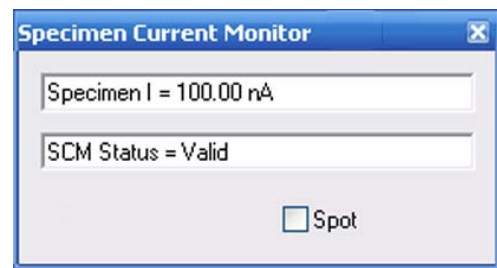
The Faraday cup consists of a strongly absorbing material with a cavity covered by an electron-microscopic aperture.

- 1 Load a Faraday cup into the specimen chamber.
- 2 Pump the specimen chamber.
- 3 Switch on the electron beam.
- 4 Set a magnification that allows transmission of the complete electron beam into the cavity through the aperture orifice.
- 5 Open the **Panel Configuration Bar**.
- 6 Double-click **Specimen Current Monitor**.

- 7 Tick the **SCM On** checkbox.

The measurement is started. The measured value is displayed in the field **Specimen I =**.

The ground connection of the sample holder is interrupted to interpose a pico-ampere meter. If there is no risk that secondary electrons or backscattered electrons leave the Faraday cup the displayed current is the same as the incident beam current.



- 8 In order to switch to **Spot** mode, tick the **Spot** checkbox.

CAUTION

For all SEM/FESEM, except MERLIN:

Risk of damaging objective lens or specimen due to collision

During specimen current measurement the touch alarm is deactivated. Ensure to untick the SCM On checkbox after finishing the specimen current measurement.

4.13.4. Using the Plasma Cleaner

The Plasma Cleaner is an optional accessory that allows you to decontaminate the specimen chamber and any loaded specimens.

The Plasma Cleaner generates reactive gas-phase radicals in a plasma. This plasma is fully contained in the Plasma Cleaner unit. The radicals migrate into the specimen chamber and chemically react with unwanted hydrocarbons.

After a plasma cleaning cycle, the specimen surface provides optimal imaging conditions even at very low imaging voltages.

CAUTION

Sensitive specimen materials might suffer damage from plasma cleaning. We recommend to test this on specimens of the same material before cleaning any important specimens.

4.13.4.1. Activating the Plasma Cleaner

CAUTION

Unstable pressure or unwanted reactions with inserted gas can damage specimen or vacuum system.

The chamber pressure needs to be stable during plasma cleaning. If the gas injection system or the charge compensation function are active, the gas insertion will affect the pressure range and can create unwanted reactions with the inserted gas. Do not use GIS or CC when using the Plasma Cleaner.

- 1 Check that the gate valve of the airlock is closed. Do not use the airlock while using the Plasma Cleaner.
- 2 Switch off the EHT.

CAUTION

The pressure range applied during plasma cleaning can damage the electron source. To protect the electron source from the harmful pressure range, close the column chamber valve.

- 3 Close the column chamber valve:
 - a Go to the **Vacuum** tab.
 - b Click **Column Chamber valve =** and set it to *Closed*.

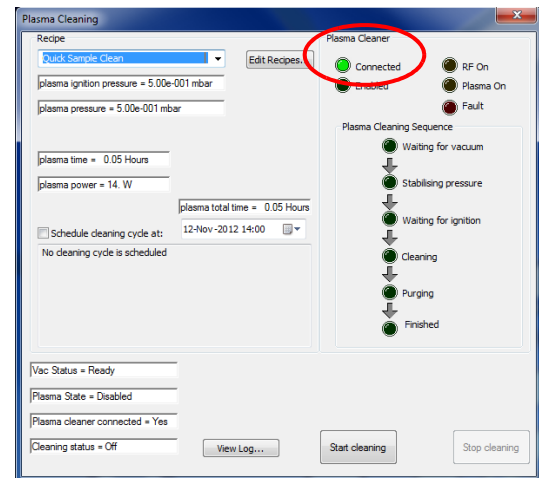
4. Operation

Working with optional accessories

- From the **Panel Configuration Bar**, select **Plasma Cleaning**.

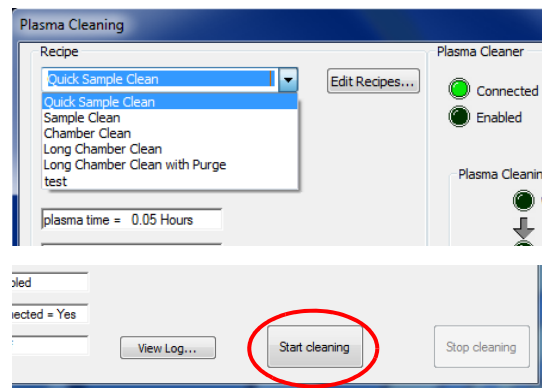
The **Plasma Cleaning** window is displayed.

- Check that the Plasma Cleaner controller hardware is switched on and the **Connected** LED is active in the software.



- Select a recipe from the **Recipe** drop-down list.

There are five preset recipes for different purposes that can not be edited. Additionally, you can create custom recipes (see next section).



- To start the plasma cleaning, click **Start cleaning**.

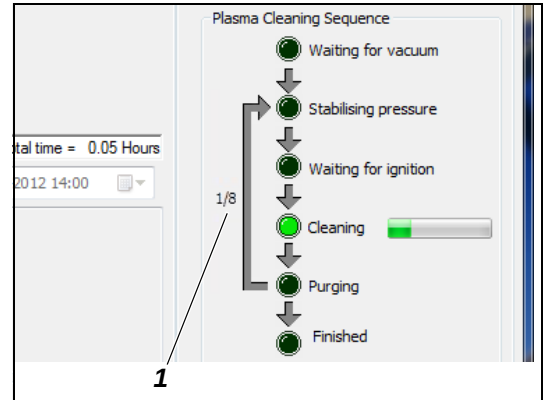
The plasma cleaning process starts.

To avoid damage, various parameters are changed automatically in the following sequence:

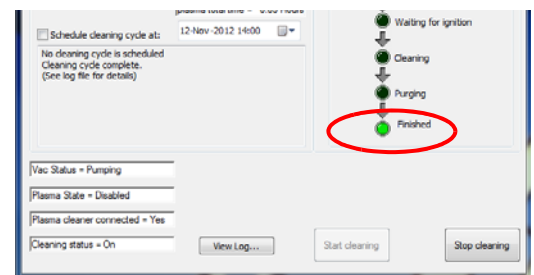
- The turbo pump is slowed down by 10 nitrogen impulses
- The specimen chamber is vented for 40 seconds
- The turbo pump is switched off
- Only the pre-vacuum pump remains active

The current status is displayed under **Plasma Cleaning Sequence**.

If the selected recipe involves nitrogen purges, the number of purge cycles (**1**) is displayed next to the flow chart. The arrow shows which steps will be repeated.



- 8 Wait until the **Finished** LED activates.
This indicates that the plasma cleaning process is complete.



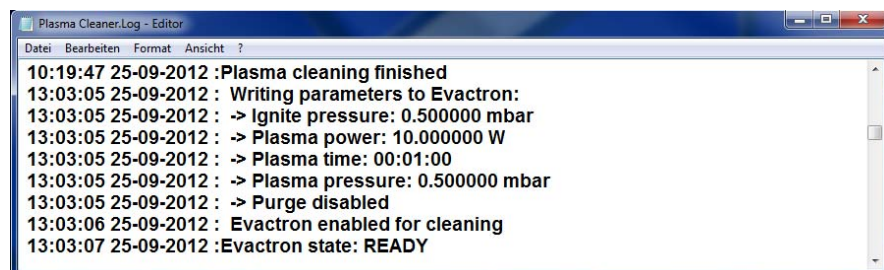
The chamber will be pumped.

- 9 Wait until 'Vac Status = Ready' is displayed.
Gun and EHT can then be switched back on and you can return to regular SEM/FESEM operation.



IMPORTANT

*You can view a log file that contains all relevant events by clicking 'View Log...'
This log file can be used for troubleshooting and to determine when the next plasma cleaning process should be scheduled.*



4.13.4.2. Creating custom recipes

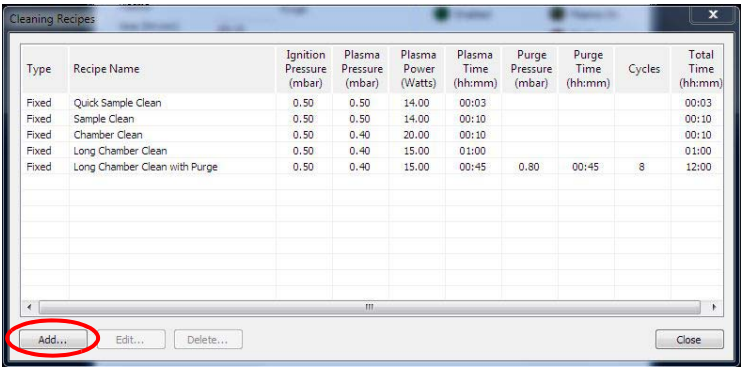
The five preset cleaning recipes should be enough for most applications.

In addition to the five preset recipes, you can create recipes for custom cleaning cycles.

- 1 Click **Edit Recipes...**

The **Cleaning Recipes** list is displayed with the five preset recipes. These recipes are fixed. This means they can not be edited or deleted. Therefore, **Edit...** and **Delete...** are greyed out. If you want to know whether or not a recipe can be edited, check the respective entry in the **Type** column.

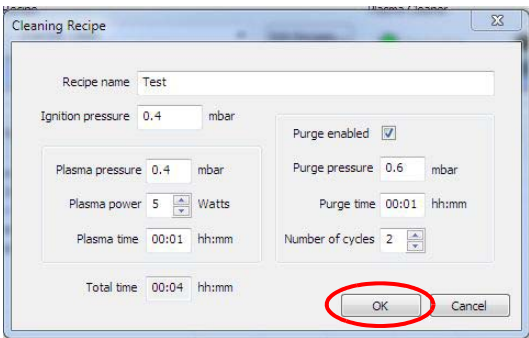
- 2 To create a new recipe, click **Add...**



Type	Recipe Name	Ignition Pressure (mbar)	Plasma Pressure (mbar)	Plasma Power (Watts)	Plasma Time (hh:mm)	Purge Pressure (mbar)	Purge Time (hh:mm)	Cycles	Total Time (hh:mm)
Fixed	Quick Sample Clean	0.50	0.50	14.00	00:03				00:03
Fixed	Sample Clean	0.50	0.50	14.00	00:10				00:10
Fixed	Chamber Clean	0.50	0.40	20.00	00:10				00:10
Fixed	Long Chamber Clean	0.50	0.40	15.00	01:00				01:00
Fixed	Long Chamber Clean with Purge	0.50	0.40	15.00	00:45	0.80	00:45	8	12:00

The **Cleaning Recipe** window opens.

- 3 Enter a name for the cleaning recipe.
- 4 Select the desired values according to your specific application.
- 5 If nitrogen purge cycles are necessary, tick the **Purge enabled** checkbox. This will add additional values that can be edited.
- 6 Once the settings are complete, click **OK**.



Recipe name: Test

Ignition pressure: 0.4 mbar

Plasma pressure: 0.4 mbar

Plasma power: 5 Watts

Plasma time: 00:01 hh:mm

Total time: 00:04 hh:mm

Purge enabled: ☒

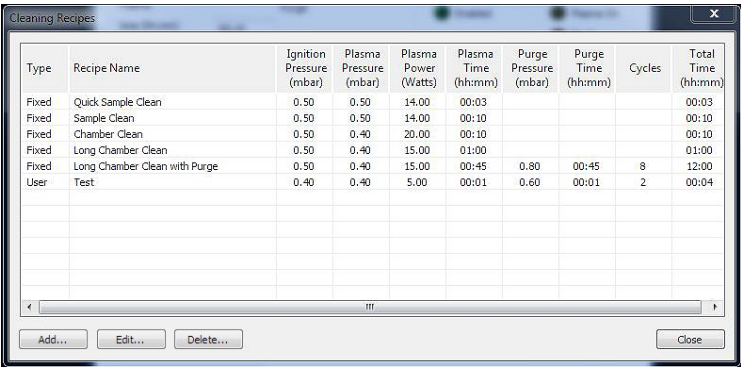
Purge pressure: 0.6 mbar

Purge time: 00:01 hh:mm

Number of cycles: 2

OK Cancel

The recipe is now added to the list of available recipes. In the **Type** column the new recipe will be displayed as *User*, which tells you that the recipe can be edited or deleted.

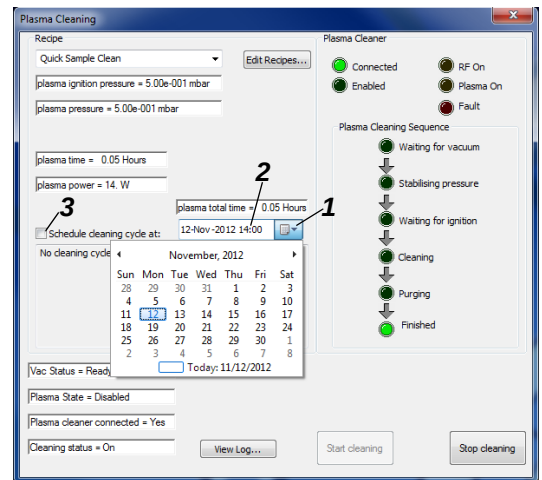


Type	Recipe Name	Ignition Pressure (mbar)	Plasma Pressure (mbar)	Plasma Power (Watts)	Plasma Time (hh:mm)	Purge Pressure (mbar)	Purge Time (hh:mm)	Cycles	Total Time (hh:mm)
Fixed	Quick Sample Clean	0.50	0.50	14.00	00:03				00:03
Fixed	Sample Clean	0.50	0.50	14.00	00:10				00:10
Fixed	Chamber Clean	0.50	0.40	20.00	00:10				00:10
Fixed	Long Chamber Clean	0.50	0.40	15.00	01:00				01:00
Fixed	Long Chamber Clean with Purge	0.50	0.40	15.00	00:45	0.80	00:45	8	12:00
User	Test	0.40	0.40	5.00	00:01	0.60	00:01	2	00:04

4.13.4.3. Setting up a schedule

If you want to schedule the next plasma cleaning, you can set up a date and time for an automated decontamination cycle.

- 1 To select a date for your cleaning schedule, click the calendar icon (1).
- 2 Once you have selected the date, enter a time (2) and activate the **Schedule cleaning cycle at:** checkbox (3).



The cleaning cycle schedule is now active. 30 seconds before the scheduled cleaning cycle a countdown will be displayed to inform you that a cleaning cycle is about to start. You have the following options:

- To abort the countdown and start the cleaning cycle right away, click **Start Now**.
- To abort the countdown and cancel the scheduled cleaning cycle, click **Cancel**.
- To start the cleaning cycle as scheduled, no action needs to be taken.

4.13.4.4. Returning to regular SEM/FESEM operation

- 1 To be able to return to regular SEM/FESEM operation,
 - click **Stop cleaning** to abort a cleaning cycle
 - close the window if no cleaning cycle is running.

The chamber will be pumped.

- 2 Wait until 'Vac Status = Ready' is displayed.
Gun and EHT can then be switched back on and you can return to regular SEM/FESEM operation.

4. Operation

Working with optional accessories

5. Troubleshooting

Error messages

When an error message occurs, a message window will pop up. This indicates a serious condition which must immediately be drawn to the operator's attention.

Most error messages are self-explaining.

The following table summarises important error symptoms and how to remedy.

Keyword	Symptom	Possible reason	Recommended action
Stage	Stage does not move. Stage does not move accurately. A stored stage position cannot be approached. Absolute stage movement is required.	Stage needs to be initialised.	Initialise the stage. Refer to section 5.1.
Stage/Joystick	Under TV control, the direction of dual joystick movement and direction of stage movement seem to be different.	TV joystick angle does not fit for the selected CCD camera.	Change the joystick TV angle. Refer to section 5.2.
Stage/Joystick	Stage cannot be moved by using the joystick	Joystick Disable checkbox is ticked	Untick the checkbox in the Stage tab of the SEM Controls panel
OptiProbe		After cathode replacement, after re-alignment of the electron optic column	Calibrate OptiProbe. Refer to section 5.3.
Touch alarm	Touch alarm message is shown.	Specimen or sample holder has touched objective or wall of the specimen chamber.	Reset touch alarm. Refer to section 5.4.
Temperature, water flow	Error message 'Stage Board too hot' (or similar) is shown.	Flow of cooling water is not OK.	Check water flow and temperature. Refer to section 5.5.
EHT	EHT cannot be switched on.	Column chamber valve is closed.	Select Airlock panel from the Panel Configuration Bar. Click Open Column Chamber Valve .
MERLIN® workstation freeze	The workstation has crashed.	CAN communication has failed.	Check the CAN communication as described in section 5.7.

5.1. Initialising the stage

The stage needs to be initialised before any absolute stage movement can be executed.

Executing this function requires the *Stage Initialise* privilege in the user profile.

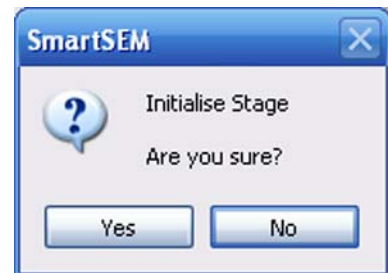
Prerequisite: Specimen chamber has to be evacuated.

- 1 Select **Stage/Stage initialise** from the menu.
- 2 Confirm by clicking on **Yes**.



IMPORTANT

If initialisation of the stage does not solve the stage problem, contact your ZEISS service representative.



5.1.1. Defining the post initialisation position of the stage

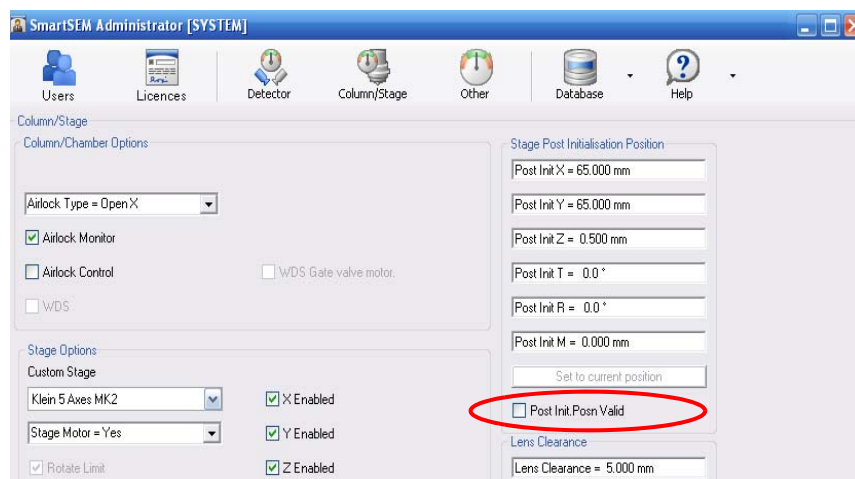
You can configure the position to which the stage drives after the initialisation procedure. Otherwise the stage will drive to the centre position.

Changing this setting requires the *Supervisor* privilege.

- 1 Open the SmartSEM[®] Administrator.
- 2 Click **Column/Stage**.
- 3 In the **Stage Post Initialisation Position** field, enter the desired position.

Alternatively:

- a Move the stage to the required position.
 - b Click **Set to current Posn.**
- 4 To activate the function, tick the **Post Init. Posn Valid** checkbox.



5.2. Changing the joystick TV angle

In TV mode (chamberscope) it might occur that dual joystick (optional) and stage seem to move to opposite directions. This is because the selected CCD camera is installed in a certain angle relatively to the stage. Thus, the camera shows a side-inverted view.

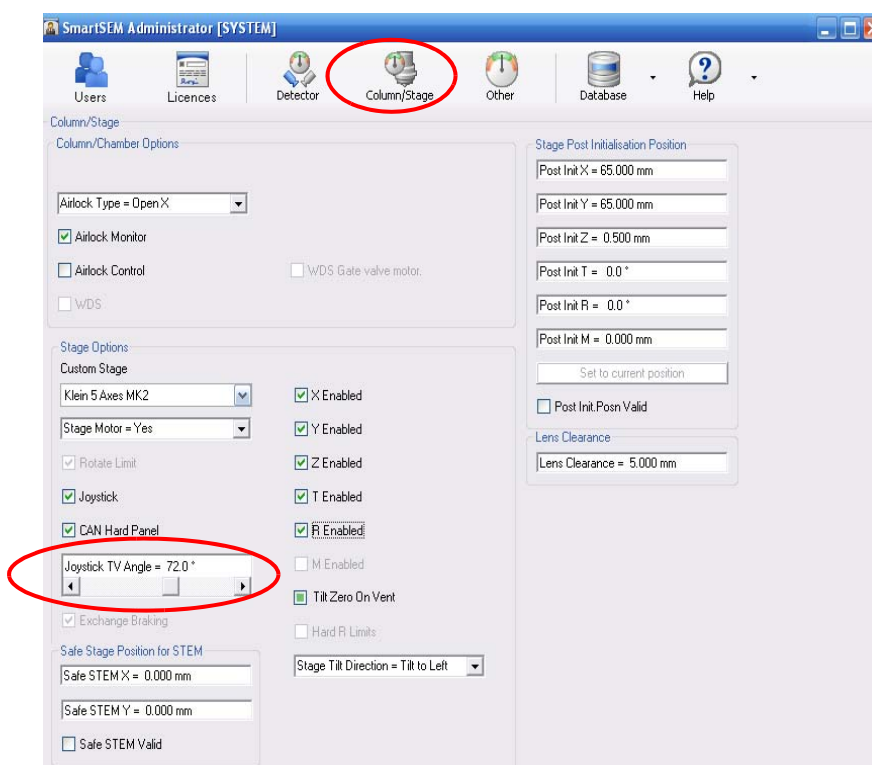
To remedy, change the joystick TV angle setting in the software. Changing this setting requires the *Supervisor* privilege.



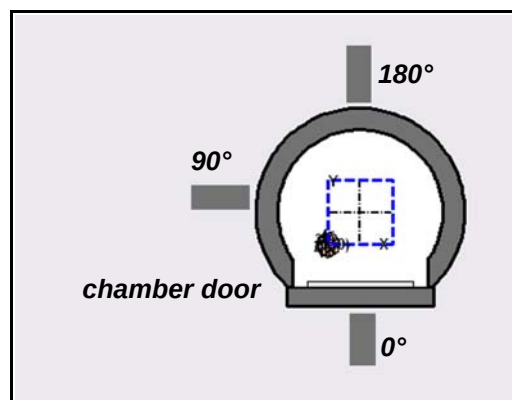
IMPORTANT

If you are working with two CCD cameras: The joystick TV angle can only be set for one CCD camera. When selecting the other CCD camera, you have to change the setting.

