

### Introduction to VP SEM - Imaging

The purpose of this lab is to introduce you to operation of the SEM in “variable pressure” mode. The main aspect will be introducing specimens that are NOT conductively coated:

Imaging of uncoated insects, observing:

- (a) pros/cons of the BSE and the ESED detectors and
- (b) optimizing depth of field for these 3D objects

Each student should get ~15 minutes on the instrument. Save acquire several images/spectra, saving in 777 folder on the computer.

**VP-SEM Imaging:** The specimen holders have sticky carbon tape, and upon it are mounted several Weeks Hall volunteers (house flies, bugs, spiders, etc..). Using what you have learned about operating the Hitachi S3400N, correctly measure the specimen and properly insert the specimen into the chamber. **Pump down in VP-SEM** vacuum mode to 30 Pa. Select initial settings you think might be beneficial for imaging: 15 HV, \_\_\_ Filament, \_\_\_ Gun Bias, 50 Probe Current, Aperture setting = 0 (Always check the aperture setting before you start!)

Notice that under Image in the right hand column, “SE” is not accessible. Why?

The default image in VP-SEM is BSE. Leave it there to start.

Locate an “interesting area” and then make any necessary adjustments in order to optimize (1) depth of field and (2) objective lens focus. You may wish/need to (3) change the gas pressure and also (4) change the scanning mode from one long 20 second acquisition to 16 averaged rapid acquisitions. As the class progresses, write down “lessons learned” about these concepts and adjustments to the SEM. You will summarize these in a paragraph afterwards.

Depth of field: when you start, you will be setting the sample to the “normal” 10 mm working distance. Focusing upon one bug, at this working distance, can you have the whole insect in focus? \_\_\_\_\_ Adjusting the objective lens, what do you estimate the height of the bug to be? \_\_\_\_\_ mm

As you zoom in on an area, do you observe part of the image getting white/whiter?\_\_\_\_  
What is this?

Why does it occur upon zooming in at higher mag?

For all changes made, observe the same field of view in both BSE and ESED modes.

If/When you lengthen working distance, what is the impact on the images?

If/When you increase the gas in the chamber, what is the impact on the images?

Recall that images can be acquired both in one long slow 20 second capture, or 16 very fast captures that are averaged. When would the later be good?

Also, the BSE Detector has some settings you need to be aware of. "Normally" it is set for Gain of 3, but for very low currents you want to set to 4 (HR=high resolution with low currents).

Also you can operate the BSE with the diodes mathematically added/subtracted (Composition vs Topography), AND you can add an off axis BSE diode for "Topo" with enhanced shadowing effect.

If you make other adjustments to the SEM (E0, probe current, apertures), note them and comment upon the effect upon the images.

Also look up and answer what 30 Pascals (Pa) is equal to in:

Torr?

mm of Mercury?

Millibars?

For your assignment, write up a paragraph describing what factors are involved with imaging in VP-SEM mode. Include images if relevant.

Versions: 10/4/09 10/6/09 2/20/12 2/18/13 3/6/14 10/3/16 02/9/2018