STEPS NECESSARY TO CAPTURE AN IMAGE AND SAVE TO FILE

1. PROPER SAMPLE PREP (PG 2)

2. VENT CHAMBER (PG 3, step1)

3. PLACE SAMPLE IN CHAMBER AT APPROPRIATE DISTANCE AND PUMP CHAMBER (PG 3, steps 2-3)

4. SET **WORKING DISTANCE (WD)** IN SOFTWARE AFTER SAMPLE IS IN FOCUS (PG 4, step 4)

5. Adjust to desired magnification. (PG 5)

5. ADJUST **CONTRAST/BRIGHTNESS** WHILE USING VIDEOSCOPE (PG 6, step 2)

6. ADJUST **FOCUS** WHILE USING SLOWSCAN 3 & SELECTED AREA BOX (PG 6, steps 3-6)

6. **PRESS F2** (PhFreez) TO CREATE STATIC IMAGE, "IN/OUT>IMAGE…" TO SAVE IMAGE,STORED ON "E:\"="C:\USER on EDAX computer (PG 7, steps 3-4)

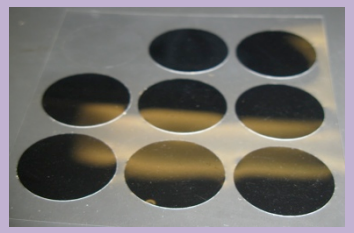
SPECIMEN PREPARATION FOR SEM

If specimens are nonconductive:
- They should be sputter or carbon coated before beginning placing in the SEM chamber. if samples are coated, you still need to limit beam energy to the sample.
- Alternatively, low voltage can be performed (please discuss with MSE Tech staff regarding this).
- **Please follow the SOP for coating your specimen for more details.**

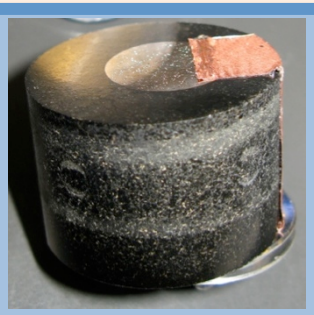
Aluminum stubs are available in 2 sizes: 0.5" and 1"

For free standing metallic samples:
- Need to make a connection with the sample to the aluminum stub.

Carbon tabs, carbon paste and copper tape are available to attach samples to stub and to provide a conductive pathway out of specimen.



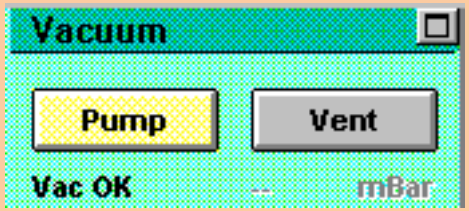
Conductive samples in metallographic mount:
- Need to make a connection from sample to stub by attaching tape to specimen
- For more information on metallographic prep, **please see the SOP for LECO Mounting Press and ATM Grinder/Polisher**



TIP:
For mounted samples, if looking at the edge of the sample either use conductive mounting material or lightly sputter coat to reduce image distortion and charge buildup in the nonconductive mounting material.

INSTALLING A SPECIMEN INTO THE SEM

In the software, click on the "Vent" button.
- Confirm venting
- After **20 seconds to 1 minute** open door and click Vent button again to stop venting, this helps to conserve on the dry Nitrogen gas

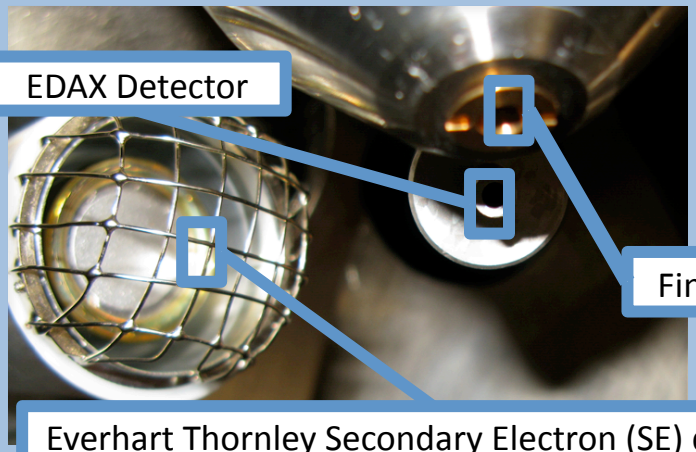


Click on the "Pump" button. You will see, messages below button:
- "Pumping", "Pre-Vac" and "Vac OK"
- **Once "Vac OK" is seen** (2-5 minutes), proceed to turn on the beam. **See PG 4 for more instructions.**

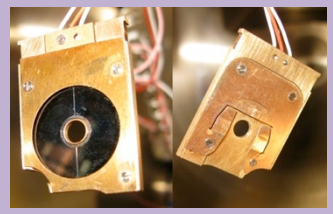
Place sample in the hole on the SEM stage.