- 1 Open the SmartSEM® Administrator.
- 2 Click **Column/Stage**.



- 3 Double-click the **Joystick TV Angle** field.
- 4 Enter an angle depending on the installation location of the CCD camera.
When the CCD camera is installed:
at the back: Enter 180°.
at the front: Enter 0°.
at the side: Enter 90°.



5.3. Calibrating OptiProbe

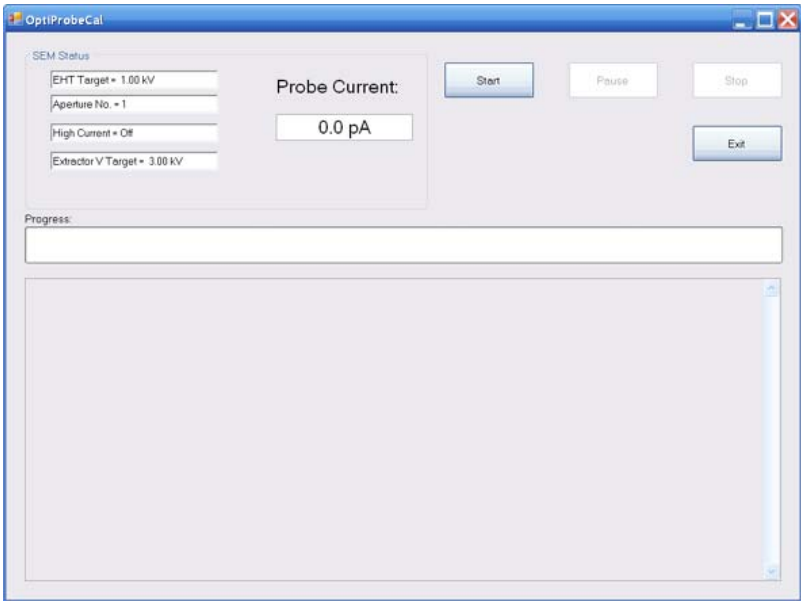
After cathode replacement or after re-alignment of the electron optic column, OptiProbe has to be calibrated.
A calibration wizard facilitates the calibration procedure.

Parts required	Part no.
Faraday cup, orifice diameter at least 200 µm	348342-8055-000

- 1 Load a Faraday cup into the specimen chamber.
- 2 Set WD 5 mm and select spot mode.
Focus the spot into the orifice of the Faraday cup.
- 3 Select **Start/Programs/SmartSEM/Opti-Probe calibration**.
The **OptiProbe Cal** dialog opens.
- 4 Click **OK**.



The **OptiProbe Cal** window opens.



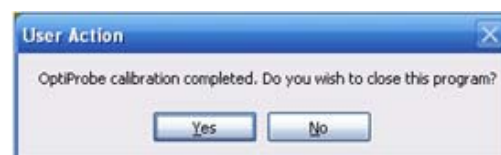
- 5 To start the calibration, click **Start**.

The **User Action** window is shown.

- 6 Click **OK**.
An automatic calibration routine is performed, which takes about fifteen minutes.



- 7 When the calibration procedure is finished, a message appears.
- 8 To finish the dialog, click **Yes**.



Now OptiProbe is ready to be used.

5.4. Resetting touch alarm

To prevent damage, a touch alarm is integrated in the SEM/FESEM: If specimen or sample holder touch chamber walls, detectors or objective lens, the stage is stopped immediately. An audible warning and an on-screen message are given.

- 1 Accept the warning by clicking on **OK**.
- 2 Move the stage in the reverse direction.



5.5. Checking water flow and temperature

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Water Flow/Temperature**.

The **Water Flow/Temperature** panel opens.

- 3 Check the entries.

Note that the current values for **EO Temp** and **EO Temp Limit** are only shown in case of an error.



Resetting overheat

To reset overheat:

- a Remedy the reason for overheating.
- b Click **Reset Overheat**.
- c Close and restart SmartSEM®.



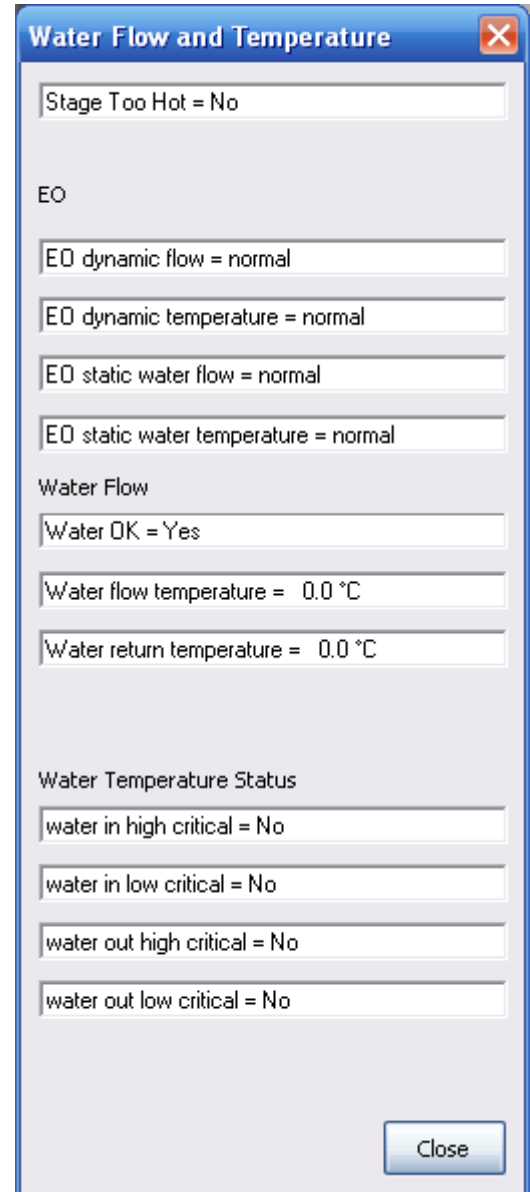
5.6. Checking water flow and temperature (MERLIN® only)

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **Water Flow/Temperature**.

The **Water Flow/Temperature** panel opens.

- 3 Check the entries.

If a value is critical, it is displayed in red.



The screenshot shows a window titled "Water Flow and Temperature" with a close button (X) in the top right corner. The window contains several status indicators:

- Stage Too Hot = No
- EO
- EO dynamic flow = normal
- EO dynamic temperature = normal
- EO static water flow = normal
- EO static water temperature = normal
- Water Flow
- Water OK = Yes
- Water flow temperature = 0.0 °C
- Water return temperature = 0.0 °C
- Water Temperature Status
- water in high critical = No
- water in low critical = No
- water out high critical = No
- water out low critical = No

A "Close" button is located at the bottom right of the window.

5.7. Checking the CAN communication (MERLIN® only)

If the workstation does not react to your commands anymore:

- 1 Open the **Panel Configuration Bar**.
- 2 Double-click **CAN Communication**.

The **CAN Communication** window opens.

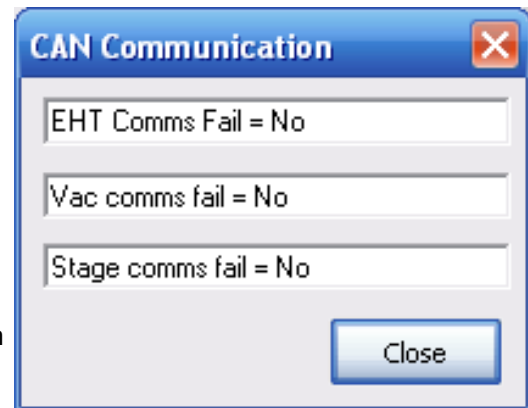
- 3 Check the entries.

If any of the values is indicated as Yes,

- a make sure that all cable connections between workstation and PC are plugged in correctly.

If this does not help,

- a reset the workstation as described in the workstation manual.



IMPORTANT

*If the problem persists,
contact your ZEISS service representative.*

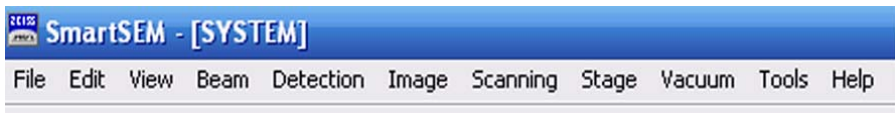
6. Summary of software functions

The different software functions can be called via:

- Menu bar
- Panel Configuration Bar
- Toolbars
 - Toolbar
 - Annotation bar
- Shortcuts

6.1. Menus

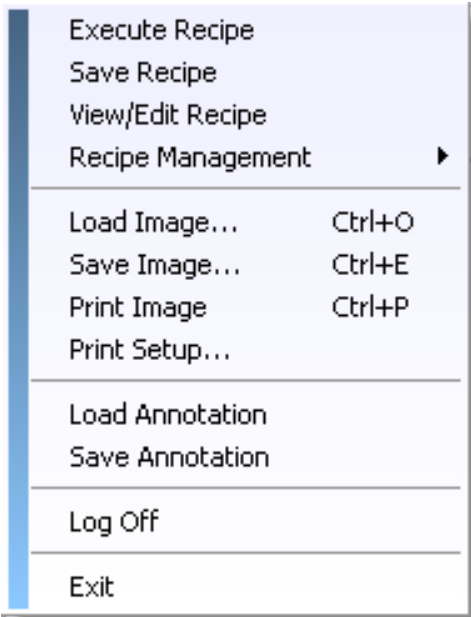
The different panels and dialogs necessary to operate the SEM/FESEM can be called by using the menu bar and its submenus.



6.1.1. Menu File

The menu **File** offers the possibility to manage recipes (i.e. a 'snapshot' of a sample-specific set of SEM/FESEM parameters),

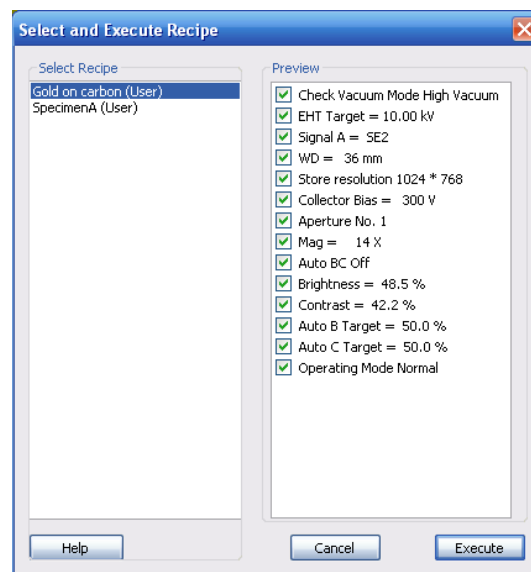
- to load, save and print images,
- to use annotations, and
- to close SmartSEM®.



6.1.1.1. Execute Recipe

Opens the **Select and Execute Recipe** window.

- **Select Recipe** section
Allows selection of a recipe.
- **Preview** section
Checkboxes to activate/deactivate a parameter.
- **Help**
Calls the help function.
- **Cancel**
Aborts the selection.
- **Execute**
Runs the selected recipe.



6.1.1.2. Save Recipe

Opens the **Save Recipe** dialog.

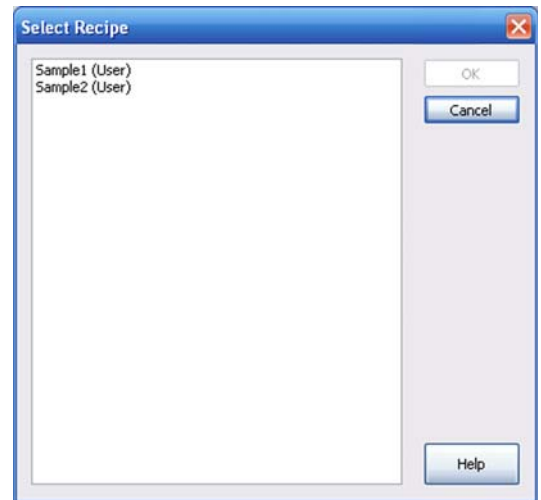
- **OK**
Confirms the selection.
- **Cancel**
Aborts the selection.
- **VV**
Allows you to select a recipe ingredient list.



6.1.1.3. View/Edit Recipe

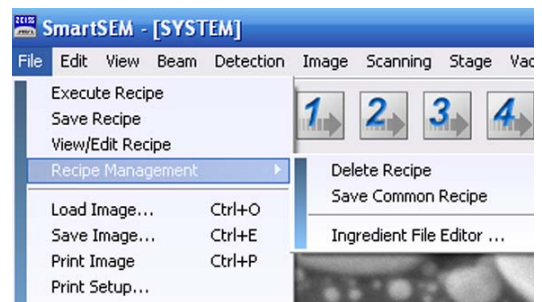
Opens the **Select Recipe** dialog.

- **Select recipe** section
Allows you to select a recipe.
- **OK**
Confirms the selection.
- **Cancel**
Aborts the selection.
- **Help**
Calls the help function.



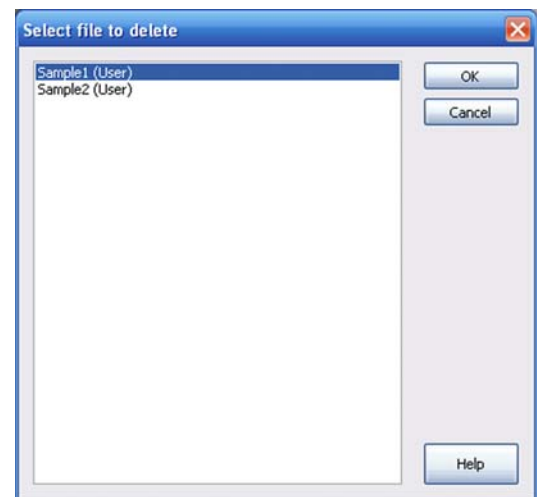
6.1.1.4. Recipe Management

Opens a submenu with three selections.



Delete Recipe

- **Select file to delete** section
Allows you to select a recipe.
- **OK**
Confirms the selection.
- **Cancel**
Aborts the selection.
- **Help**
Calls the help function.



6. Summary of software functions

Menus

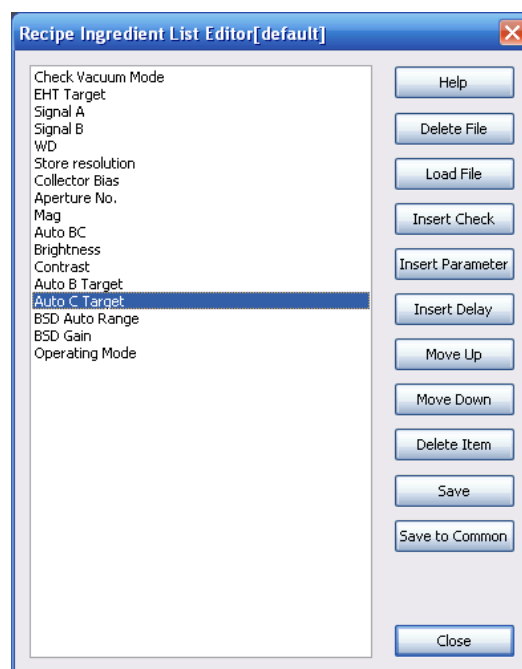
Save Common Recipe

- **OK**
Confirms the selection.
- **Cancel**
Aborts the selection
- **VV**
Allows you to select a recipe ingredient list.



Ingredient File Editor

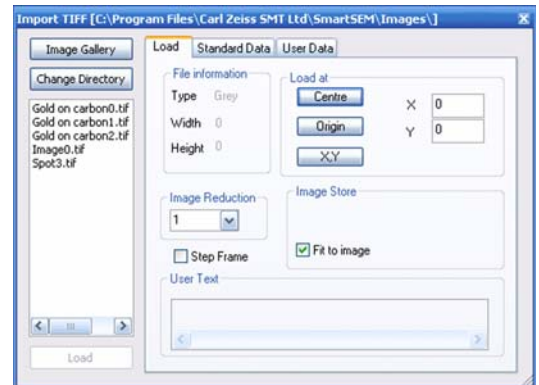
- **Help**
Calls the help function.
- **Delete File**
Deletes the selected file.
- **Load File**
Loads the selected file.
- **Insert Parameter**
Adds a parameter.
- **Insert Delay**
Adds a delay.
- **Move Up**
Changes the position of the item in the list.
- **Move Down**
Changes the position of the item in the list.
- **Delete Item**
Removes an item from the list.
- **Save**
Saves the list so that it can be used together with a user-specific recipe.
- **Save to Common**
Saves the list so that it can be used together with a common recipe.
- **Close**
Closes the **Ingredient File Editor**.



6.1.1.5. Load Image

Opens the **Import TIFF** window.

Alternatively, type **<Ctrl + O>**.

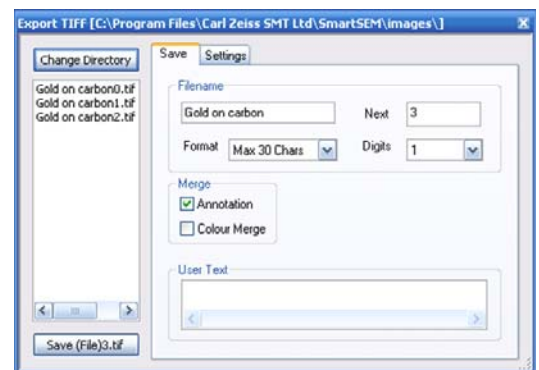


6.1.1.6. Save Image

Opens the **Export TIFF** window.

Alternatively, type **<Ctrl + E>**.

- **Change Directory**
Selects the directory.
- **Save xxx.tif**
Saves the file.
- **Annotation**
Has to be ticked, when annotations or measurements should be saved with the image.
- **Colour merge**
Has to be ticked, when colour annotations or measurements should be saved with the image.

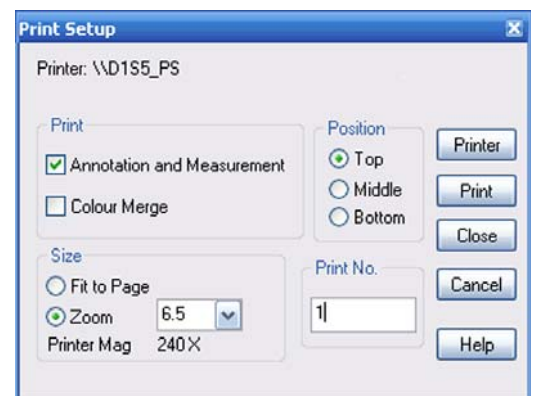


6.1.1.7. Print Image

Opens the **Print Setup** window.

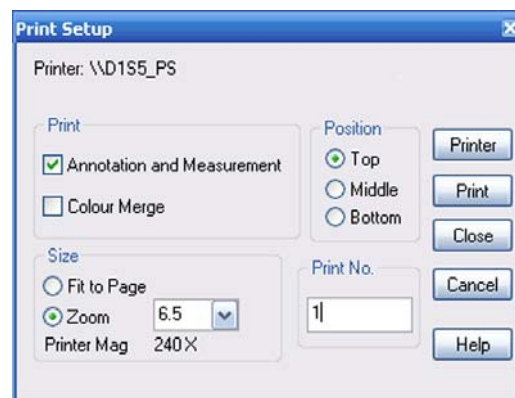
Alternatively, type **<Ctrl + P>**.

Refer to section 6.1.1.8.



6.1.1.8. Print Setup

- **Annotations and Measurements**
Prints annotations and measurements together with the image.
- **Colour Merge**
Has to be ticked, when colour annotations or measurements should be printed.
- **Size**
Selects the size of the image (*Fit to Page/Zoom*)
- **Position**
Selects the position on the sheet (*Top/Middle/Bottom*).
- **Printer**
Opens the printer selection dialog.
- **Print**
Prints the image.
- **Close**
Closes the dialog.
- **Cancel**
Aborts the selection.
- **Help**
Calls the help function.



6.1.1.9. Load Annotation

Offers the possibility to load a previously saved annotation.

6.1.1.10. Save Annotation

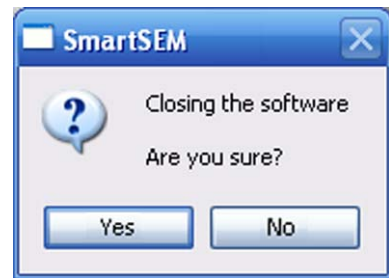
Offers the possibility to save an annotation or a set of annotations.

6.1.1.11. Log Off

Shuts down the SmartSEM® user interface and all other SmartSEM® applications such as the RemCon32 program.

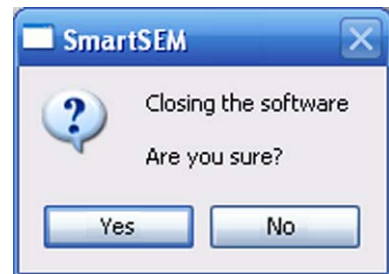
The EM Server remains active.

- **Yes**
Confirms the action.
- **No**
Aborts the action.

**6.1.1.12. Exit**

Shuts down the SmartSEM® user interface.
The EM Server remains active.

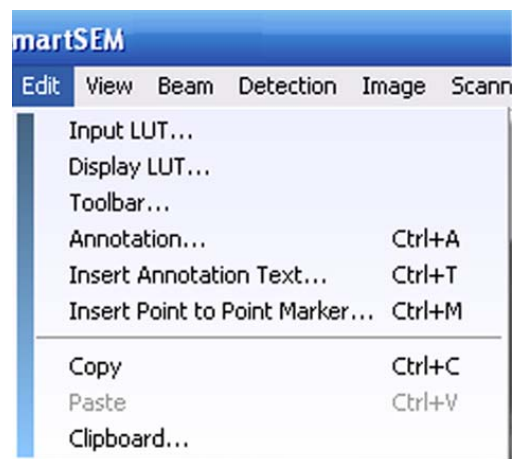
- **Yes**
Confirms the action.
- **No**
Aborts the action.



6.1.2. Menu Edit

The menu **Edit** offers the possibility

- to edit current or saved images, e.g. by modifying brightness and contrast, inserting measurements or annotations, copying images by using the buffer store,
- to edit the user-specific current toolbar,
- to work with annotations,
- and to copy and paste items.

