

# Guide to operate the FEI Apreo SEM

## Specimen Preparation and Handling

The sample material must be able to withstand a high vacuum environment without outgassing. It must be clean and conductive. Oil, dust, or other materials may cause sample charging or contaminate the chamber, which could hinder or even prevent evacuation.

**Note:** 1) Always wear NFCF-supplied lint- / powder-free clean room gloves when manipulating inside the specimen chamber to minimize oils, dust, or other contaminants pollution of the chamber environment.

2) Consider plasma cleaning your samples before load it into SEM chamber.

**Caution!** Store samples in a dry nitrogen storage cabinet when possible. Dust on samples can get drawn into the electron / ion column, degrading performance

## Mounting Specimen on Holder

Attach the specimen to the specimen holder using any suitable SEM vacuum-quality adhesive. The specimen must be electrically grounded to the sample holder to minimize specimen charging.

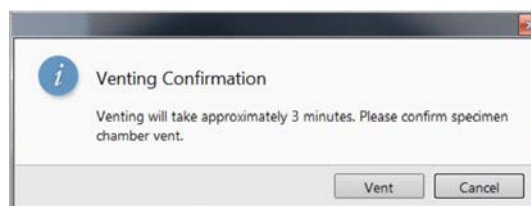
## Operation Pre-Check

To ensure correct operation check the following list before continuing.

Adjustment	Electron Beam Setting
Column Use Case	Standard ( <i>OptiPlan does not work with EDS and EBSD options</i> )
Accelerating Voltage	Select voltage relative to specimen type: 900 V – 30 kV
Beam Current (Spot size)	5 pA - 50 nA ( <i>specimen dependent</i> )
Scan rate	fast scan (dwell time 0.1 - 0.3 $\mu$ s)
Working Distance (FWD)	10 mm at 0 deg. tilt for EDS only; (16-18 mm at +60 ~ +70 deg. tilt for EBSD or EBSD+EDS)
Magnification	Set to lowest – from 20 $\times$ to 200 $\times$
Detector	ETD (SEI). T1 in-lens BSE and T2 in-lens SEI
Filtering	Live or Average (2-4 frames for fast scans)

## Inserting / Exchanging Specimen

1. Click on the **Vacuum** module / **Vent** button. The confirmation dialog appears. After switching the High Voltage off the vacuum system switches off the pumps and opens appropriate valves to vent the system. After a specified venting time (~3 minutes) the venting valve will close.



### Note :

If the venting valve closes before the chamber is at the atmospheric pressure (the door is not possible to open), click on the Vent button once more to open it again.

2. When vented, open the specimen chamber and, using **lint-free gloves or tweezers**, place a mounted specimen into the specimen holder at mounting hole #12 or #4 on the multipurpose stage.
3. Close the specimen chamber door and click on the **Vacuum** module / **Pump** button.
4. While pumping, choose the highest specimen point and bring it to the **10 mm** Free Working Distance (FWD, green line in CCD Quad) by holding down the mouse wheel and moving the mouse cursor up.

## Imaging Onscreen

1. When the vacuum status is **PUMPED** (see the Status bar), click on the **System** module, click the **e-beam** button to open the electron beam shutter.

2. Select an appropriate **Column Use Case** (e.g. Standard for EDS/EBSD) and the detector (**ETD**) and resume the active display (Display 1), where an image appears.
3. Focus the image and **Link Z to FWD**.
4. Adjust to a suitable magnification; optimize the imaging using the **Contrast & Brightness, Focusing, Astigmatism Correction** etc.

### High Resolution Imaging

1. Click the icon of *Open Sample Exchange Window*, and then define the *Working Folder* to save images to;
2. Use the mouse wheel over the *Chamber scope* image in the Sample exchange dialog to move the sample in the **Z**-axis to the working distance of approximately **10mm**;
3. From the main menu, go to **Stage → Take Nav-Cam Photo** to take a specimen navigation image;
4. Navigate to the sample of interest using the *Nav-Cam* image in the third quad display or using the sample holder drawing on the *Stage Control* page;
5. Setting imaging parameters as following:
  - a. High Voltage: **2 kV**, Probe Current: **0.1 nA**;
  - b. Set the electron beam to Display:
    - i. Display 1: ETD detector (*SE contrast*);
    - ii. Display 2: T1 detector (*BSE contrast*);
    - iii. Display 3: T2 detector (*SE contrast*).
  - c. Press the **Beam On** and start scanning with image resolution = 768, dwell time = 200 us, averaging = 4.
  - d. Adjust **Contrast** and **Brightness** for all appropriate displays;
  - e. **Focus** the overview image and **Link Z** to free working distance;
  - f. Navigate to the area of interest at low magnification;
6. Adjusting the Image:
  - a. Bring the sample to the working distance of **2 mm**, which is optimized for high resolution imaging, and focus;
  - b. Increase magnification until you can see the feature of interest;
  - c. Move the stage to a recognizable feature next to the area of interest;
  - d. Decrease the probe current to **25 pA**;
  - e. Focus once again – use *Reduced Area* to make focusing easier;
  - f. Use (**Auto**) **Stigmator** to correct astigmatism.
7. Taking the Final Image:
  - a. Focus once again;
  - b. Adjust **stigmator** manually if the image after focusing still show astigmatism;
  - c. Adjust **contrast** and **brightness** if necessary;
  - d. Move stage to the area of interest;
  - e. Take the final image with the following scanning parameters: *image resolution = 1536, dwell time = 5 us, line integration = 10*.