Specimen should be 10mm from final lens for EDAX and most imaging, this is the working distance (WD):
- Slightly closer for very high magnification (7-9mm)
- Further away for low magnification or greater depth of field (12-20mm)
- For setup in the software, see pg 4, step 4

View inside the SEM chamber



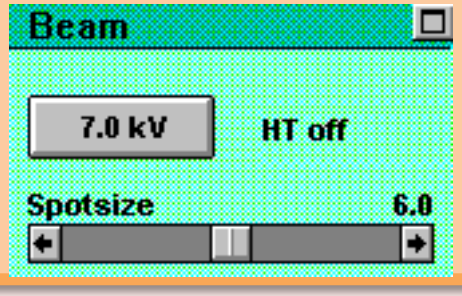
Backscattered Electron (BSE) detector. To use the detector, slide it onto the final lens.



TIP: The stage height can be adjusted in 3 ways:
- Z knob on outside of stage
- Loosening and adjustment the cone
- Z setting in the software

TURNING ON BEAM AND MAKING AN IMAGE

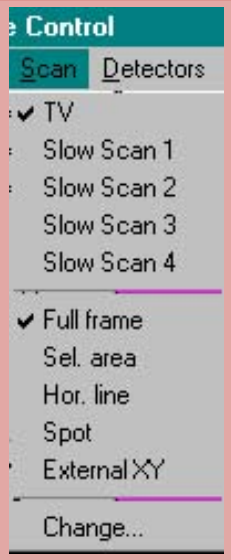
Click the beam button, labeled with the voltage. The button will become yellow.



To adjust the voltage:
- Click the box in the corner to expand options
- Use Acc. Voltage slider
- **OR** Use the Beam presets listed under the "Beam" drop down menu
- If desired voltage is not listed click on "Change…"and add voltage to the list.
- See pg 7 for add info on Voltage adjustments

To adjust the Spotsize:
- Adjust the Spotsize slider in the Beam box
- Smaller Spotsize at high magnification
- Larger Spotsize at low magnification

Begin scanning in TV mode:
- Fastest scanning rate, lowest resolution
- Select by using TV button or under the "Scan" drop down menu
- **Use the TV mode to:**
  - Find desired specimen features
  - To set appropriate WD
  - To move across sample
  - Switch between TV and slow scan by clicking on the TV button or **F6**



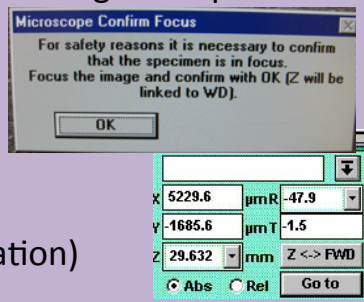
For the safety of the SEM, it is important to properly set the working distance (WD) before continuing to image the specimen.

When the beam turns on a dialogue box appears:

a. Focus the highest part of the specimen

b. Confirm dialogue box by clicking OK

c. Adjust Z in software to be appropriate distance (see pg3, step 2 for more information)



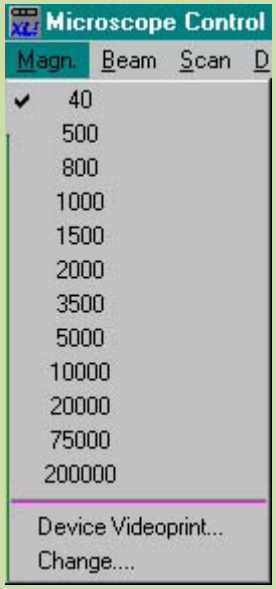
*__TIP__: A function row toolbar shortcut key can be accessed by pressing F1

Toolbar				BShift0							PrevApp
Help	PhFreez	¥Scope	Dbar	XHD	SA-FF	Meas	T¥-SS	ACB	AStig	AFocus	Stage
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F13

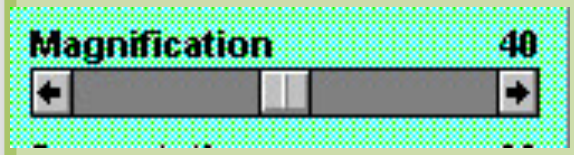
ADJUSTING MAGNIFICATION AN ICON ROW

There are multiple methods for the adjustment of magnification.