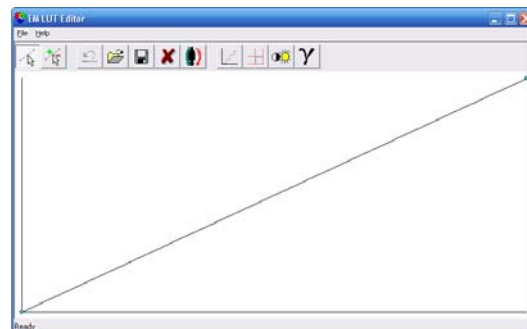


6.1.2.1. Input LUT

Opens the **EM LUT Editor** window.

The LUT editor is an applet that allows you to modify the Input LUT

Requires the licence GAMMALUT.

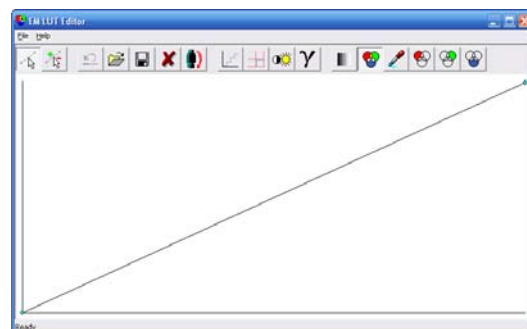


6.1.2.2. Display LUT

Opens the **EM LUT Editor** window.

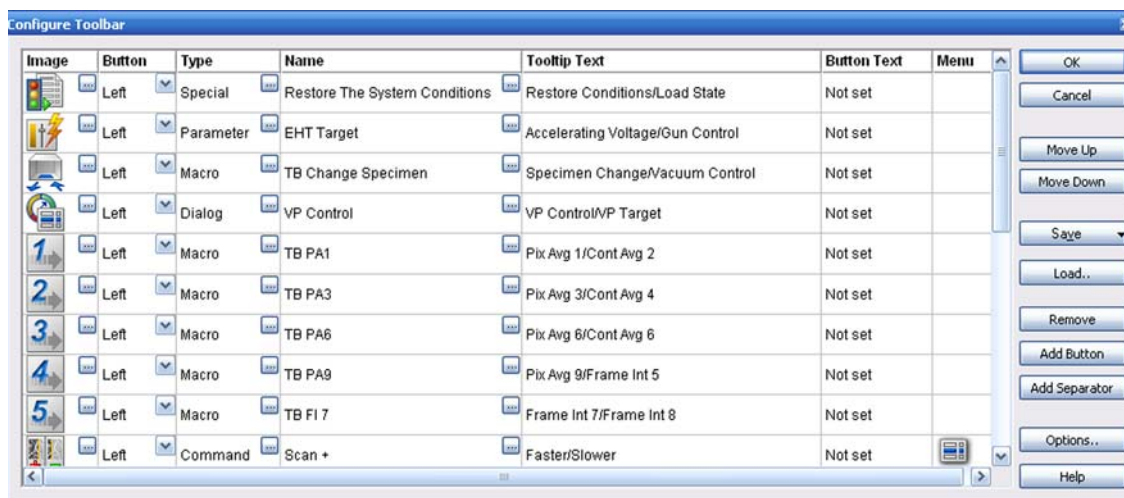
The LUT editor is an applet that allows you to modify the Display LUT

Requires the licence GAMMALUT.



6.1.2.3. Toolbar

Opens the **Configure Toolbar** window.



- **OK**
Confirms the action.
- **Cancel**
Aborts the action.
- **Move Up**
Changes the position of the selected toolbar icon.
- **Move Down**
Changes the position of the selected toolbar icon.
- **Save**
Save As: Saves the toolbar with a user-specific name.
Save As Common Toolbar: Saves the toolbar that can be recalled by other users.
- **Load**
Loads a previously saved toolbar.
- **Remove**
Deletes the selected toolbar icon.
- **Add Button**
Inserts a new toolbar icon.
- **Add Separator**
Inserts a space between the toolbar icons.
- **Options**
Opens the **Global Toolbar Options** panel.
- **Help**
Calls the help function.

6.1.2.4. Annotation

Shows annotations.

Alternatively, type <Ctrl + A>.

6.1.2.5. Insert Annotation Text

Opens the **Annotation Caption** window.

Alternatively, type <Ctrl + T>.

- **Insert Into Caption**

- Time Now**

- Inserts the current time.

- Date Now**

- Inserts the current date.

- User Name**

- Inserts the name of the current user.

- **WordWrap Enabled**

- If ticked, text is made up.

- **OK**

- Confirms the selection.

- **Undo**

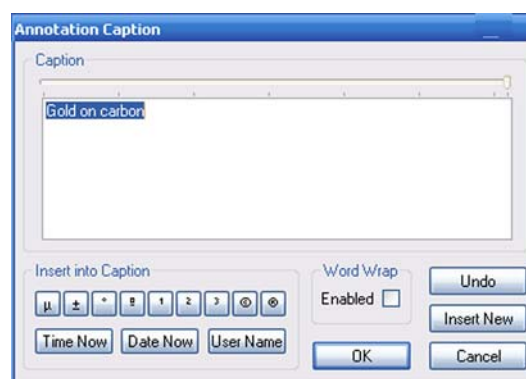
- Cancels the selection.

- **Insert New**

- Adds another annotation.

- **Cancel**

- Aborts the selection.



6.1.2.6. Insert Point to Point Marker

Adds a point to point marker.

Alternatively, type <Ctrl + M>.

6.1.2.7. Copy

Copies an item.

Alternatively, type **<Ctrl + C>**.

6.1.2.8. Paste

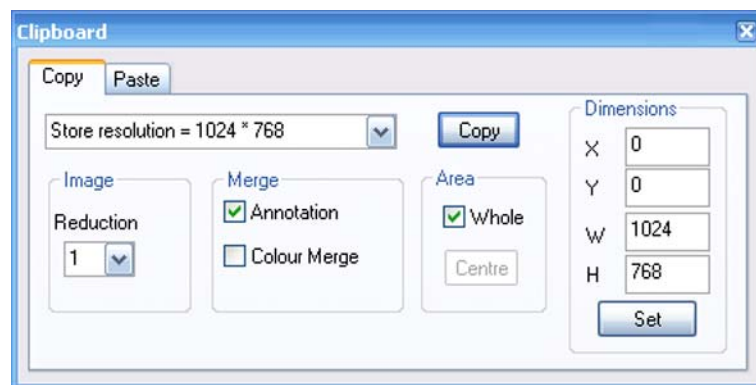
Inserts an item.

Alternatively, type **<Ctrl + V>**.

6.1.2.9. Clipboard

Allows you to copy and paste images by using the buffer store.

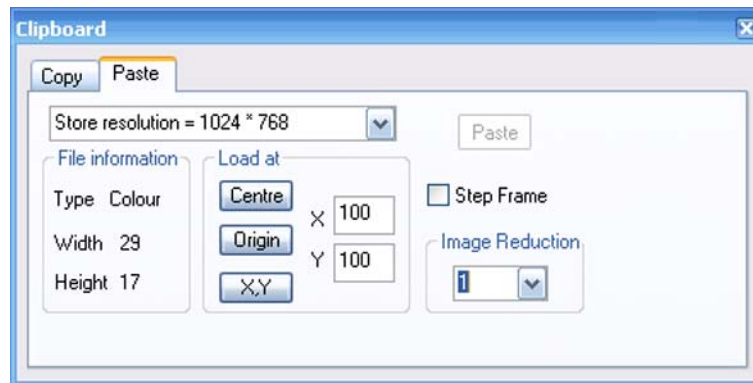
Requires the licence CLIP.



- **Store resolution**
Selects the storage resolution.
- **Copy**
Copies the image to the buffer.
- **Reduction**
Allows you to reduce the size of the stored image. Selection possible between 1 (original size) and 8.
- **Annotation**
If ticked, data zone, annotations and measurements are copied together with the image.
- **Colour Merge**
Has to be ticked, if colour annotations or measurements should be copied.
- **Whole**
If ticked, the whole screen area, which will be overlayed blue, will be copied as the image.
- **Dimensions**
Sets the image dimensions.
- **Set**
Adopts the dimension settings.

6. Summary of software functions

Menus



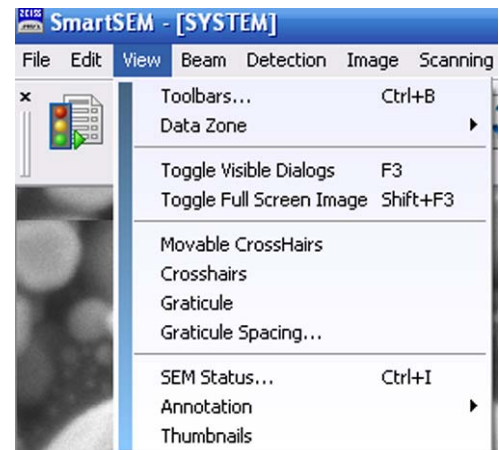
- **Store resolution**
Selects the storage resolution.
- **Centre**
Displaces the position of the shown graticule.
- **Origin**
Displaces the position of the shown graticule.
- **YX**
Displaces the position of the shown graticule.
- **Paste**
Inserts the image.
- **Image Reduction**
Sets the image reduction factor.

6.1.3. Menu View

The menu **View** offers features mainly referring to the design of the SmartSEM[®] user interface.

Moreover, it is possible to enable or disable a certain group of measurements and annotations.

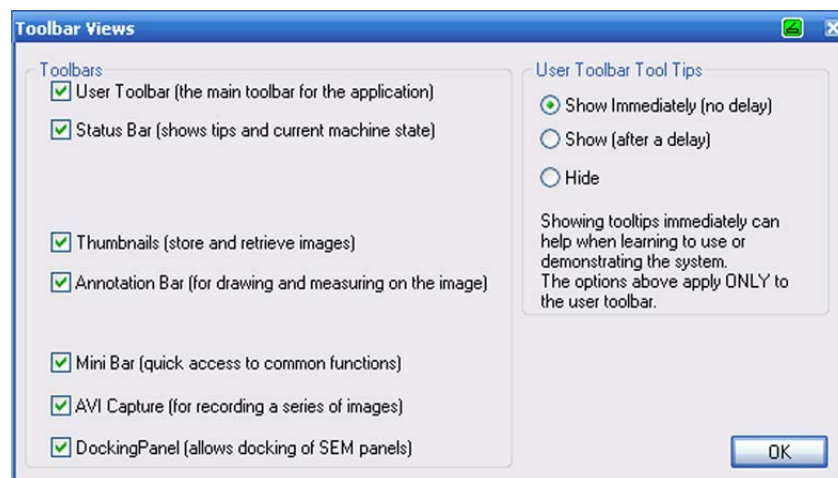
In the SEM Status window, the user can establish a list of different parameters which can be displayed and interactively changed in this window.



6.1.3.1. Toolbars

Opens the **Toolbar Views** window.

Alternatively, type **<CTRL+B>**.



- By deactivating the checkboxes the respective feature is hidden.
- One of the radio buttons below **User Toolbar Tool Tips** has to be selected.

Show immediately/Show: A short explanation (tool tip) is displayed whenever the mouse button is placed on one of the user toolbar icons.

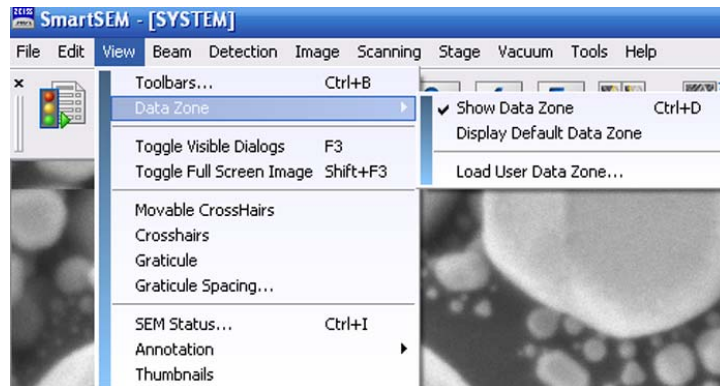
Hide: The tool tip information is not shown.

6. Summary of software functions

Menus

6.1.3.2. Data Zone

Allows you to select the data zone to be shown.



- **Toggle Data Zone <Ctrl + D>**
Shows/hides the data zone.
- **Display Default Data Zone**
Shows a standard data zone.
- **Hide Data Zone(s)**
If ticked, the data zones are not shown.
- **Unhide Data Zone(s)**
If ticked, the data zones are shown.
- **Load Data Zone**
Allows loading a data zone.

6.1.3.3. Toggle Visible Dialogs

Shows/hides visible dialogs.

Alternatively, type <F3>.

6.1.3.4. Toggle Full Screen Image

Hides all bars and panels (complete Windows® interface) to show a full screen image.

Alternatively, type <SHIFT + F3>.

To show bars and panels again press <SHIFT + F3>.

6.1.3.5. Movable Crosshairs

- Displays movable crosshairs
If this function is activated, a tick is shown in the pull-down menu.

6.1.3.6. Crosshairs

- Displays crosshairs
If this function is activated, a tick is shown in the pull-down menu.

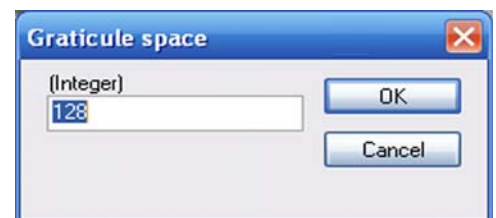
6.1.3.7. Graticule

- Shows a grid on the image.
If this function is activated, a tick is shown in the pull-down menu.

6.1.3.8. Graticule Spacing

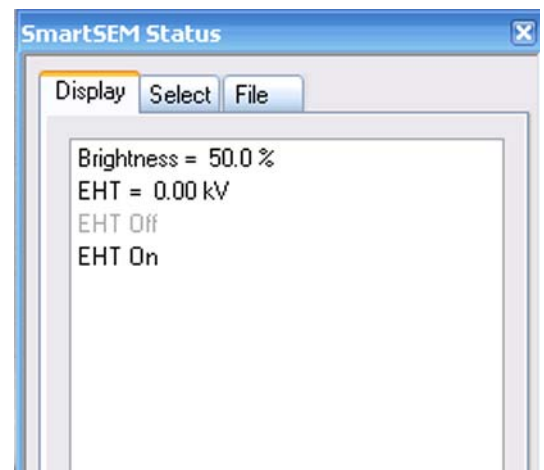
Allows you to select the space between the graticule lines.

- **OK**
Confirms the selection.
- **Cancel**
Aborts the selection.

**6.1.3.9. SEM Status**

This submenu opens the **SmartSEM Status** window which allows showing, editing and setting of frequently used SEM parameters.

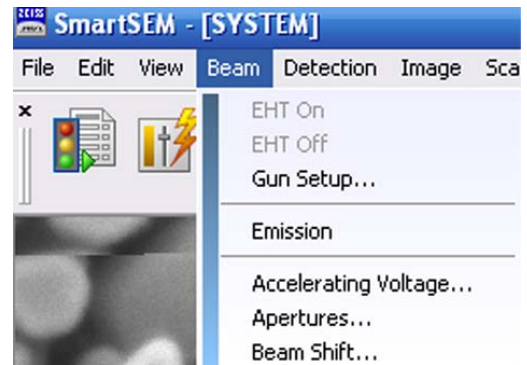
- **Display**
Shows the selected parameters.
- **Select**
Allows you to select the parameters to be shown.
- **File**
Allows you to load, save or delete a combination of parameters.

**6.1.3.10. Thumbnails**

Shows thumbnails.

6.1.4. Menu Beam

The menu **Beam** allows you to control the electron beam parameters.



6.1.4.1. EHT On/EHT Off

Switches the acceleration voltage EHT on or off.

6.1.4.2. Gun Setup

Opens the **Gun Service** panel.

This submenu is reserved for the ZEISS service representative in order to set specific gun parameters.

Each Schottky emitter has its individual values for filament heating current and extractor voltage. The respective values are set by the ZEISS service representative after the cathode has been changed.

CAUTION

Modifications of the filament heating current affect emitter life and resolution.

Therefore, any modification should be discussed with the local ZEISS service representative in advance.

6.1.4.3. Emission

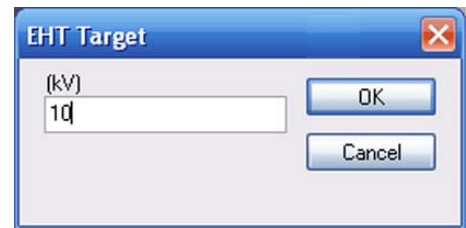
Changes to emission image mode.

Mainly used by ZEISS service representatives.

6.1.4.4. Accelerating Voltage

Opens the **EHT Target** panel.

- **OK**
Confirms the setting.
- **Cancel**
Aborts the setting.



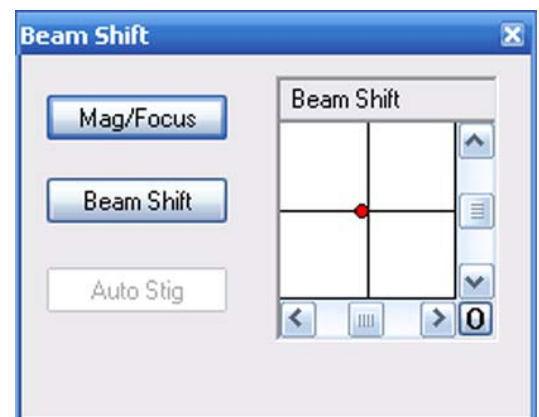
6.1.4.5. Apertures

Selects the **Apertures** tab on the **SEM Controls** panel.

6.1.4.6. Beam Shift

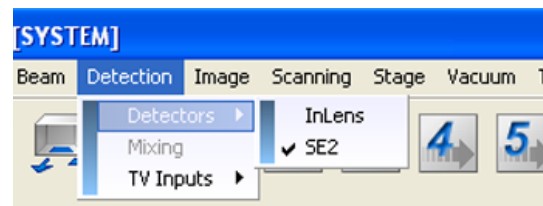
Opens the **Beam Shift** panel.

- **Mag/Focus**
Activates the magnification/focus function.
- **BeamShift**
Activates the Beam Shift function.



6.1.5. Menu Detection

Offers the possibility to select detection settings.



6.1.5.1. Detectors

Allows you to select a detector.
The selected detector is ticked.

6.1.5.2. Mixing

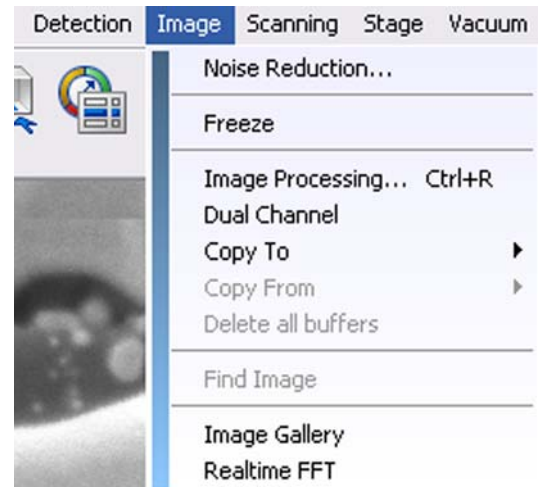
Allows you to mix the signals of two different detectors.
If active, this submenu is ticked.
Requires the licence SIGMIX.

6.1.5.3. Further submenus depending on installed detectors

Allow controlling the detectors installed.

6.1.6. Menu Image

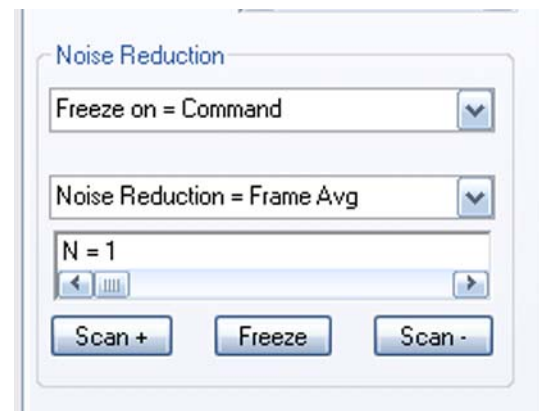
The menu **Image** allows you to freeze the image, to perform noise reduction, process images, and to manage images.



6.1.6.1. Noise Reduction

Opens the noise reduction functions.

- **Freeze on =**
Selects the moment of freezing the image.
- **Noise Reduction**
Selects the noise reduction method.
Refer to section 4.4.6.
- **Freeze/Unfreeze**
Freezes/unfreezes the live image.



6.1.6.2. Freeze/Unfreeze

Freezes respectively unfreezes the live image.

6.1.6.3. Image Processing

Opens the **Image Processing** panel with several tabs.
Requires the licence IMMATH.

Threshold tab

- **Black threshold**
Sets the threshold for black.
- **White Threshold**
Sets the threshold for black.
- **Image Detect**
Selects the type of threshold.
- **Reset LUT**
Resets the Look-up-table.
- **Update**
Calculates the area fraction.

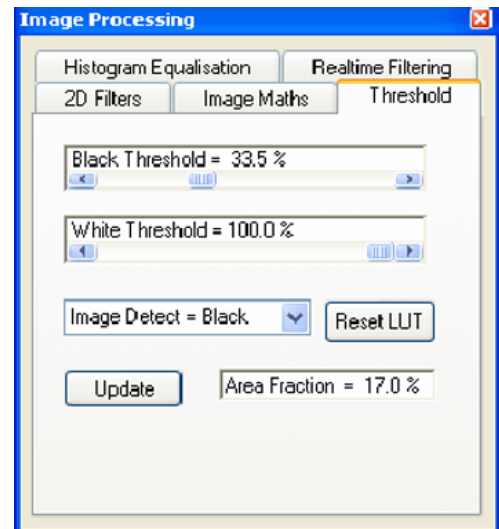
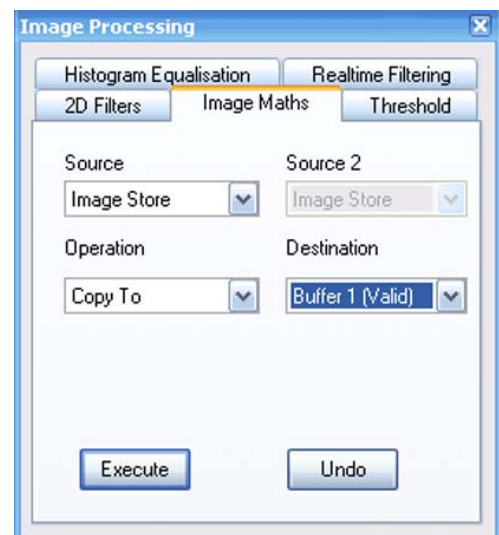


Image Maths tab

- **Source**
Selects the source.
- **Source 2**
Selects source 2.
- **Operation**
Selects the operation.
- **Execute**
Executes the selected operation.
- **Undo**
Aborts the settings.

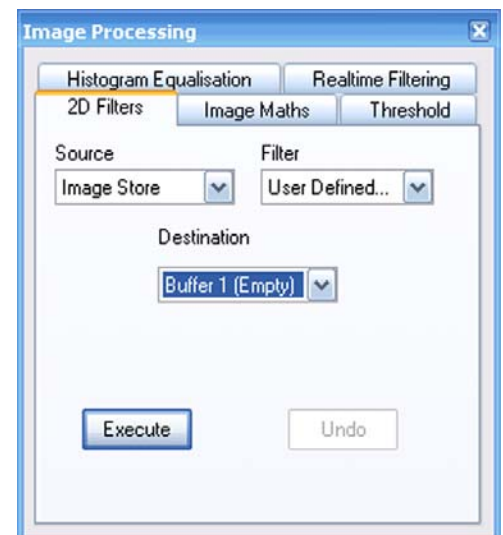


Histogram Equalisation tab

- **Histogram Equalise Store**
Calculates the grey scale distribution.
- **Histogram Equalise LUT**
Uses Display LUT for image transformation.
- **Reset LUT**
Undoes the calculated Display LUT.

**2D Filters tab**

- **Source**
Selects the storage to which the transformation will be applied to.
- **Filter**
Selects a filter from the drop-down list.
- **Destination**
Defines the buffer.
- **Execute**
Starts the image processing.
- **Undo**
Aborts the settings.



Pre-defined kernel
filter matrices:

$$\text{Smooth} \begin{pmatrix} 1 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 1 \end{pmatrix} / 16$$

$$\text{Sharpen} \begin{pmatrix} -1 & -1 & -1 \\ -1 & 9 & -1 \\ -1 & -1 & -1 \end{pmatrix}$$

$$\text{Sharpen 2} \begin{pmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{pmatrix}$$

$$\text{Horizontal Edge} \begin{pmatrix} 2 & 2 & 2 \\ 0 & 0 & 0 \\ -2 & -2 & -2 \end{pmatrix}$$

$$\text{Vertical Edge} \begin{pmatrix} -2 & 0 & 2 \\ -2 & 0 & 2 \\ -2 & 0 & 2 \end{pmatrix}$$

$$\text{Edge Detect} \left(\begin{pmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{pmatrix} + \begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix} \right) / 2$$

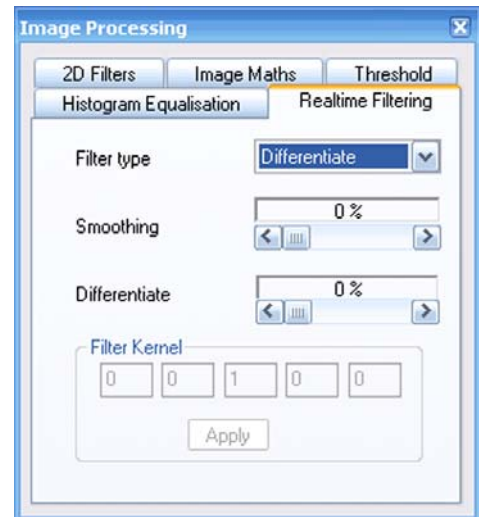
$$\text{Edge Detect 2} \left(\begin{pmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{pmatrix} + \begin{pmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{pmatrix} \right) / 2$$

$$\text{Laplacian} \begin{pmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{pmatrix}$$

$$\text{Laplacian 2} \begin{pmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{pmatrix}$$

Realtime Filtering tab

- **Filter type**
Selects the type of filter, e.g. *Smooth* and *Differentiate*.
- **Smoothing**
Sets the degree of smoothing.
- **Differentiate**
Sets the degree of differentiation.



6.1.6.4. Dual Channel

Allows you to display the live image on a second monitor.
If active, this submenu is ticked.
Requires the licence DUAL-CHANNEL.

6.1.6.5. Copy To

Selects the buffer the image is to be copied to.

6.1.6.6. Copy From

Selects the buffer the image is to be loaded from.

6.1.6.7. Delete all buffers

Deletes all buffers.

6.1.6.8. Find Image

Activates an automatic procedure to find an image.

6.1.6.9. Image Gallery

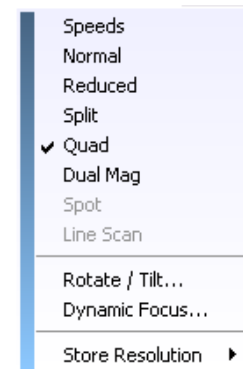
Shows the images of a directory as thumbnails.

6.1.6.10. Realtime FFT

Shows a Fourier transformation of the current image. Aid for image optimisation.

6.1.7. Menu Scanning

The menu **Scanning** allows to control scanning parameters.

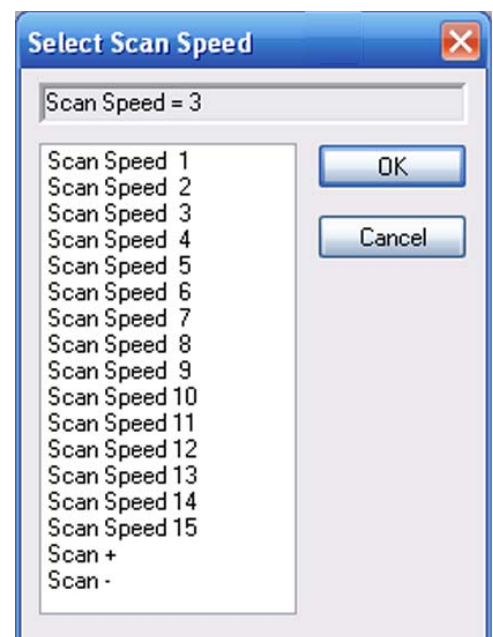


6.1.7.1. Speeds

Offers the possibility to select the scan speed.

Selection of fifteen scan speeds requires the licence SCANEXP.

- **OK**
Confirms the selection.
- **Cancel**
Aborts the selection.



6.1.7.2. Normal

Returns from special scanning modes such as Reduced, Spot, Line, Split, or Dual Mag to the normal scanning mode.

If active, this submenu is ticked.

6.1.7.3. Reduced

Scans only a small frame (reduced raster), which is suitable for alignment procedures.
If active, this submenu is ticked.

6.1.7.4. Split

Activates the split screen function: The image area is subdivided into two zones. Different detectors can be assigned to each zone.

Requires the licence SPLIT.

6.1.7.5. Quad

Activates the quad split screen function: The image area is subdivided into four zones. Different detectors can be assigned to each zone.

Requires the licence QUAD.

6.1.7.6. Dual Mag

Allows zooming an image without freezing the image at basis magnification.

Requires the licence DUALMAG.

6.1.7.7. Spot

Positions the electron beam on a particular spot on the specimen surface.

Requires the licence SPOT.

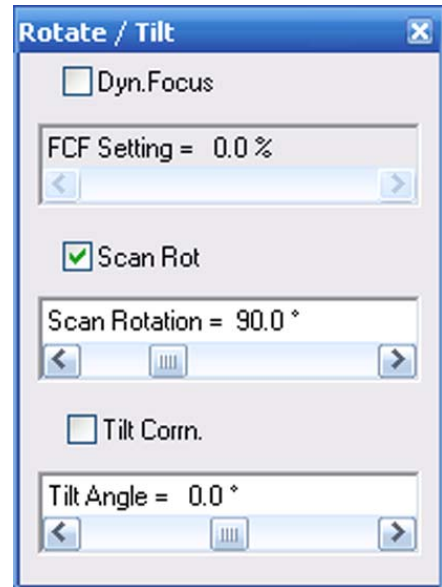
6.1.7.8. Line Scan

Allows scanning a defined line while the image is frozen.

6.1.7.9. Rotate/Tilt

Opens the **Rotate/Tilt** panel.

- **Scan Rot**
If ticked, the scan rotation is active.
Requires the licence SCANROT.
- **Scan Rotation**
Allows setting of the scan rotation angle.
- **Tilt Corr.**
If ticked, the tilt correction is active.
- **Tilt Angle**
Allows adjustment of the tilt angle.

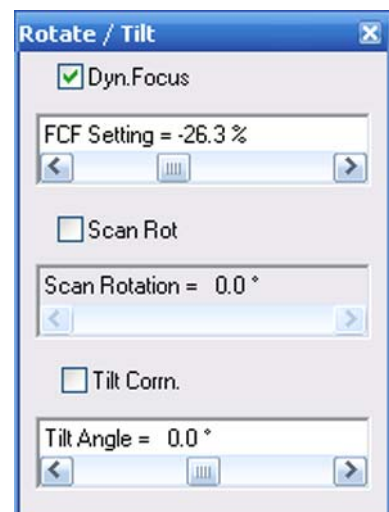


6.1.7.10. Dynamic Focus

Allows you to dynamically adapt the focus of tilted specimen surfaces.

Requires the licence DYNFOCUS.

- **Dyn. Focus**
If ticked, the dynamic focus is active.
- **FCF Setting**
Sets the degree of the dynamic focus (FCF=Frame Corrected Focus).

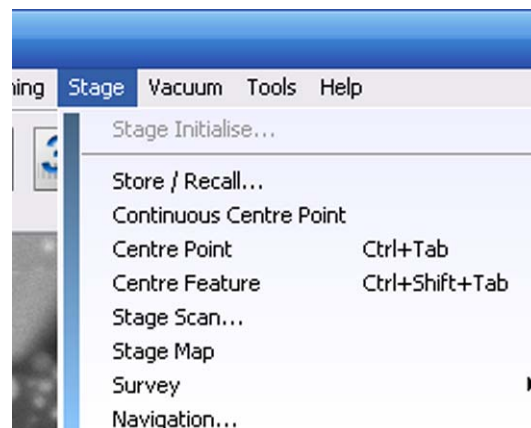


6.1.7.11. Store Resolution

Allows you to select the storage resolution from a drop-down menu.

6.1.8. Menu Stage

The menu **Stage** allows you to control several stage functions.



6.1.8.1. Stage Initialise

Initialises the stage.
Requires the *Stage Initialise* privilege.

6.1.8.2. Store/Recall

Opens the **Stage Points List** (refer to section 6.2.36.).

6.1.8.3. Continuous Centre Point

If selected, the software remains in centre point mode after each point selection allowing repetitive centre point actions.

To quit **Centre Point** mode, right-click.

6.1.8.4. Centre Point

Allows marking a spot in the image which is then automatically moved to the centre of the image area.

Requires the licence CENTRE.

6.1.8.5. Centre Feature

Allows selecting a feature or range in the image which is automatically centered and magnified so that the selected image feature fills the complete image area.

Requires the licence CENTRE.

6.1.8.6. Stage Scan

Allows you to scan an exactly defined series of regularly distributed image fields.

- **Setup Wizard**
Opens the wizard.



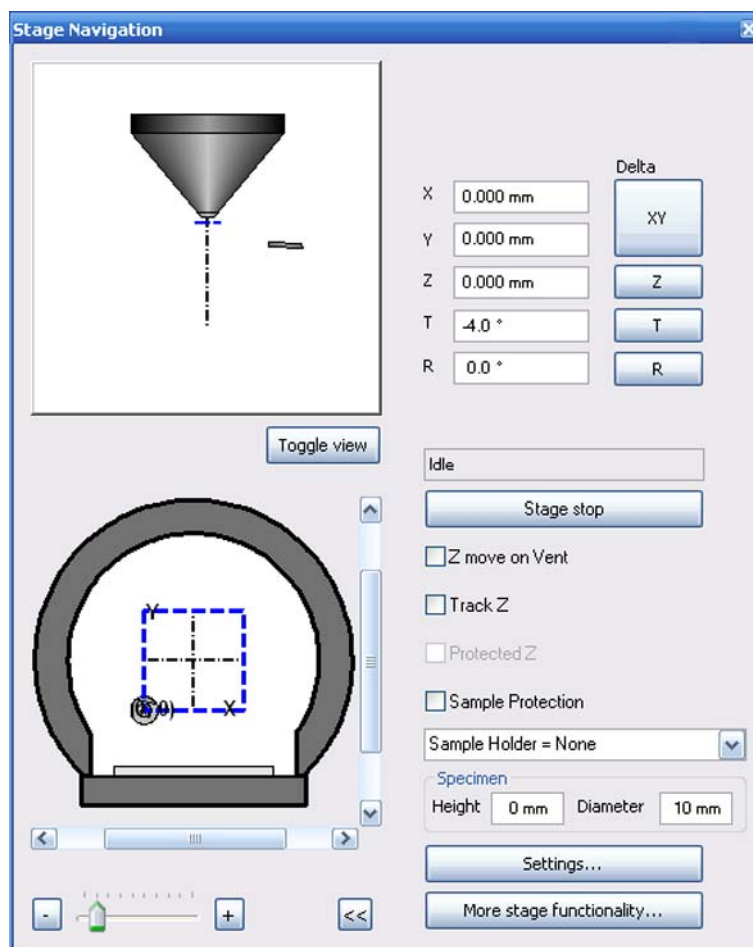
6.1.8.7. Stage Map

This function allows using a frozen image in zone 0 as an overview for the selection of interesting features on the specimen surface.
Requires the licence CENTRE.

6.1.8.8. Survey

Opens the submenu.
Requires the licence SURVEY.

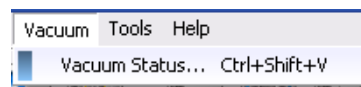
6.1.8.9. Navigation



- **Toggle view**
Changes the view.
- **Stage stop**
Stops the stage immediately.
- **Z move on Vent**
If ticked, the stage is driven to the lowest Z when the specimen chamber is ventilated.
- **Track Z**
If ticked, the focus will be automatically re-adjusted after every change if the Z coordinate
- **Protected Z**
If ticked, the current Z coordinate is compared with the new coordinate when calling saved stage coordinates.
If the new Z position is higher than the current one, the stage drives to the X/YT/R coordinate first, then to the new Z position.
If the new Z position is lower than the current one, Z is moved first, then the other axes.
- **Settings**
Opens the **Stage Navigation** setting dialog.
- **More stage functionality**
Opens a drop-down list.

6.1.9. Menu Vacuum

The menu **Vacuum** allows the control of the most important parameters of the vacuum system.



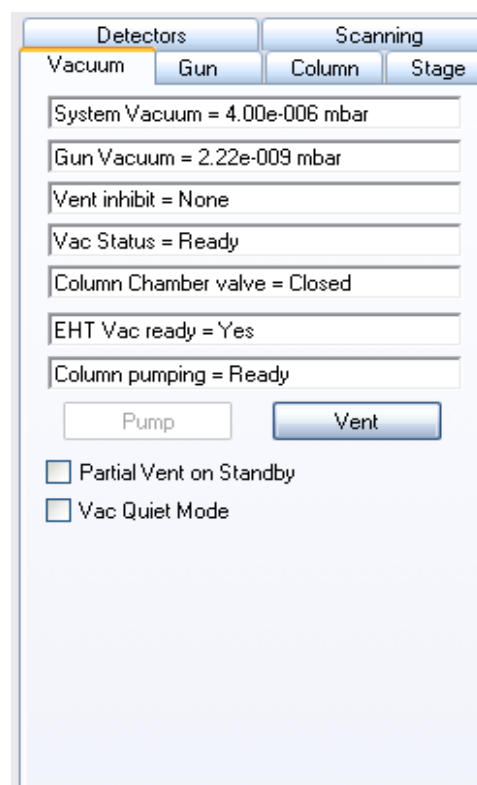
6.1.9.1. Vacuum Status

Selects the **Vacuum** tab on the **SEM Controls** panel.

Alternatively, type <CTR+SHIFT+V>.

Standard vacuum system

- **System Vacuum**
Indicates the vacuum in the specimen chamber.
- **Gun Vacuum**
Indicates the vacuum in gun head and liner tube.
- **Vent inhibit**
None
Beam Present: EHT is on
- **Vac Status**
Indicates status of vacuum release.
Ready: Specimen chamber is evacuated and ready to switch on EHT/Gun.
At Air: Specimen chamber is ventilated.
- **Column Chamber Valve**
Indicates the position (*open/closed*) of the column chamber valve which separates cathode head and specimen chamber.
- **EHT Vac ready**
Indicates status for high voltage release
- **Pump / Vent:**
Evacuates/Ventilates the specimen chamber.
Vent is available when the electron beam is switched off.
Pump is available after changing the specimen.
- **Partial Vent on Standby**
If ticked, the specimen chamber will be ventilated partially when the SEM/FESEM is switched to STANDBY mode.
Tick the checkbox if the vacuum is OK and the SEM/FESEM will not be operated for a longer time (e.g. weekend). This can help to prevent oil vapours from penetrating into the specimen chamber during STANDBY mode.



IMPORTANT

If the SEM/FESEM is vented or partially vented, it is NOT possible to start the bakeout.

VP vacuum system

- **System Vacuum**
Indicates the vacuum in the specimen chamber.
- **Vent inhibit**
None
Beam Present: EHT is on
- **Vac Status**
Indicates status of vacuum release.
Ready: Specimen chamber is evacuated and ready to switch on EHT/Gun.
At Air: Specimen chamber is ventilated.
- **EHT Vac ready**
Indicates status for high voltage release
- **Pump / Vent:**
Evacuates/Ventilates the specimen chamber.
Vent is available when the electron beam is switched off.
Pump is available after changing the specimen.
- **Partial Vent on Standby**
If ticked, the specimen chamber will be ventilated partially when the SEM/FESEM is switched to STANDBY mode.
Tick the checkbox, if the vacuum is OK and the SEM/FESEM will not be operated for a longer time (e.g. weekend). This can help to prevent oil vapours from penetrating into the specimen chamber during STANDBY mode.



IMPORTANT

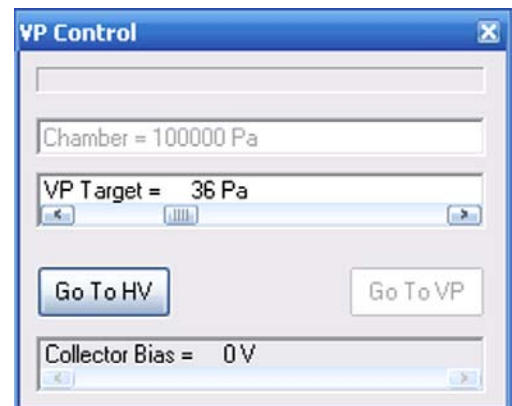
If the SEM/FESEM is vented or partially vented, it is NOT possible to start the bakeout.

- **Go to HV @ Shutdown**
If ticked, the SEM/FESEM is automatically switched to HV mode, when switching the SEM/FESEM to STANDBY.
- **Chamber**
Indicates the actual pressure in the specimen chamber in VP mode
- **VP Target**
Slider used to adjust the desired pressure in the specimen chamber
- **Go To HV / Go To VP**
Changes to High vacuum mode/Variable pressure mode.

6.1.9.2. VP Control (VP instruments only)

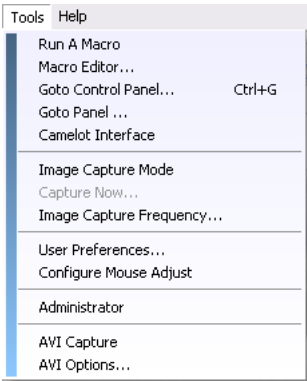
The submenu **VP Control** opens the **VP Control** panel.

- **Chamber**
Indicates the actual pressure in the specimen chamber in VP mode.
- **VP Target**
Slider used to adjust the pressure in the specimen chamber.
- **Go To HV / Go To VP**
Changes to High vacuum mode/Variable pressure mode.
- **Collector Bias**
Sets the collector bias of the VPSE detector.



6.1.10. Menu Tools

The menu **Tools** offers the possibility to work with macros, to customise the software and to start recording a video.



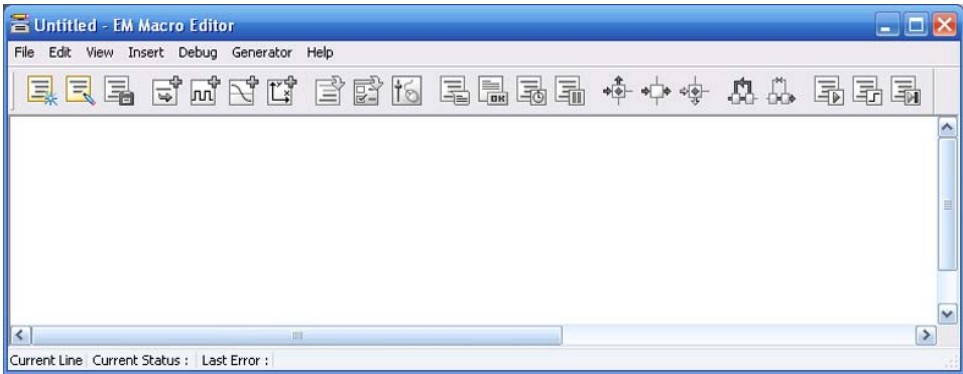
6.1.10.1. Run A Macro

Opens the **Selected a Macro to be Executed** dialog.



6.1.10.2. Macro Editor

Opens the macro editor.

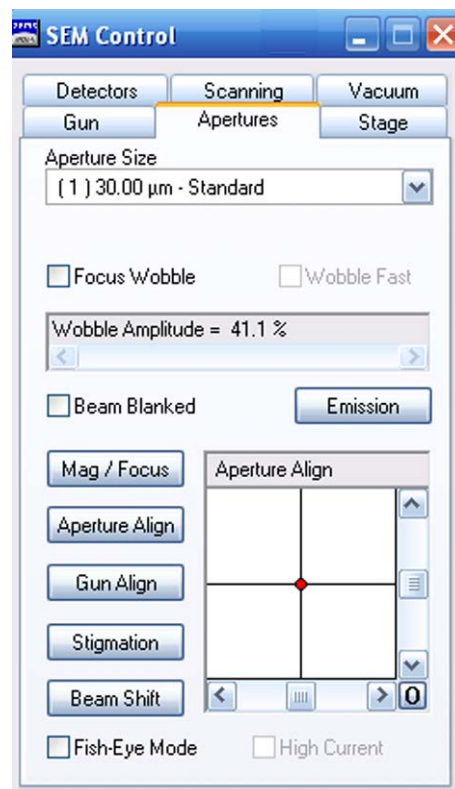


6.1.10.3. Goto Control Panel

Opens the **SEM Controls** panel, which has six (standard vacuum system) or seven (VP vacuum system) tabs.