Magnification Pull Down Menu:
Useful if precise magnification numbers are important.
- Use “Change…” to change the presets

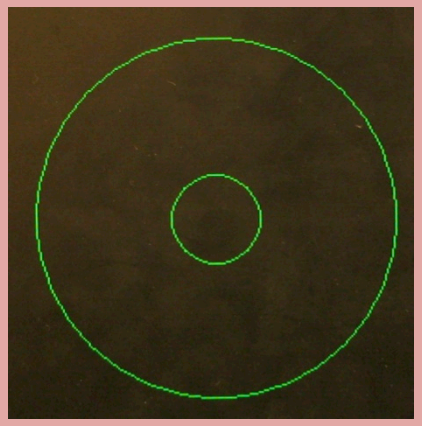


Magnification Slider:
- Arrow key adjusts smaller magnification step
- Grey area by larger magnification increment
- Slider button in middle slides magnification higher and lower



Most common method for adjustment of magnification:
- Use the “+” or “-” keys on the number pad
- “+” : doubles magnification
- “-” : cuts magnification in half

Track Mode (movement):
- Center of two circles turns mouse into either a “+” for increasing or “-” for decreasing magnification



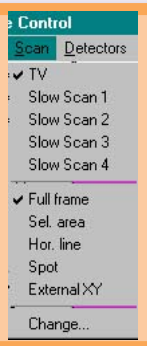
*__TIP__: Final focusing should be done at a slightly higher magnification to minimize any defect in focusing.

Complete icon row:

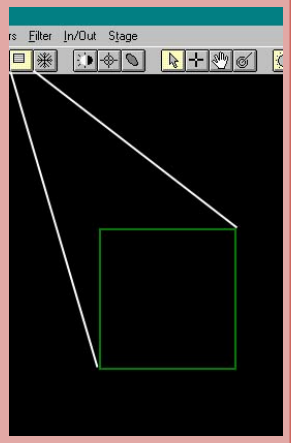
CONTRAST/BRIGHTNESS & FOCUS ADJUSTMENTS

Switch from a TV scan to taking an image in Slow Scan 1 or 2 for contrast and brightness adjustments

- As you go from TV scan to Slow Scan 4 the scan rate becomes *slower* but the image resolution is *higher*.

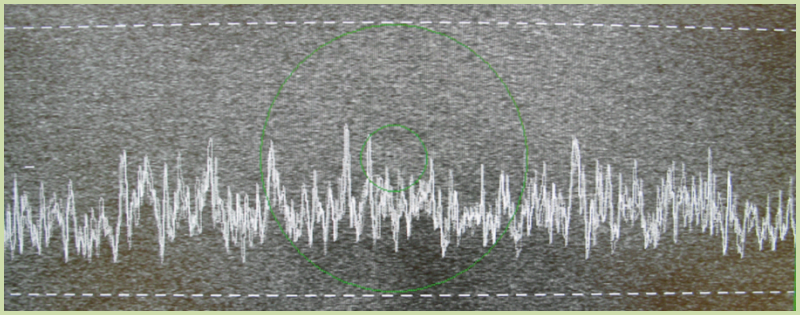


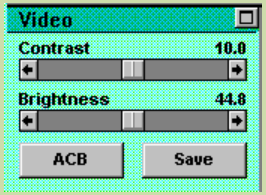
Turn to Slow Scan 3 and use the Sel. area box (F6) to adjust the focal point.



- **To adjust the position of the box:** Left click and hold *inside* the box, While waiting for screen to raster, then move to the desired location.
- **To adjust the size of the box:** Left click and hold *outside* the box, While waiting for screen to raster and drag the mouse, ideally making the box taller than wider and not too big (otherwise, this defeats the purpose for using the box).

Adjust the contrast brightness by clicking the "Videoscope" button or **F3**

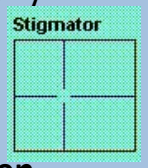




- Adjusting the **contrast** primarily alters the peak height while **brightness** mostly alters the overall position of the line.
- In order to obtain a good image, it is necessary to be between the upper and lower limits of the dashed lines. If it falls outside those lines, that information is lost and cannot be retrieved.
- Use the adjustment sliders under the "Video" box.

To adjust focus, right click and drag the mouse back and forth in the direction of the double arrows.

Under the " Control Area: Imaging' here is a Stigmator controller to adjust for any defect in the lens system and chamber. It can also be accessed by holding right click and shift simultaneously. **Adjust in just the X or Y at a time and adjust the focus in between**



TIP: Make any adjustments of focus at a higher magnification than where you want to capture your image. Any defect in your focusing will be minimized by doing this step.

FINAL IMAGE CAPTURE AND SAVING IMAGE

Continue to adjust the contrast/brightness, focus and Stigmator until a desired image is produced.

Press F2 (PhFreez) or the button on the function row.