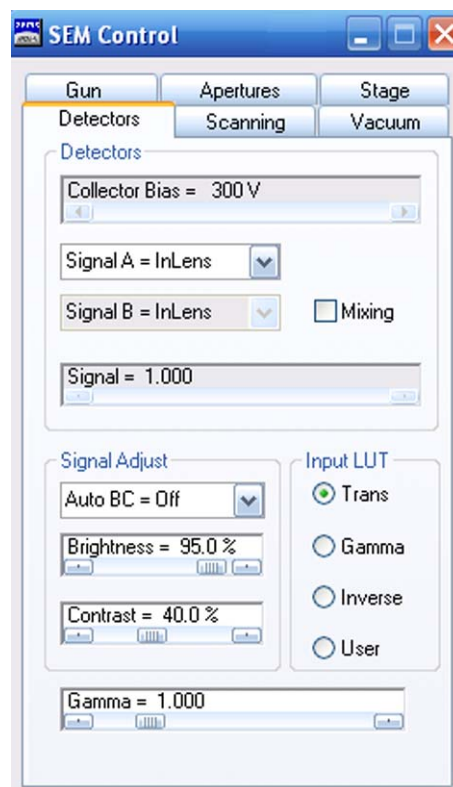
Apertures tab

- **Aperture Size.**
Indicates the selected aperture sizes.
Drop-down list allows selection of another aperture
- **Focus Wobble**
If ticked, the focus wobble is active in a reduced raster. Used to optimise the image
- **Wobble Fast**
Accelerated wobble speed
- **Wobble Amplitude**
Allows changing the extent of the wobble movement if the Focus Wobble checkbox is ticked.
- **Beam Blanked**
If ticked, the electron beam is removed from the beam path, the specimen is not scanned any more. This function blanks / unblanks the beam with the scanning coils in the column.
The optional Beam Blanker is not controlled by this checkbox.
- **Emission**
Changes to emission mode, which is mainly reserved to ZEISS service representatives.
- **Navigation box**
Navigation box for adjustment of the parameters shown on the buttons on the left.
- **Mag/Focus**
Allows setting of the magnification
- **Aperture Align**
Allows setting of the aperture alignment
- **Gun Align**
Allows setting of the gun alignment
- **Stigmation**
Allows setting of the stigmator
- **Beam Shift**
Allows setting of the beam shift.
- **Fisheye Mode**
If ticked, **Fisheye Mode** is active.
Requires licence FISHEYE.
- **High Current**
If ticked, high current mode is active.
Requires licence HIGH CURRENT.



Detectors tab

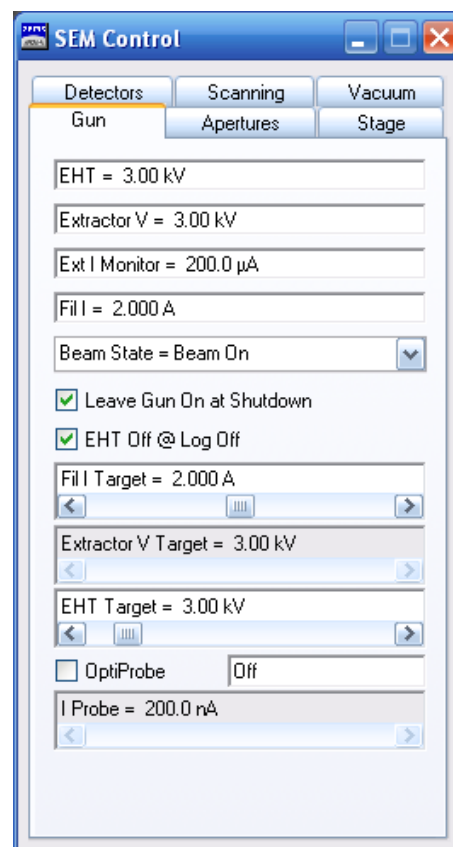
- **Collector Bias**
Sets the collector voltage.
- **Signal A**
Selects the active signal to be displayed on the monitor
- **Signal B**
Selects the signal to be mixed with A
- **Mixing**
If ticked, the signals A and B are mixed (requires the licence SIGMIX)
- **Signal**
Indicates the percentage of signal A while mixing
- **AutoBC**
Sets the AutoBC function
Off: Switched the function off
B: Automatic adjustment of brightness
C: Automatic adjustment of contrast
BA: Automatic adjustment of brightness and contrast
- **Brightness**
Adjusts brightness
- **Contrast**
Adjusts contrast
- **Input LUT**
Trans: Regular image display
Gamma: Allows user to adjust gamma with the **Gamma** slider
Inverse: Inverts the image display
User: Opens the **EM LUT Editor** window (section 6.1.2.1.)
- **Gamma**
Adjusts gamma



Gun tab

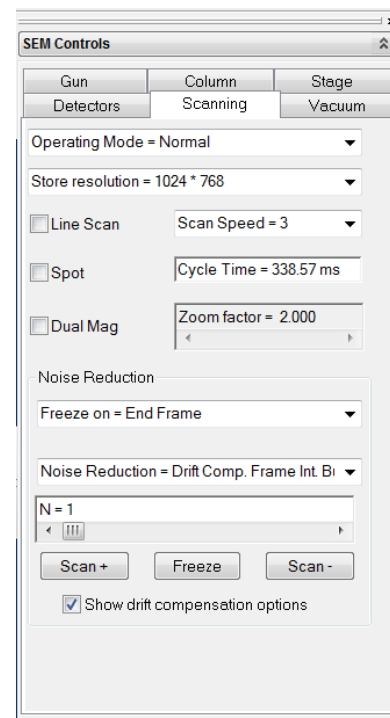
- **EHT**
Indicates actual acceleration voltage
- **Extractor V**
Indicates the current value of the extractor voltage
- **Ext I Monitor**
Indicates the current value of the extractor current
- **Fil I**
Indicates the current value of the filament heating current
- **Beam state**
Indicates the beam state
Drop-down list allows to switch EHT on/off and to switch the gun on/off
- **Leave Gun On at Shutdown**
If ticked, the gun stays on when closing the SmartSEM[®] software and changing to STANDBY mode.
- **EHT Off@ Log Off**
If ticked, the EHT is automatically shut down when the SmartSEM[®] software is closed by using **Log Off** or **Exit** from the menu
- **FIL I Target**
Allows user to set the filament heating current
- **Extractor V Target**
Requires *Service* setting under **Tools/User Preferences/User Access Level**
- **EHT Target**
Allows user to set the acceleration voltage

Each Schottky emitter has its individual values for filament heating current and extractor voltage. The respective values are set by the ZEISS service representative after the cathode has been changed.
- **OptiProbe**
Allows automatic setting of the probe current.
With additional hardware only.



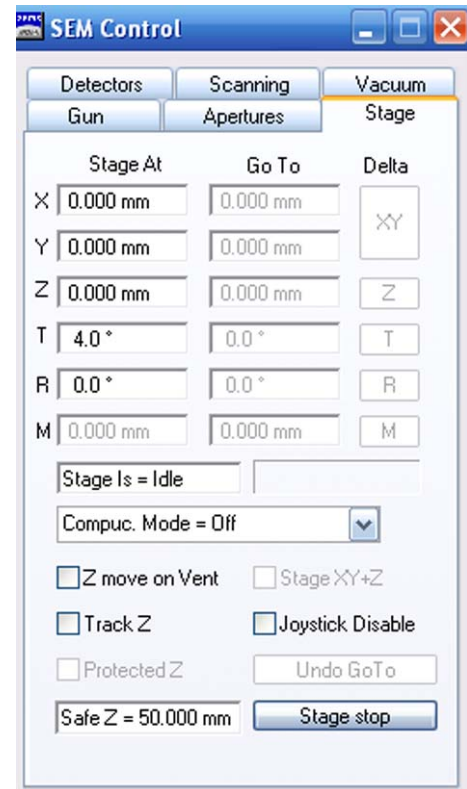
Scanning tab

- **Operating Mode**
Selects the operating mode
Normal
Split: Subdivides the image area into two zones (requires the licence SPLIT)
Reduced: Scan a small frame (reduced raster)
Emission: Changes to emission mode
- **Store resolution**
Select the stored resolution
- **Line Scan**
If ticked, a line is scanned permanently
- **Spot**
If ticked, spot mode is active (requires the licence SPOT)
- **Dual Mag**
If ticked, the dual mag function is active (requires the licence DUALMAG)
- **Scan Speed**
Sets the velocity of the scan
- **Cycle Time**
Indicates the cycle time depending on the selected scan speed
- **Zoom factor**
Sets the zoom factor
- **Freeze on**
Defines when the image is frozen.
- **Noise Reduction**
Selects the noise reduction method
- **N=**
Selects the number of images to be used for frame and line integration and averaging.
- **Scan+/Scan-**
Increases/decreases the scan speed
- **Freeze/Unfreeze**
Freezes/Unfreezes the scan
- **Show drift compensation options**
If ticked, the **DCFA/I Advanced Options** dialog opens.



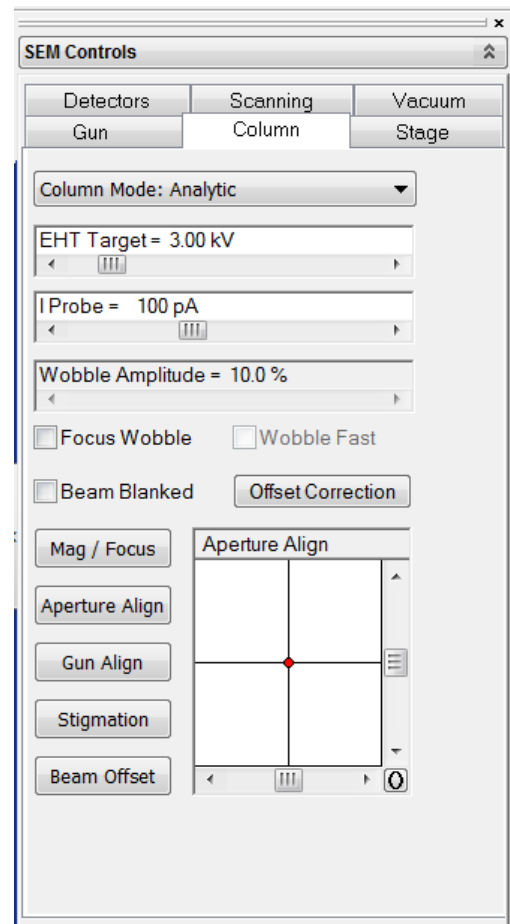
Stage tab

- **Stage At**
Indicates position of the stage axis
- **Go To**
Coordinates to be approached
- **Stage Is**
Current state of the stage
Busy: stage is moving
Idle: stage is standing still
- **Z move on Vent**
If ticked, the stage is driven to the lowest Z when the specimen chamber is ventilated.
- **Track Z**
If ticked, the focus will be automatically re-adjusted after every change of the Z coordinate.
- **Protected Z**
If ticked, the current Z coordinate is compared with the new coordinate when calling saved stage coordinates.
If the new Z position is higher than the current one, the stage drives to the X/Y/T/R coordinate first, then to the new Z position.
If the new Z position is lower than the current one, Z is moved first, then the other axes.
- **Stage XY + Z**
Affects the Stage Scan function.
If ticked, Z is moved in relation to the Z start coordinate if the stage moves in tilt direction.
- **Joystick Disable**
If ticked, the dual joystick is disabled.
- **Undo Go To**
Cancels the last movement.
- **Stage Stop**
Stops the stage immediately.



Column tab (MERLIN® only)

- **Column mode**
Selects the column mode.
Column Mode: High Resolution
Column Mode: Analytic
Column Mode: Depth of Field
Column Mode: Fish-eye
- **EHT Target**
Sets the EHT target.
- **I Probe**
Sets the I probe.
- **Wobble Amplitude**
Allows changing the extent of the wobble movement if the Focus Wobble checkbox is ticked.
- **Focus Wobble**
If ticked, the focus wobble is active in a reduced raster. Used to optimise the image.
- **Wobble Fast**
Accelerated wobble speed.
- **Beam Blanked**
If ticked, the electron beam is removed from the beam path, the specimen is not scanned any more. This function blanks / unblanks the beam with the scanning coils in the column. The optional Beam Blanker is not controlled by this checkbox.
- **Offset Correction**
Performs an offset correction.
- **Navigation box**
Navigation box for adjustment of the parameters shown on the buttons on the left.
- **Mag/Focus**
Allows setting of the magnification
- **Aperture Align**
Allows setting of the aperture alignment
- **Gun Align**
Allows setting of the gun alignment
- **Stigmation**
Allows setting of the stigmator
- **Beam Offset**
Allows setting of the beam offset.



Vacuum tab

Refer to section 6.1.9.

Gun Vacuum tab (VP instruments only)

Refer to section 6.1.9.

6.1.10.4. Goto Panel

Opens the **Panel Configuration Bar**.

Refer to section 6.2.

6.1.10.5. Camelot Interface

Allows the communication with the Camelot software.

Connect tab

- **Port Number**
Select the port number.
- **Start Listening**
Toggles between *Start Listening* and *Stop Listening*.

**6.1.10.6. Image Capture Mode**

Enables the image capture mode.

6.1.10.7. Capture Now

Saves the frozen image together with the Windows® overlay.

6.1.10.8. Image Capture Frequency

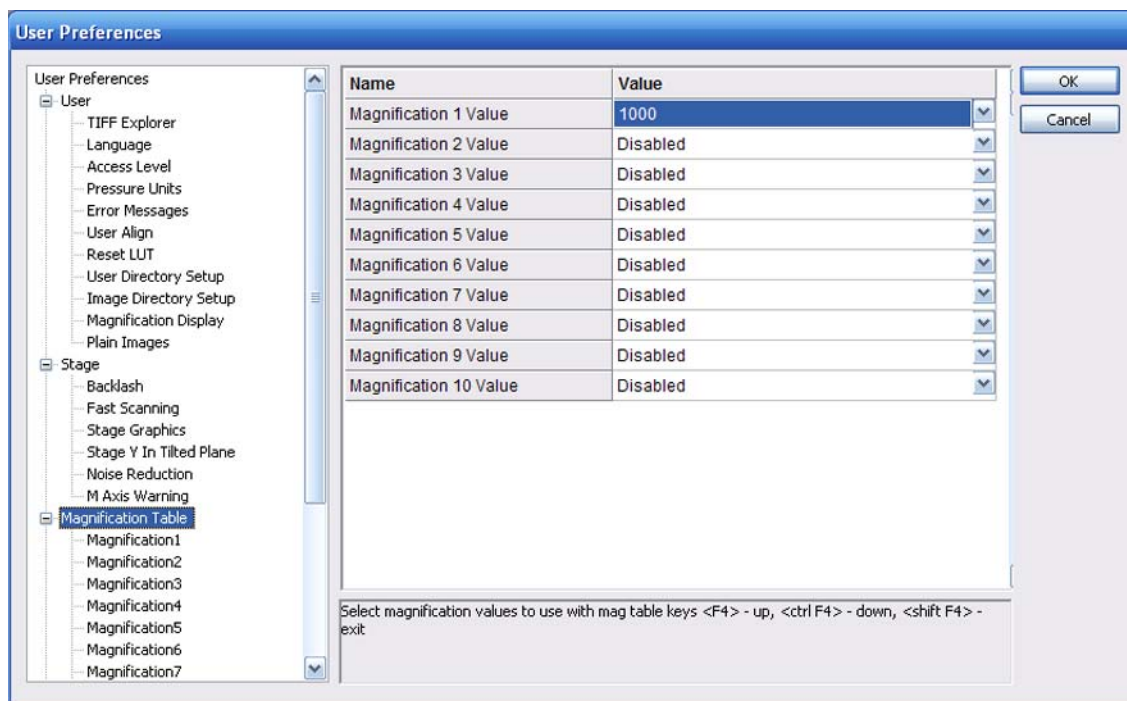
Sets the image update frequency.

6. Summary of software functions

Menus

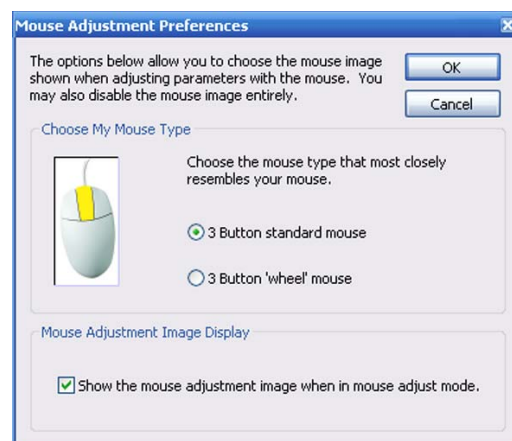
6.1.10.9. User Preferences

Opens the user preferences dialog.



6.1.10.10. Configure Mouse Adjust

- **OK**
Confirms the settings.
- **Cancel**
Aborts the settings.
- **3 Button wheel/standard**
Selects the type of mouse
- **Show the mouse adjustment...**
If ticked, the mouse image is shown.



6.1.10.11. Administrator

Changes to the SmartSEM® Administrator.

6.1.10.12. AVI Capture

Allows you to take a video sequence (AVI file).

AVI toolbar before start



AVI toolbar during record



AVI toolbar during play



Starts record



Plays the saved video sequence



Opens the **AVI File Capture Options** panel



Stops record



Pauses record



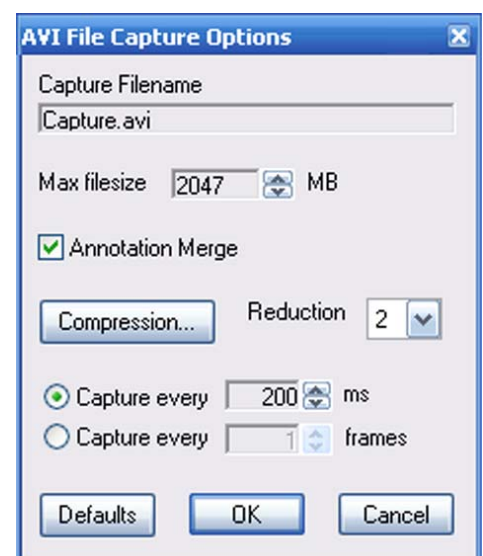
Fast forward during AVI play



Rewinds during AVI play

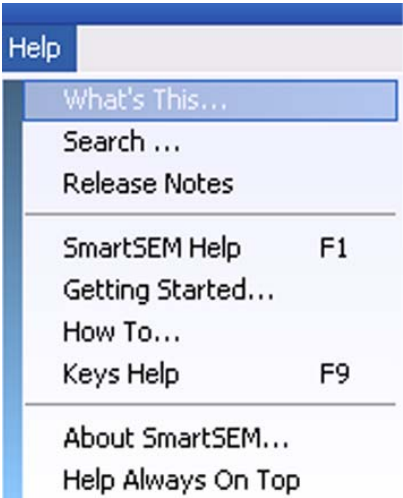
6.1.10.13. AVI Options

- **Capture Filename**
Sets the file name.
- **Max file size**
Sets the maximum size of the file.
- **Annotation merge**
If ticked, the annotations will be recorded in the AVI file.
- **Compression**
Selects the reduction factor.
- **Defaults**
- **OK**
Confirms the settings.
- **Cancel**
Aborts the settings.



6.1.11. Menu Help

The menu **Help** leads to a multitude of help texts and functions.



6.1.11.1. What's This

Activates the context-sensitive help.
The mouse cursor is equipped with a questions mark and can be moved to a point of interest on the screen.
Left-clicking indicates the appropriate help text.

6.1.11.2. Search

Opens the search function.

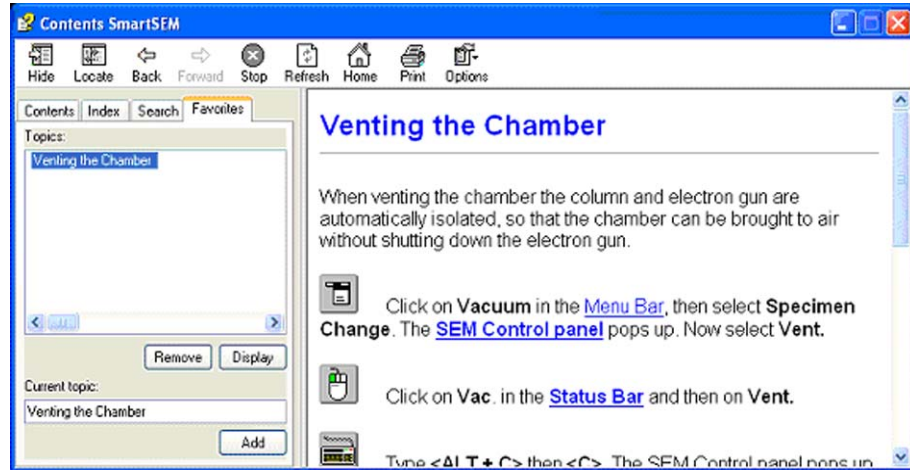
6.1.11.3. Release Notes

Shows a list of documents that contain information on software version history, such as new functions, bug fixes and special features.

6.1.11.4. SmartSEM Help

Leads to a range of help topics.

Comprises the tabs **Contents**, **Index**, **Search**, and **Favorites**. Favorites can be added by clicking on the **Add** button.



6.1.11.5. Getting Started

Opens a step-by-step guide for the first steps of operation.

6.1.11.6. How To

Opens a a step-by-step guide for frequently used operation sequences.

6.1.11.7. Keys help

Shows a list of the shortcuts (key combinations) for the operation of SmartSEM®.

6.1.11.8. About SmartSEM

Shows identification data of the installed SmartSEM® version.

6.1.11.9. Help Always On Top

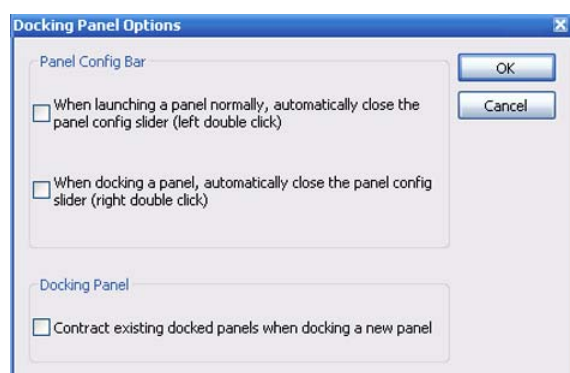
Brings help texts to the fore.

6.2. Panels on the Panel Configuration Bar

To access the **Panel Configuration Bar**, select **Tools/Goto Panel** from the menu.
Alternatively, click the arrow button at the right side of the image area.

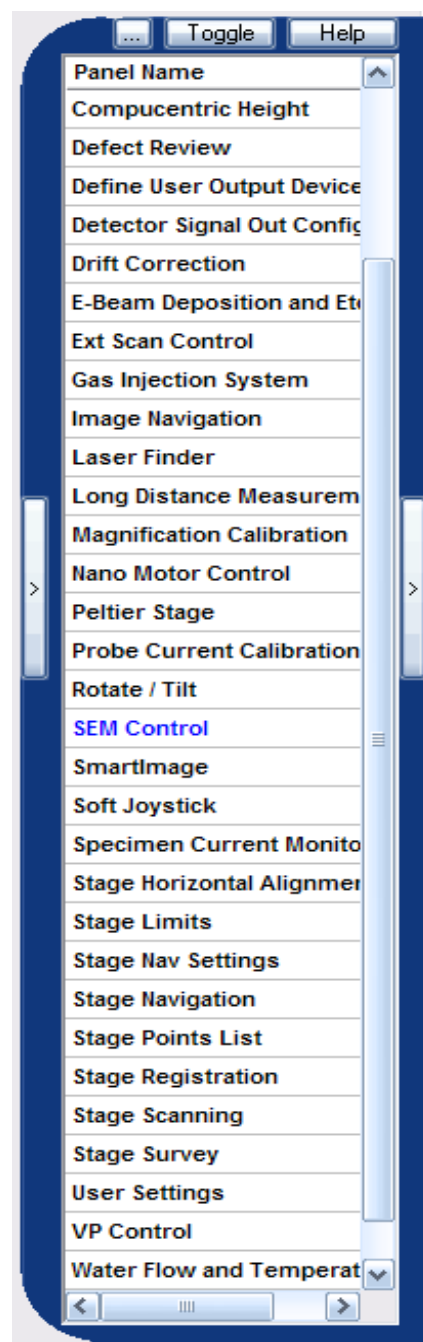
A list of panel opens.

- ...
Opens the **Docking Panel Options** dialog.



- **Toggle**
Shows/hides the docking panel.
- **Help**
Calls the help function.
- >
Hides the Panel Configuration Bar.

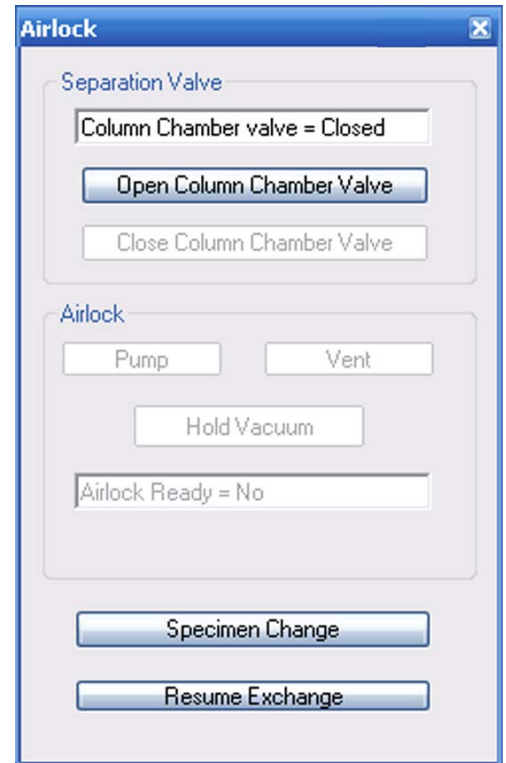
To select a panel, double-click the panel name.



6.2.1. Airlock (optional)

Airlocks are used to reduce the possible contamination of the specimen chamber.

- **Column Chamber valve =**
Indicates the status of the column chamber valve, which separates gun area and specimen chamber
- **Open Column Chamber valve/Close Column Chamber valve**
Opens/Closes the column chamber valve if EHT is switched off
- **Pump/Vent**
Starts pumping/venting procedure the airlock
- **Hold Vacuum**
Pumps of the specimen chamber are switched off, but the airlock is not vented. Thus, the vacuum in the transfer room is preserved.
- **Airlock Ready=**
Indicates status of the airlock
- **Specimen Change/Resume Exchange**
Activates pre-defined macros to automate airlock procedure



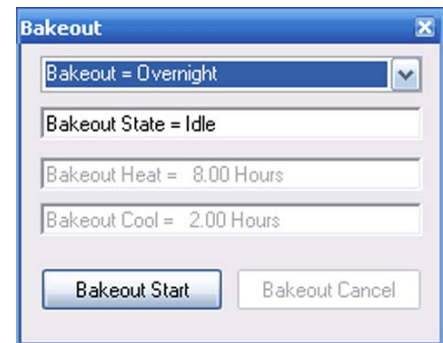
6.2.2. Bakeout

Requires the *Supervisor* privilege.

CAUTION

To prevent parts of the SEM/FESEM from being damaged, refer to the detailed instructions in the instruction manual of the SEM/FESEM before starting the bakeout procedure.

- **Bakeout**
Selects the bakeout duration.
Quick: 2 h heating / 1 h cooling
Overnight: 8 h heating / 2 h cooling
Weekend: 40 h heating / 3 h cooling
User: To be defined by the operator.
- **Bakeout State =**
Indicates the current state.
Idle/Heating/Cooling
- **Bakeout Heat=**
Indicates the heating period set.
- **Bakeout Cool**
Indicates the cooling period set.
- **Bakeout Start**
Starts the bakeout procedure.
- **Bakeout Cancel**
Aborts the bakeout procedure.



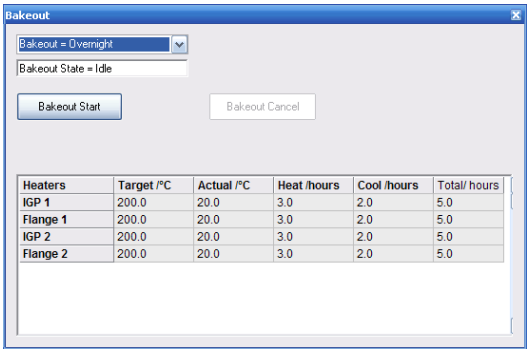
6.2.3. Bakeout (MERLIN® only)

Requires the *Supervisor* privilege.

CAUTION

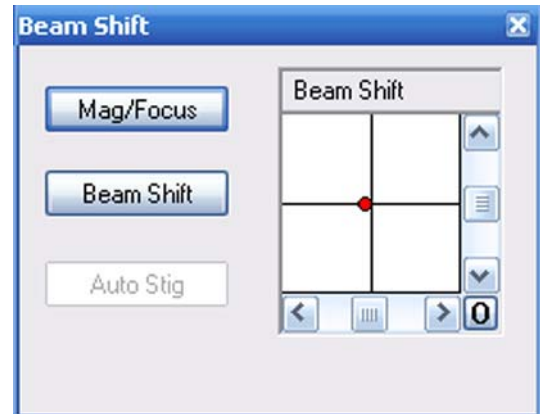
To prevent parts of the SEM/FESEM from being damaged, refer to the detailed instructions in the instruction manual of the SEM/FESEM before starting the bakeout procedure.

- **Bakeout**
Selects the bakeout duration.
Quick: 2 h heating / 1 h cooling
Overnight: 8 h heating / 2 h cooling
Weekend: 40 h heating / 3 h cooling
User: To be defined by the operator.
- **Bakeout State =**
Indicates the current state.
Idle/Heating/Cooling
- **Target /°C**
Displays the target temperature.
- **Actual /°C**
Displays the current temperature.
- **Heat /hours**
Displays the selected heating duration in hours.
- **Cool /hours**
Displays the selected cooling duration in hours.
- **Total /hours**
Displays the total bakeout duration including heating and cooling.
- **Bakeout Start**
Starts the bakeout procedure.
- **Bakeout Cancel**
Aborts the bakeout procedure.



6.2.4. Beam Shift

- **Mag/Focus**
Changes to magnification and focus setting.
- **Beam Shift**
Activates the beam shift function.
Assigns beam shift X and Y to the left mouse button.
- **Beam Shift** navigation box
Changes the position of the specimen by shifting the beam.



6.2.5. BSD Control (optional)

Allows control of detectors with four diode quadrants such as AsB™ detector and 4QBSD.

- **Quadrants**
Symbolise the four quadrants
Normal (+)
Inverted (-)
Disabled
- **BSD Gain**
Selects the gain range.
- **BSD:COMPO**
Activates compositional mode (all quadrants are in normal mode)
- **BSD:TOPO**
Activates topography mode.
- **Apply**
Applies the changes
- **BSD: Set TOPO**
Changes the settings for TOPO.
- **BSD Auto range**
If ticked, the auto range function is activated.

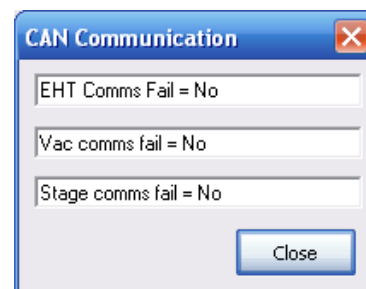


6.2.6. CAN Communication (MERLIN® only)

Displays the status of the Controller Area Network (CAN) communication for EHT, vacuum and stage.

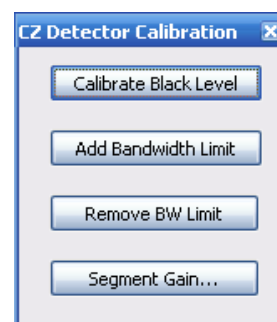
This dialog is only used to display the communication states of the subsystems for diagnostic purposes.

- **EHT Comms Fail**
Indicates if the CAN communication with EHT unit has failed.
- **Vac comms fail**
Indicates if the CAN communication with the Vac Board has failed.
- **Stage comms fail**
Indicates if the CAN communication with the Stage Board has failed.



6.2.7. CZ Detector Calibration (optional)

Requires setting *Service* under **Tools/User Preferences/User Access Level**.



6.2.8. Calibrate Stage Centre

- **Centre: Pos X**
Indicates the last value for X.
- **Centre: Pos Y**
Indicates the last value for Y.
- **OK**
Confirms the settings.
- **Cancel**
Aborts the settings.
- **Next**
Leads to the next step of the calibration procedure

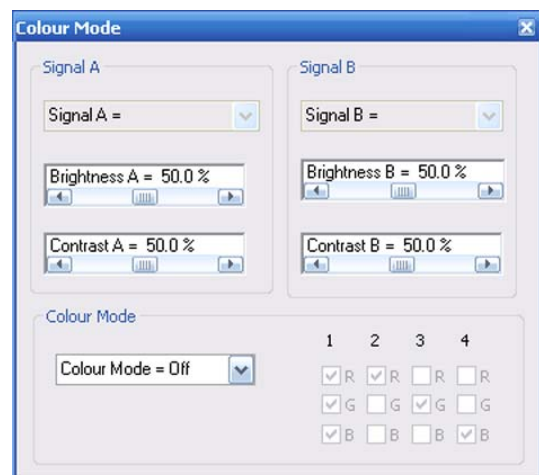


6.2.9. Calibrate Stigmation

This dialog should only be used by authorised ZEISS service representatives.

6.2.10. Colour Mode (licence: Colour Mode)

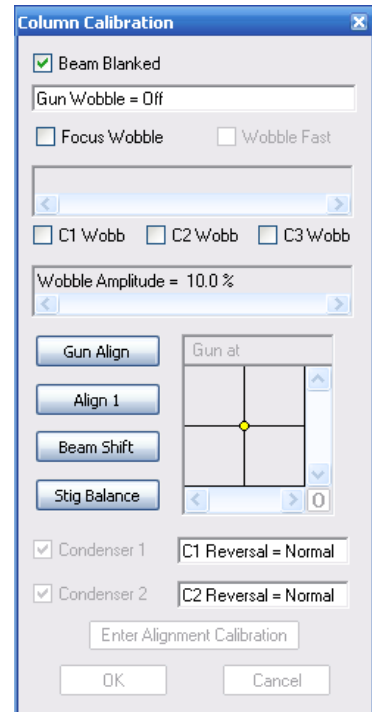
- **Brightness A**
Sets brightness of signal A
- **Contrast A**
Sets contrast of signal A
- **Colour Mode**
Select colour mode
- **Brightness B**
Sets brightness of signal B
- **Contrast B**
Sets contrast of signal B



6.2.11. Column Calibration

Requires *Service* setting under **Tools/User Preferences/User Access Level**

Follow the instructions in the panel.



6.2.12. Compucentric Height (licence COMPU)

This dialog allows you to measure the compucentric height. (Refer to the SmartSEM® help for a detailed description)

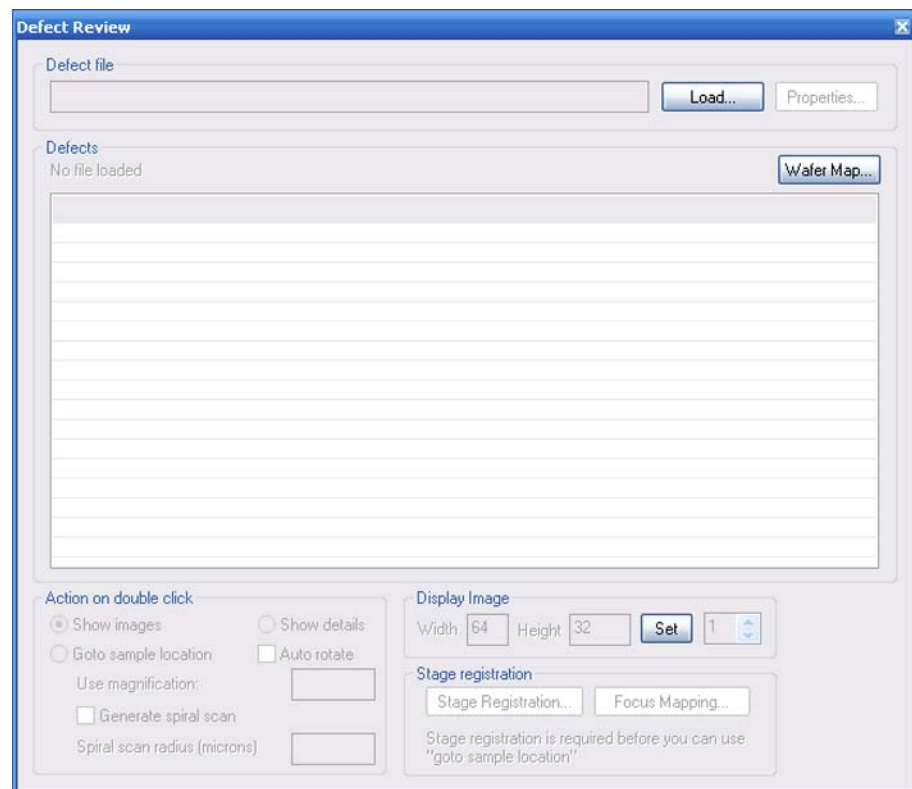


The 'Compucentric Height' dialog box is divided into three main sections:

- 1) Centre a feature then press Read**: Contains a 'Read' button and an unchecked 'Stage Backlash' checkbox.
- 2) Tilt the stage**: Includes a 'Tilt To' spinner set to 8, a 'Nudge size' spinner set to 0.05, and buttons for 'Tilt', 'Go Back', 'Up', 'Down', and 'Stage stop'.
- 3) Centre it again, and press calculate**: Displays 'Compu. Height = 0.000 mm' and 'Compu. Tilt Error = 0.2664' in text boxes. Below these is a horizontal bar with left and right arrow buttons. At the bottom of this section are 'Calculate' and 'Estimate from WD' buttons.

At the very bottom of the dialog are three buttons: 'Load...', 'OK', and 'Cancel'.

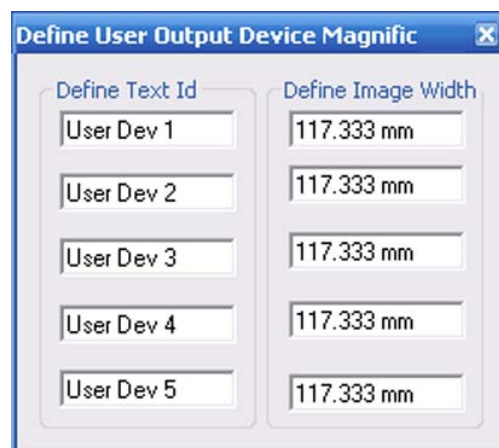
6.2.13. Defect Review (licence DEFECT REVIEW)



- **Load**
Loads a defect file (*.rff).
- **Properties**
Shows properties of the selected defect file.
- **Wafer map**
Shows a two dimensional view of the wafer.

6.2.14. Define User Output Device Magnification

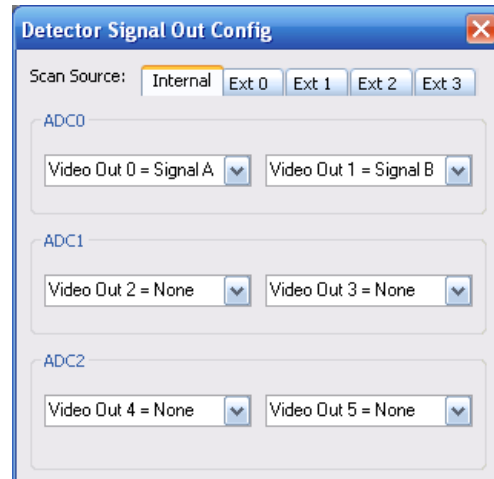
- **Define Text ID**
Shows the name
- **Define Image Width**
Indicates the width



6.2.15. Detector Signal Out Configuration (MERLIN® only)

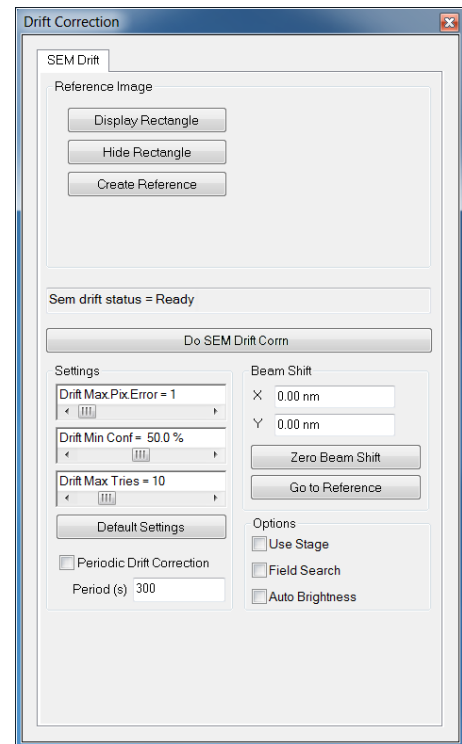
This dialog is used to configure external detector outputs on the system. There are two detector outputs on each detector board fitted. Each may be configured as Signal A, Signal B or a specified detector name e.g. Inlens. A separate configuration can be selected for internal scan and each of the 4 external scan inputs. A detector signal can only be assigned to one video out.

- **Scan Source**
Allows you to select the scan source.
Internal
Ext 0
Ext 1
Ext 2
Ext 3
- **Video Out 0-5**
Allows you to select the signal depending on the selection in the other Video Out drop down lists.



6.2.16. Drift Correction

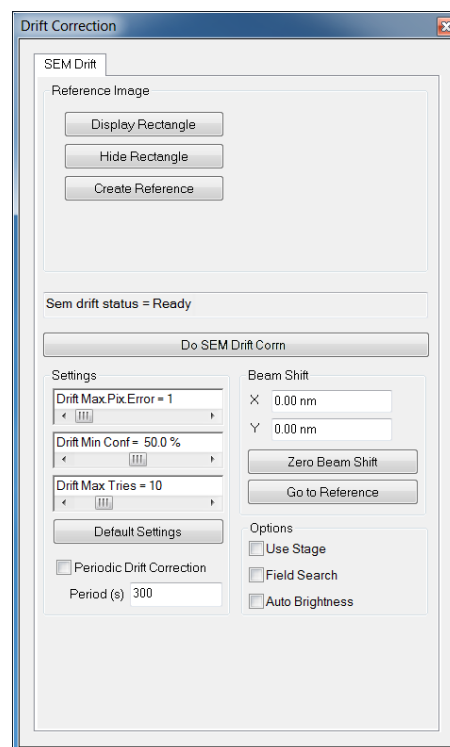
- **Reference Image**
 - **Display Rectangle**
Displays a movable frame. The image range inside the frame defines the reference image for the drift correction.
 - **Hide Rectangle**
Hides the movable frame.
 - **Create Reference**
Acquires a reference based on the current settings.
- **SEM drift status =:**
 - **No reference**
Reference has not yet been set.
 - **Busy**
Busy creating reference.
 - **Ready**
Reference has been created.
Do SEM Drift Corr can be clicked.
- **Do SEM Drift Corr**
Starts the SEM drift correction.
- **Settings**
 - **Drift Max. Pix.Error =**
This determines how close consecutive drift correction attempts should be to each other if they are to be considered as the same.
 - **Drift Min Conf =**
As the drift correction algorithm uses a statistical image matching algorithm there is an element of uncertainty over whether the drift values it returns are correct. The certainty level determines the minimum certainty that the drift values are correct required to use those values to adjust the drift. Generally this should be a bit lower than the values returned during the test drift correction on the Take reference image page. A minimum of 25% is allowed. Values of 50% are quite reasonable and although you can enter up to 100% it is unlikely that an image would match with that strength of correlation. Note: The percentages are measures of correlation, not of probability; for example a certainty of 50% does not mean that for every 10 matches returned with this value 5 are wrong, in fact it is quite likely that they are all correct.
 - **Drift Max Tries =**
When the drift correction algorithm is being used it takes the current image more than once and sees if the drift values returned are the same within certain limits on consecutive attempts this helps prevent mistakes. Max attempts sets how many times it should try to get a match before it decides that the drift correction is not working. If you set this to 0 then no drift correction will be used. If more than Max Attempts are required to find a matching image then the system assumes that the drift correction is not working and ignores it until the next drift interval.
 - **Default Settings**
Restores the default settings.
 - **Periodic Drift Correction Period(s)**
Allows you to schedule a periodic drift correction. A drift correction will be carried out every-time the set timespan in seconds has expired. This can only be used after a reference has been created.