To save an image, Go to “Image…” under the In/Out drop down menu.

File system steps to save an image:

- “E:\” drive is the storage location, images will be stored under “C:\Users” on the EDAX computer (running Windows XP)
- Use UofM uniquename for folder name
- Due to the nature of the NT file system:
  - Files and folders have a maximum of 8 characters
  - To move up a level the typed command is “..” (can be done for multiple levels, ie “../../..”)
  - To create a new folder or move into a folder the typed command is “./nameoffolder/”

Images are in .tif file extension, and have a resolution of 712 x 484.

Images that appear on the Teaching SEM Computer screen are accurate representations of your sample. HOWEVER, when the images are saved and then opened on another computer, the images will be expanded in the horizontal direction by about 13%. This occurs because the pixels on the Teaching SEM screen are rectangular in shape, not square. The computer saves the image file pixel by pixel and when the file is opened on a computer where the pixels are square, the image is distorted. Correct the distortion by using your image-viewing program to compress the image in the horizontal direction (the image width) by about 13%.

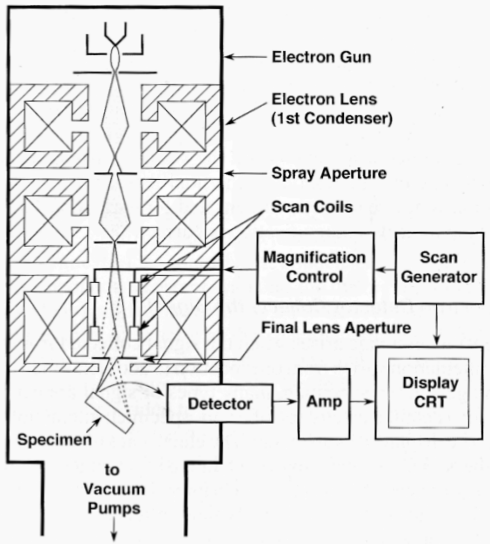
TIP: There are alternative directions for saving an image found in the SOP for the EDAX software.

ADDITIONAL INFORMATION AND RESOURCES

JEOL's Introductory Guide to the SEM provided to us by EMAL can be found on the online SOP for the XL30 SEM and in the logbook next to the unit

A more comprehensive study of the SEM and EDAX analysis can be found in the text book, ***"Scanning Electron Microscopy and X-Ray Microanalysis"** by Goldstein, Newbury, Joy, Lyman, Echlin, Lifshin, Sawyer and Michael. This book can be found in 2224B, Justin Scanlon's office.

Schematic of SEM electron column*:



Schematic diagram of the conventional self-biased thermionic tungsten hairpin electron gun*:

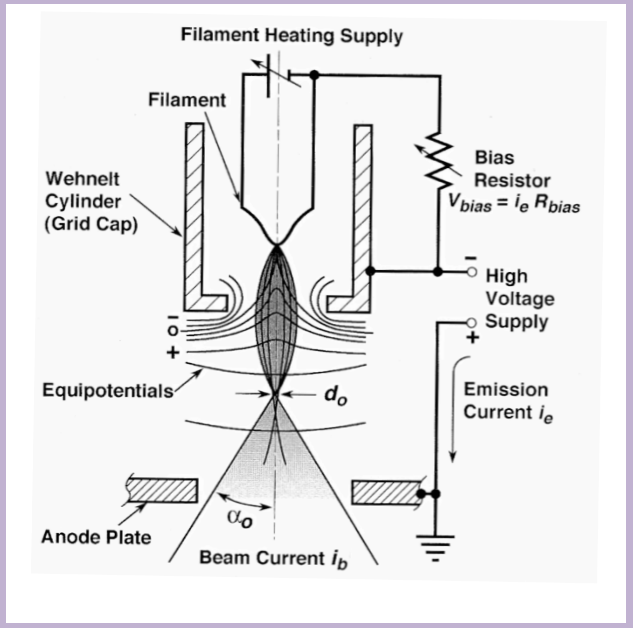
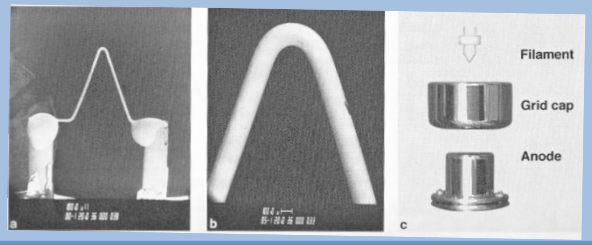


Image showing tungsten hairpin. The electron source is 30-100 microns*.



TIP: Practice makes perfect. The more usage of the SEM you take advantage of, the more comfortable with the controls and you will be able to get the desired images.