6. Summary of software functions

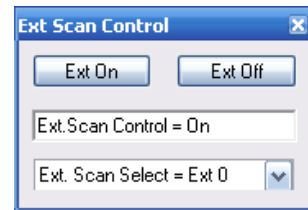
Panels on the Panel Configuration Bar

- **Beam Shift**
 - **X/Y**
Displays the current beam shift in X/Y.
 - **Zero Beam Shift**
Sets the X/Y beam shift to zero.
 - **Go to Reference**
Moves the specimen stage to the reference point.
- **Options**
 - **Use Stage**
If activated, only the stage is used for drift correction.
 - **Field Search**
If activated, the reference point is searched in a larger field outside the rectangle.
Recommended in case of stronger drift .
 - **Auto Brightness**
If activated, the Auto Brightness is activated to optimise image recognition.



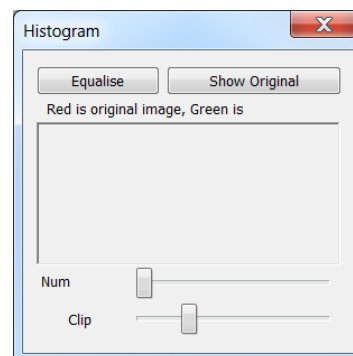
6.2.17. Ext Scan Control

- **Ext On**
Switches external scan control on
- **Ext Off**
Switches external scan control off
- **Ext. Scan Select**
Allows you to set the Ext Scan value



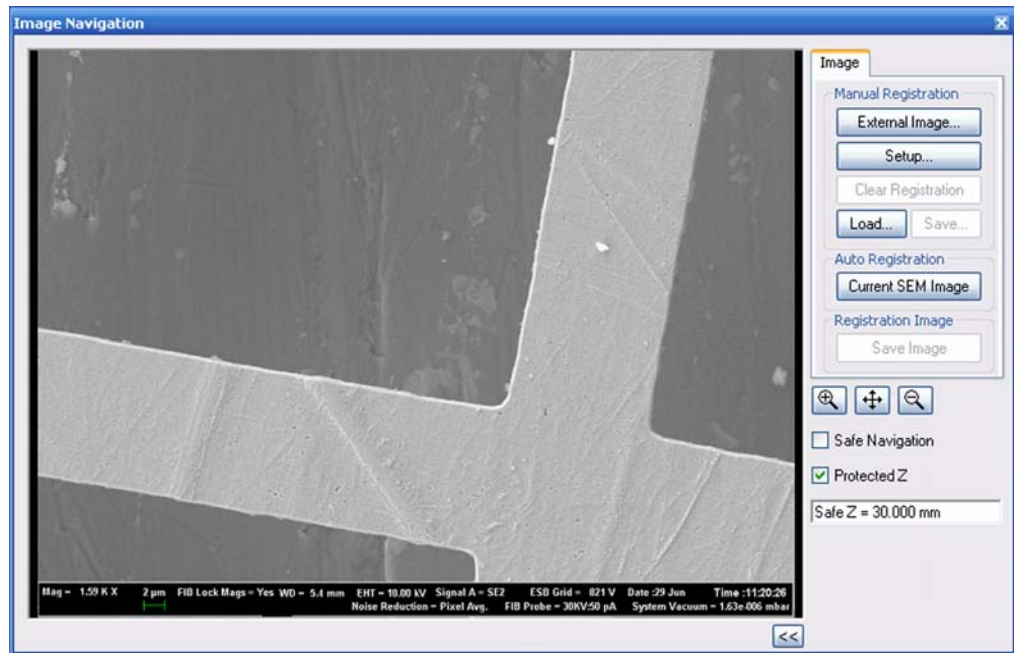
6.2.18. Histogram

- **Equalise**
Displays the equalised image in the image area.
- **Show Original**
Displays the original image in the image area.
- **Num Regions:**
CLAHE computes several histograms, each corresponding to a distinct region of the image. The **Num Regions** slider sets the number of regions for the histograms.
- **Clip Limit:**
Sets the limit value for the clipping of image content.
All information above this limit value is clipped and therefore not visible in the equalised image.



6.2.19. Image Navigation

Allows you to load an image from a variety of sources and then set-up a stage registration between the image and the stage. This will enable to navigate the stage by clicking on the image. There are two ways to register an image: manually (Manual Registration) or automatically (Auto Registration).



CAUTION

Danger of damaging stage or stubscope

When using the stubscope, the stage will often be at high Z values.

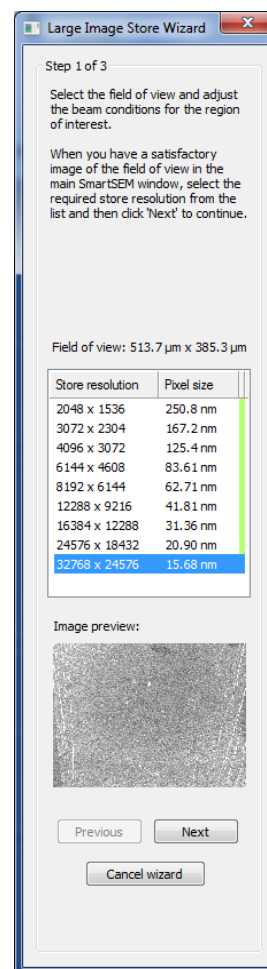
Tick the 'Protected Z' checkbox and set an appropriate value for Safe Z whenever moving between electron axis and stubscope axis.

- **External Image**
Loads an externally generated image from a file.
- **Setup**
Starts the Stage Registration wizard.
- **Clear registration**
Cancels the registration.
- **Load**
Loads an image.
- **Save**
Saves an image.
- **Current SEM Image**
Loads the current SEM image.

6.2.20. Large Image Store Wizard

The Large Image Store Wizard guides you through a process with three main steps to obtain images with high pixel resolution.

- **Field of view:**
Displays the currently selected field of view in μm .
- **Store resolution:**
Allows you to select a store resolution and the corresponding pixel size.
- **Image preview:**
Displays a preview of the currently selected ROI.
- **Next** (active if resolution has been selected):
Continues with the next step.
- **Previous** (active in steps 2 and 3):
selects the previous step.
- **Cancel wizard:**
Closes the Large Image Store Wizard.



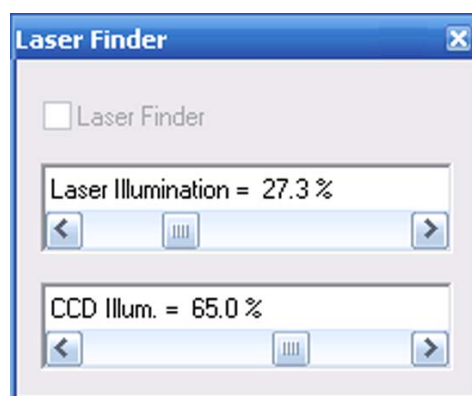
6.2.21. Laser Finder (optional)

The Laser Finder is an accessory option designed to ease finding the area of interest on the specimen surface.

CAUTION

To prevent parts of the SEM/FESEM from being damaged, refer to the detailed instructions in the Instruction Manual Laser Finder before using the Laser Finder.

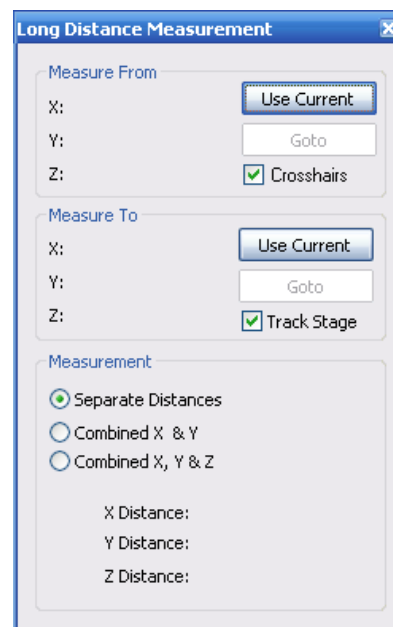
- **Laser Finder**
If ticked, the Laser beam is active.
- **Laser Illumination**
Changes brightness of laser spot.
- **CCD Illum.**
Changes brightness of infrared light for CCD TV camera detection.



6.2.22. Long Distance Measurement

This allows you to measure the physical distance between two points on the specimen, which cannot be seen in a single field of view so cannot be measured using annotation.

(Refer to the SmartSEM® help for a detailed description).



6.2.23. Magnification Calibration

Requires *Service* or *Expert* setting under **Tools/User Preferences/User Access Level**.

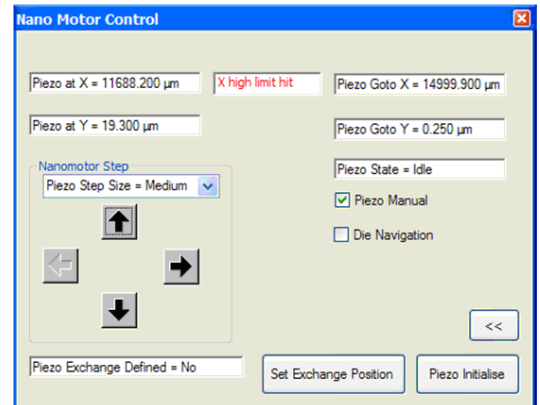
- **Calibration mode**
Selects the calibration mode
Cal Mode Off
Cal Stig Balance
Cal Output Dev
Cal User Magnification



6.2.24. Nano Motor Control

This window refers to the optionally available Piezo Substage for AURIGA®. For detailed information on the Piezo Substage, refer to the Instruction Manual Piezo Substage.

- **Piezo at X**
Displays the current position of the Piezo stage in X direction.
- **Piezo at Y**
Displays the current position of the Piezo stage in Y direction.
- **X/Y high/low limit hit**
If a X/Y high/low limit is reached, a message box is displayed in red. Otherwise the box is hidden.
- **Nanomotor Step**
This function allows you to select the step size from a drop down menu.
Coarse
Medium
Fine



The arrow buttons can be used to move the stage in single steps of the defined size, or to continuously move the Piezo stage when pressing down one of the arrow buttons. To be able to move the Piezo stage with the arrow buttons, the **Piezo Manual** checkbox has to be ticked.

- **Piezo Exchange Defined**
Indicates whether a specimen exchange position is defined for the Piezo stage or not. An exchange position can be set by clicking on **Set Exchange Position**.

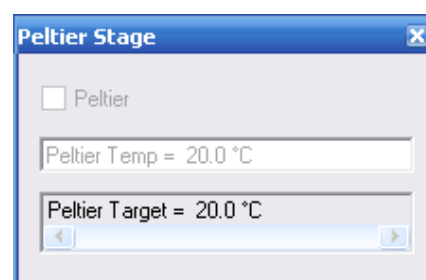
6. Summary of software functions

Panels on the Panel Configuration Bar

- **Piezo Goto X / Y**
Allows you to enter predefined coordinates in a separate window.
When clicking on **OK**, the Piezo stage will move to the entered coordinates.
- **Piezo State**
Indicates the current state of the Piezo stage
Idle: stage is standing still
Moving: stage is moving
Uninitialised: stage has not been initialised yet
- **Piezo Manual**
Activates/deactivates the arrow buttons.
- **Die Navigation**
- **Fold in / out icon**
Folds in / out the lower part of the window.
- **Set Exchange Position**
Allows you to set a specimen exchange position for the Piezo stage.
- **Piezo Initialise**
Initialises the Piezo stage

6.2.25. Peltier Stage

- **Peltier**
Indicates if a Peltier cool stage is fitted and the Peltier Fitted checkbox in the SmartSEM[®] Administrator is ticked.
- **Peltier Temp**
Indicates the current Peltier temperature if a Peltier cool stage is fitted and the Peltier Fitted checkbox in the SmartSEM[®] Administrator is ticked.
- **Peltier Target**
Indicates the Peltier target temperature.

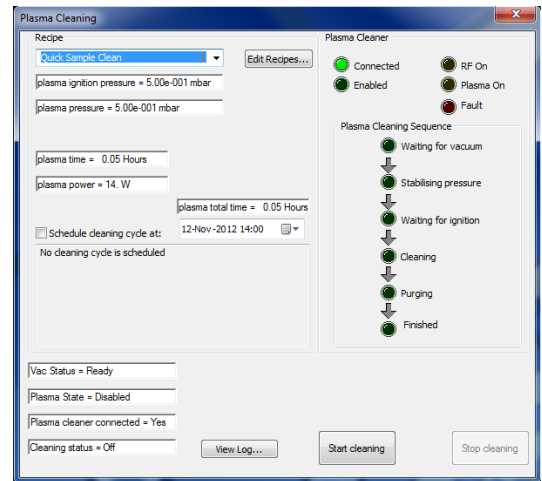


6.2.26. Plasma Cleaning

6.2.26.1. Main window

Recipe

- **Recipe drop-down list**
Opens a selection of available recipes.
- **Edit Recipes...**
Opens the **Cleaning Recipes** list.
- **Recipe values**
Shows the following values of the currently selected recipe:
 - Plasma ignition pressure
 - Plasma pressure
 - Plasma time
 - Plasma power
 - Plasma total time
- **Schedule cleaning cycle at:**
If activated, a cleaning cycle will be carried out at the currently selected time and date with the active recipe.
- **Date and time field**
Allows you to select a time and date for a scheduled plasma cleaning cycle.
- **Status message area**
Shows status and error messages.
- **Vac Status**
Displays the currently present vacuum status.
- **Plasma State**
Displays the currently present plasma status.
- **Plasma cleaner connected**
Shows if a Plasma Cleaner is connected.
- **Cleaning status**
Shows if a plasma cleaning cycle is running.



Plasma Cleaner

- **Connected**
If active, the Plasma Cleaner controller hardware is switched on and connected.
- **Enabled**
If active, a plasma cleaning process is running. This LED is also present on the Plasma Cleaner controller hardware (**ENABLE/DISABLE**).
- **RF On**
If active, a plasma cleaning cycle is running and the radio frequency is on, which is necessary for the plasma to start. This LED is also present on the Plasma Cleaner controller hardware (**RF ON**).
- **Plasma On**
If active, a plasma cleaning cycle is running and the plasma has ignited. This LED is also present on the Plasma Cleaner controller hardware (**PLASMA ON**).
- **Fault**
If active, the Plasma Cleaner is in error state.
- **Plasma Cleaning Sequence**
Displays the steps of the currently running plasma cleaning cycle and their completion status.
- **View Log...**

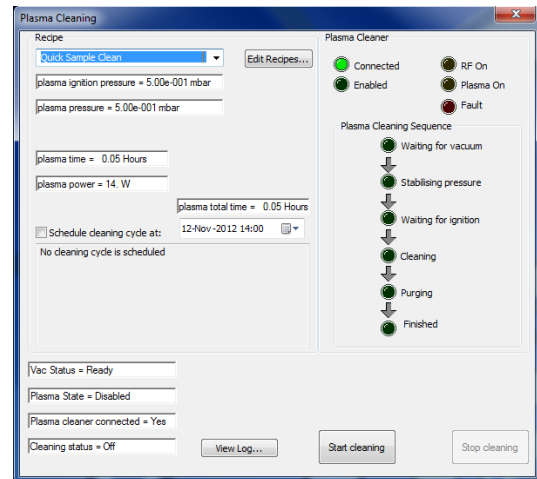
Opens the Log file.

Start cleaning

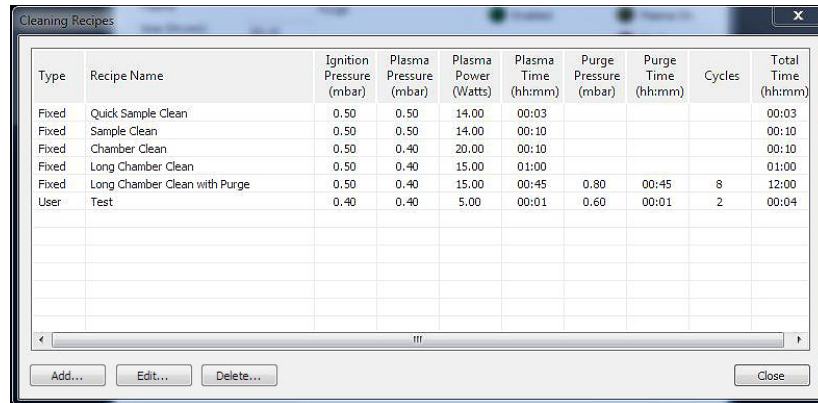
Starts a plasma cleaning cycle using the current settings.

Stop cleaning

Stops the currently running plasma cleaning cycle and pumps the chamber.



6.2.26.2. Cleaning Recipes list

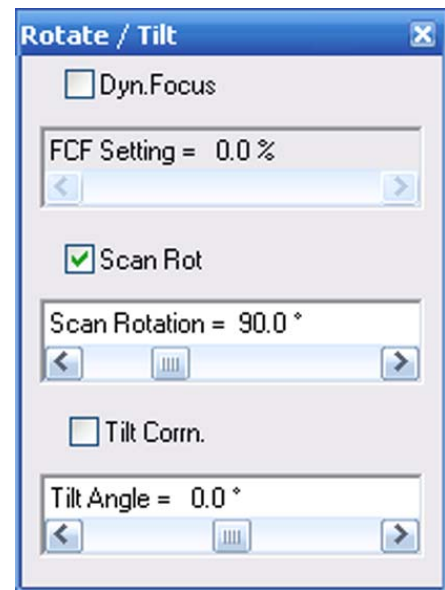


Type	Recipe Name	Ignition Pressure (mbar)	Plasma Pressure (mbar)	Plasma Power (Watts)	Plasma Time (hh:mm)	Purge Pressure (mbar)	Purge Time (hh:mm)	Cycles	Total Time (hh:mm)
Fixed	Quick Sample Clean	0.50	0.50	14.00	00:03				00:03
Fixed	Sample Clean	0.50	0.50	14.00	00:10				00:10
Fixed	Chamber Clean	0.50	0.40	20.00	00:10				00:10
Fixed	Long Chamber Clean	0.50	0.40	15.00	01:00				01:00
Fixed	Long Chamber Clean with Purge	0.50	0.40	15.00	00:45	0.80	00:45	8	12:00
User	Test	0.40	0.40	5.00	00:01	0.60	00:01	2	00:04

- **Type**
Displays the type of recipe:
- **Fixed**: Not editable and not deletable
- **User**: Editable and deletable
- **Recipe Name**
Displays the name of the recipe.
- **Ignition Pressure (mbar)**
Displays the plasma ignition pressure.
- **Plasma Pressure (mbar)**
Displays the plasma operating pressure.
- **Plasma Power (Watts)**
Displays the plasma operating power. Up to 20 Watts can be selected.
- **Plasma Time (hh:mm)**
Displays the plasma time.
For recipes without nitrogen purge, **Plasma Time** equals **Total Time**.
- **Purge Pressure (mbar)**
Displays the nitrogen purge pressure.
- **Purge Time (hh:mm)**
Displays the timespan for each nitrogen purge.
- **Cycles**
Shows the number of cycles. One cycle consists of plasma cleaning and a nitrogen purge.
This value is only present if the recipe includes one or more nitrogen purges.
- **Total Time (hh:mm)**
Displays the total time required to run the recipe. It is determined by the values **Plasma Time**, **Purge Time** and **Cycles**.
- **Add...**
Opens a dialog that allows you to create a new recipe.
- **Edit...**
Opens a dialog that allows you to edit the currently selected recipe. This is only available for 'User' type recipes.
- **Delete...**
Opens a dialog that allows you to delete the currently selected recipe. This is only available for 'User' type recipes.
- **Close...**
Closes the **Cleaning Recipes** list.

6.2.27. Rotate/Tilt

- **Scan Rot**
If ticked, the scan rotation is active.
Requires the licence SCANROT.
- **Scan Rotation**
Allows setting of the scan rotation angle.
- **Tilt Corr.**
If ticked, the tilt correction is active.
- **Tilt Angle**
Allows adjustment of the tilt angle.



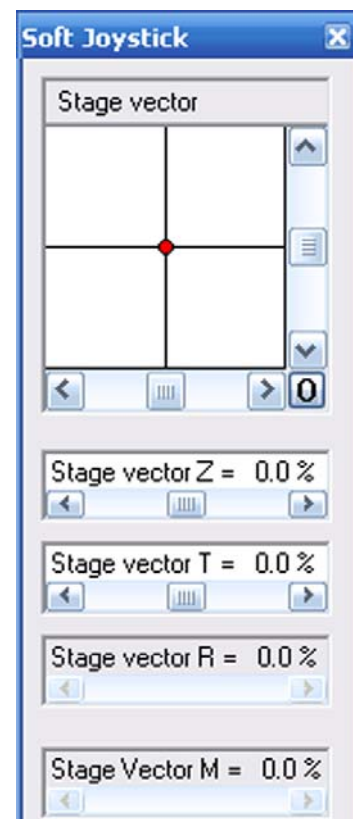
6.2.28. SEM Controls

Refer to section 6.1.10.3.

6.2.29. Soft Joystick

The **Soft Joystick** window opens.

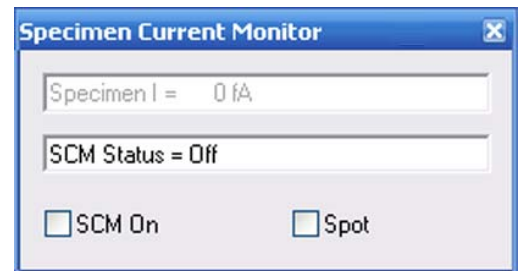
- **Stage vector** navigation box
Moves the X- and Y-axes.
- **Stage vector Z**
Moves the Z-axis.
- **Stage vector T**
Move the T-axis.
- **Stage vector R**
Rotates the stage.
- **Stage vector M**
Moves the M-axis.



6.2.30. Specimen Current Monitor

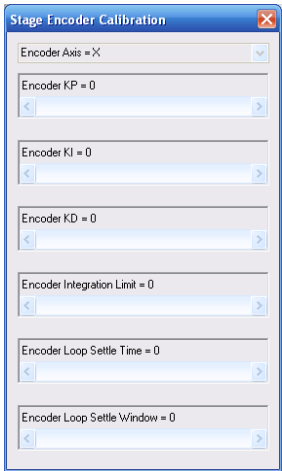
The **Specimen Current Monitor** dialog opens.

- **SCM On**
If ticked, the specimen current monitor is switched on.
- **Spot**
If ticked, spot mode is active, i.e. the electron beam is positioned on a particular spot on the specimen surface.
Requires the licence SPOT.



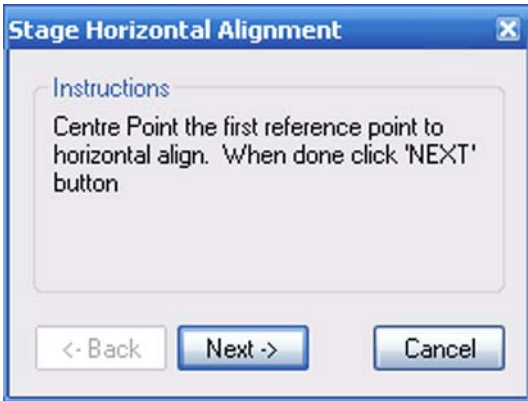
6.2.31. Stage Encoder Calibration

Requires setting *Service* under **Tools/User Preferences/User Access Level**.



6.2.32. Stage Horizontal Alignment

Follow the instructions.

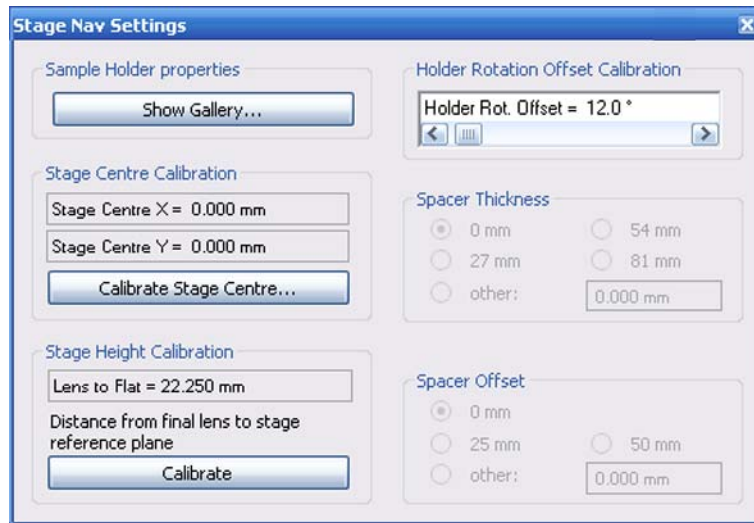


6.2.33. Stage Limits

Allows entering the stage limits.



6.2.34. Stage Nav Settings



- **Show Gallery**
Shows the Sample Holder Gallery
- **Calibrate Stage Centre**
Calibrates the centre of the stage.
- **Calibrate**
Calibrates the height of the stage.

6.2.35. Stage Navigation

Refer to section 6.1.8.9.

6.2.36. Stage Points List

- **Save/Load**
 - **Load**

This function loads the coordinate list from a previously saved file. The current list of position data is deleted.
 - **Save**

Saves the active list to the user directory. The extension is *.XYZ.
- **On Goto**

Opens a drop-down list with these entries:

 - **Set Magnification**

If activated, the magnification of a list entry will be applied when the respective entry is selected. If deactivated, the magnification will remain at the current setting.
 - **Set Working Distance**

If activated, the working distance will of a list entry will be applied when the respective entry is selected. If deactivated, the magnification will remain at the current setting.
 - **Move XY Only**

If activated, the stage will only move in X and Y when a list entry is selected.
- **Add**

Opens the **Label Request** dialog that allows you to add a new stage position with a custom label.
- **Del**

Allows you to delete a stage position from the list. Only available if a list entry has been selected.
- **Edit**

Allows you to edit a stage position on the list. Only available if a list entry has been selected.
- **Undo Stage Goto**

Cancels the stage movement.
- **Stage stop**

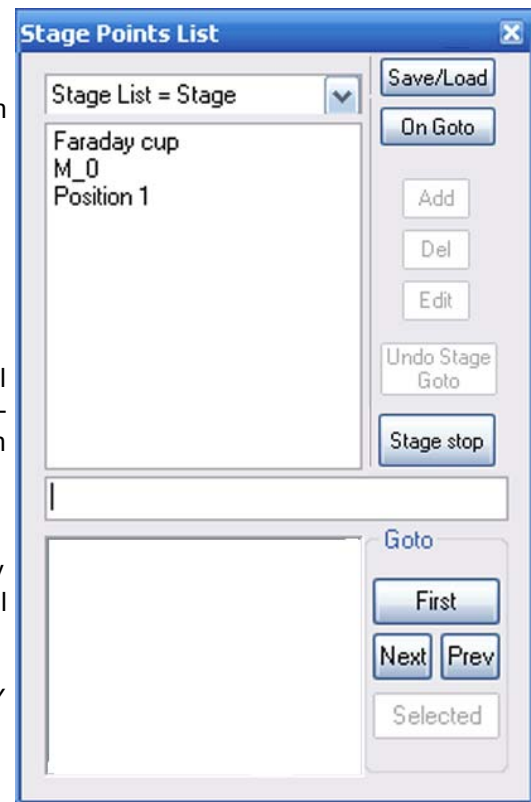
Stops the movement.
- **Goto**
 - **First**

Moves the stage to the position defined by the first entry in the Stage Points List.
 - **Next**

Moves the stage the position defined by the next entry in the Stage Points List.
 - **Prev**

Moves the stage to the position defined by the previous entry in the Stage Points List.
 - **Selected**

Moves the stage to the position defined by the highlighted entry in the Stage Points List.



6.2.37. Stage Registration (licence STAGEREG)

Allows you to define a user specific 2D coordinate system.



6.2.38. Stage Scanning (licence STAGESCAN)

Allows you to scan an exactly defined series of regularly distributed image fields.

- **Setup Wizard**
Starts the wizard



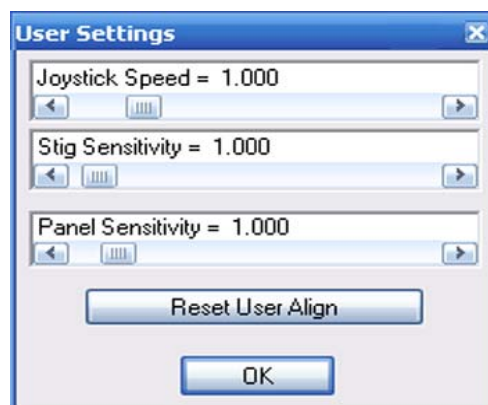
6.2.39. Stage Survey (licence SURVEY)

Survey Mode provides the facility to enter a defined state Survey Mode State. Typically a long working distance and low magnification to achieve a wide field of view in which the specimen may be reviewed for features of interest. (Refer to the SmartSEM[®] help for a detailed description)



6.2.40. User Settings

- **Joystick speed**
Changes the speed of the joystick
- **Stig Sensitivity**
Changes the sensitivity of the stigmator
- **Panel Sensitivity**
Changes the sensitivity of the control panel encoders such as Focus
- **Reset User Align**
Resets the user-specific user alignment table
- **OK**
Confirms the settings



6.2.41. VP Control (VP instruments only)

- **VP Target**
Sets the desired pressure.
- **Go To HV/Go To VP**
Toggles between high vacuum mode (HV) and variable pressure mode (VP).
- **Collector Bias**
Sets the collector bias of the VPSE detector.



6.2.42. Water Flow/Temperature

- **Stage Too Hot**
Indicates the temperature status.
- **EO Too Hot**
Indicates the temperature status.
- **Water OK**
Indicates the water status.
- **EO Temp**
Only in case of an error: Indicates the current temperature of the EO Board.
- **EO Temp Limit**
Only in case of an error: Indicates the limit temperature of the EO Board.
- **SEM Overheat**
Indicates the status.
- **Reset Overheat**
Quits the error message.
- **Close**
Closes the Water Flow/Temperature dialog.



The image shows a software dialog box titled "Water Flow/Temperature". It contains several status indicators, each in a text box: "Stage Too Hot = No", "EO Too Hot = No", "Water OK = Yes", "EO Temp = 0.0 °C", "EO Temp Limit = 35.0 °C", and "SEM Overheat = OK". At the bottom of the dialog, there are two buttons: "Reset Overheat" and "Close".

6.2.43. Water Flow/Temperature (MERLIN® only)

- **Stage Too Hot**
Indicates the temperature status.

EO

This section covers all water supply of the EO board, which is divided in the EO dynamic and the EO static.

- **EO dynamic flow**
Indicates the status of the EO dynamic water flow.
- **EO dynamic temperature**
Indicates the status of the EO dynamic water temperature.
- **EO static water flow**
Indicates the status of the EO static board water flow.
- **EO static water temperature**
Indicates the status of the EO static water temperature.

Water Flow

This section covers overall water flow and temperatures

- **Water OK**
Indicates the water flow status.
- **Water flow temperature**
Indicates the water flow temperature.
- **Water return temperature**
Indicates the water return temperature.

Water Temperature Status

This section summarises all water thresholds.

- **Water in high critical**
Indicates if the water in high critical value has been reached.
- **Water in low critical**
Indicates if the water in low critical value has been reached.
- **Water out high critical**
Indicates if the water out high critical value has been reached.
- **Water out low critical**
Indicates if the water out low critical value has been reached.
- **Close**
Closes the Water Flow/Temperature dialog.

Water Flow and Temperature

Stage Too Hot = No

EO

EO dynamic flow = normal

EO dynamic temperature = normal

EO static water flow = normal

EO static water temperature = normal

Water Flow

Water OK = Yes

Water flow temperature = 0.0 °C

Water return temperature = 0.0 °C

Water Temperature Status

water in high critical = No

water in low critical = No

water out high critical = No

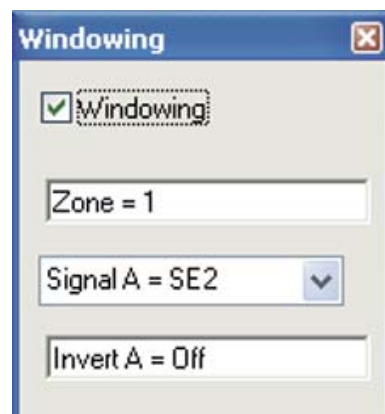
water out low critical = No

Close

6.2.44. Windowing

Windowing allows you to display two different detector signals on the monitor.

- **Windowing**
If ticked, the windowing function is active.
- **Zone =**
Selects the active zone.
Zone 0: outside the reduced raster
Zone 1: inside the reduced raster
- **SignalA =**
Selects the detector signal
- **Invert A = On/Off**
Activates/deactivates the inversion of the signal of the respective zone



6.3. Assignments of toolbar icons (default toolbar)

Icon	Tool tip text	Left mouse button	Middle mouse button
	Restore Conditions/ Load State	Loads the state stored last when the program was ended.	Activates the window loading a stored state (Load State).
	Accelerating Voltage/ Gun Control	Opens the EHT target window to set the acceleration voltage	Calls the Gun tab in the SEM Controls window
	Specimen Change/ Vacuum Control	Ventilates the specimen chamber. Pumps the specimen chamber.	Calls the Gun Vacuum tab in the SEM Controls window.
	VP Control/VP Target	Calls the VP Control panel.	Assigned with the VP Target
	Pix Avg 1/ Cont Avg 2	Pixel averaging at scan speed 2	Continuous frame averaging at scan speed 2
	Pix Avg3/Cont Avg4	Pixel averaging at scan speed 3	Continuous frame averaging at scan speed 4
	Pix Avg6/Cont Avg?	Pixel averaging at scan speed 6	Continuous frame averaging at scan speed 6
	Pix Avg 9/Frame Int 5	Pixel averaging at scan speed 9	Frame averaging at scan speed 5 (image is frozen after scan)
	Frame Int/Frame Int 8	Frame averaging at scan speed 7 (image is frozen after scan)	Frame averaging at scan speed 8 (image is frozen after scan)
	Faster/Slower	Sets a higher scan speed.	Sets a lower scan speed.
	Freeze:Unfreeze/ Scanning	Freezes/unfreezes the image.	Calls Scanning tab in the SEM Controls window
	Normal/Scanning	Normal screen mode (Scan range displayed over the complete monitor). Wobbler is switched off. Mouse button assignment: magnification/focus	Calls Scanning tab in the SEM Controls window

6. Summary of software functions

Assignments of toolbar icons (default toolbar)

Icon	Tool tip text	Left mouse button	Middle mouse button
	Reduced Raster/ Apertures	Switches between reduced scan and normal screen mode.	Calls Aperture tab in the SEM Controls Panel.
	Split Screen/ Detectors	Switches between split screen and normal screen mode.	Calls Detectors tab in the SEM Controls Panel.
	Dual Magnification/ Detectors	Switches between dual magnification and normal screen mode.	Calls Detectors tab in the SEM Controls Panel.
	ChamberScope/ Detector Control	Activates the CCD TV camera. Mouse button assignment: brightness/contrast	Calls Detectors tab in the SEM Controls Panel.
	Stigmation/ Alignment	Activates the reduced raster. Mouse button assignment: StigX, StigY/ Focus	Calls wobbler and activation of reduced scanning.
	Point To Point/ Annotation Text	Inserts a point to point measurement.	Calls text editor.
	Brightness + Contrast/ Toggle ABCC	When AutoBC is deactivated in the detector window, the mouse button assignment is switched to brightness/contrast. When the AutoBC function is activated, the mouse button assignment is switched to GAIN/OFFSET	Switches from AutoBC= ON (mouse button assignment GAIN/ OFFSET) to AutoBC= OFF (mouse button assignment brightness/contrast) and back.
	Toggle INLENS:SE2/ Detector Control	Switches between In-lens and SE2 detector	Calls Detectors tab in the SEM Controls Panel.
	Magnification + Focus/ Auto Focus + Stig	Mouse button assignment: magnification/focus	Calls Auto Focus and Auto Stigmator algorithm.
	Save TIFF/ TIFF Export Dialog	Saving an image as TIFF file with the agreed settings	Calls Export TIFF window.
	Print Image/ Printer Dialog	Prints the image on the default printer.	Calls Print Setup window

6.4. MiniBar icons

Icon	Tool tip text	Function
	Start..	Allows quick access to Pump/Vent as well as EHT On/EHT Off and Gun ON/Off function.
	Recent Panels..	Allows quick access to recently used functions.
	Recipes..	Allows quick access to stored recipes

6.5. Annotation icons

Icon	Tool tip text	Function
	Select Annotation Object(s)	Allows you to select individual annotations.
	EM Mouse Control	Enables the control of EM parameters via mouse.
	Undo Last Edit	Cancels the last step.
	Load Annotation	Loads a user annotation.
	Save Annotation	Saves the annotations as user annotation.
	Delete All Visible Objects	Deletes all visible annotations.
	Export Area Selection	Defines the export area.
	Annotation Text	Adds a text the user can enter.
	EM Parameter	Adds parameters, the user has selected from a list displayed.
	Insert User Bitmap of Metafile	Adds an image, e.g. a logo.
	Annotation Line	Adds a line.
	Annotation Rectangle	Adds a rectangle.

Icon	Tool tip text	Function
	Annotation Ellipse	Adds an ellipse or a circle.
	Sticky Panel	Adds a rectangle to the overlay plane onto which annotation objects can be "stuck". The rectangle can be transparent or filled with a pattern.
	Zone Magnification	Allows you to show the magnification of a selected zone which might be helpful when the magnifications of different zones are not the same.
	Micron Marker	Adds a horizontal bar which indicates the size of an object in the image. Above the bar its length is displayed.
	Fixed Micron Marker	Adds a horizontal bar which indicates the size of an object in the image. The bar represents a fixed dimension.
	Point to Point Measure	Allows you to measure the size of a certain feature.
	Angular Measurement	Allows you to measure an angle between two objects.
	Linewidth Measure	The linewidth measurement facility is a rectangle which may be adjusted in height, width, and angle.
	Radial Measure	The radial measurement facility is a circle which may be adjusted in diameter.
	Width Measurement Cursors	Comprises a related pair of vertical lines. Each line may be adjusted in position.
	Height Measurement Cursors	Comprises a related pair of horizontal lines. Each line may be adjusted in position.
	Moveable Width Cursor	Comprises a vertical measurement bar with variable length and position.

6. Summary of software functions

Annotation icons

Icon	Tool tip text	Function
	Moveable Height Cursor	Comprises a horizontal measurement bar with variable length and position.
	Stored Vector Profile	Shows a vector profile.
	Stored Data Histogram	Shows a data histogram.
	Insert TIFF Data	Inserts tiff.

6.6. Shortcuts

Many functions and menus which are often used in the SmartSEM[®] user interface can also be opened using the keyboard.

The function keys F5, F6, F7, F8 and F11 as well as SHIFT + F5, F6, F7, F8 and F11 can be assigned with different functions via the macro editor.

The different keys and key combinations in the SmartSEM[®] software are briefly explained in the table below.

Key/Key combination	Function
<F1>	Calls the general help texts.
<Shift + F1>	Calls the context-sensitive help.
<F2>	Hides/shows the toolbar.
<Shift + F2>	Corrects the lens hysteresis.
<F3>	Hides/shows open a window in the SmartSEM [®] user interface.
<Shift + F3>	Hides/shows toolbars, menu bar, status bar etc.
<F4>	Activates the Magnification Table and switches to the next fixed magnification. or resets the Centre Feature magnification (when pressing F4 after using the Centre Feature function, the old magnification is reset.)
<Shift + F4>	Ends the use of the Magnification Table.
<F5> <F6> <F7> <F8> <F11>	Reserved for user defined macros.
<Shift + F5> <Shift + F6> <Shift + F7> <Shift + F8> <Shift + F11>	Reserved for user defined macros.
<F9>	Calls the help function for shortcut keys.
<F10>	Sets the cursor into the menu bar.
<F12> <Shift + F12>	Stops the specimen stage immediately.
<TAB>	Toggles between coarse and fine mode.
<CTRL + TAB>	Performs the Centre Point function.
<CTRL + SHIFT + TAB>	Performs the Centre Feature function.
<HOME>	Resets Beam Shift to zero.

Table 6.1: Important keys and key combinations

6. Summary of software functions

Shortcuts

Key/Key combination	Function
<SCROLL LOCK>	Toggles between Freeze and Unfreeze.
<PAUSE>	Causes currently executing macro to continue Stops a running macro
<CTRL + A>	Calls the Annotation panel.
<CTRL + B>	Calls the Toolbar View panel.
<CTRL + C>	Copies.
<CTRL + E>	Calls the Export TIFF dialog for saving the image.
<CTRL + F>	Starts Auto Focus fine.
<CTRL + G>	Switches SEM Controls panel On.
<CTRL + I>	Calls the SmartSEM Status Panel.
<CTRL + M>	Adds a point -to-point marker.
<CTRL + O>	Loads an image.
<CTRL + P>	Calls the Pint Setup dialog.
<CTRL + S>	Starts the Auto stigmation procedure.
<CTRL + T>	Inserts annotation text.
<CTRL + V>	Pastes.
<CTRL + F4>	During the use of the Magnification Table: Returns to the previously used magnification.
<CTRL + SHIFT + F>	Starts Auto Focus (coarse).

Table 6.1: Important keys and key combinations

7. Abbreviations

2D	Two dimensional
4QBSD	Four quadrant backscattered electron detector
ABCC	Automatic brightness and contrast control
Auto BC	Auto brightness and contrast
AVI	Audio video interleaved
BC	Brightness and contrast
BMP	Bitmap
CC	Charge compensation
DB	Database
EDX	Energy dispersive spectroscopy
EHT	Electronic high tension
EM	Electron microscope
EsB	Energy selective Backscattered electrons
FCF	Frame Corrected Focus = Dynamic Focus
FESEM	Field emission scanning electron microscope
FOV	Field of view
FTP	File transfer protocol
GIS	Gas injection system (optional accessory)
HV	High vacuum
I	Current
ID	Identification
JPEG	Joint Photographic Experts Group
LB	Left mouse button
LUT	Look-up table
MB	Middle mouse button
SCM	Specimen current monitor
SE	Secondary electron
SEM	Scanning electron microscope
TIF	Tagged image format
V	Voltage
VP	Variable pressure
WD	Working distance
XB	Cross Beam®

8. Glossary

Administrator	The SmartSEM® Administrator is part of the SmartSEM® program suite, which allows user management e.g. creating users and assigning them with certain privileges. The SmartSEM® Administrator is protected by an administrator password.
Annotation	Software function that allows adding notes or graphical objects to the image.
Crosshairs	A graphical object for assessing the relative position of objects in the image.
Dongle	A device that is needed in order to use protected software.
EM Server	A server that implements the internal communication between control software and microscope hardware.
Eucentric	Type of stage, the rotation axes of which intersect in the same point. The specimen surface is located in the eucentric point, where the tilt axis meets the beam axis. This guarantees that the focus is maintained when the specimen is tilted at a certain working distance.
Expert	One of the SmartSEM® user levels, good for a person with special knowledge and training in operating a FESEM.
Graticules	A grid displayed over the image.
High current	Mode which increases the active probe current obtained by a stronger activation of the condenser lens.
Ingredient list	A list that defines the contents of a recipe, i.e. the combination of saved parameters.
Licence	Licences are used to enable specific functionality in the SmartSEM® software.
LUT	Look Up Table which can be used to improve the image illumination.
Magnification Table	Function of SmartSEM® that allows you to enter fixed magnifications for quick access during the imaging procedure.
MiniBar	Part of the SmartSEM® user interface which allows quick access to recently used dialogs and to the recipe management.
Novice	One of the SmartSEM® user levels, good for a person who is new and has little experience in operating a FESEM.
OptiProbe	Optional function which allows you to continuously adjust the probe current.
Recipes	Function of SmartSEM® that allows you to save a set of SEM parameters which are ideal for a certain type of specimen.
Service/Full	The highest SmartSEM® user level.
Splash screen	Animated start screen of SmartSEM®.
Supervisor	Privilege that permits to start the Administrator and - among others - enables to edit or create user directories and to start the bakeout function.

User Preferences	Section that allows you to define user-specific pre-setting of the Smart-SEM [®] user interface e.g. language or pressure units.
Zone	Part of the image area when displaying different detector signals or image areas.

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