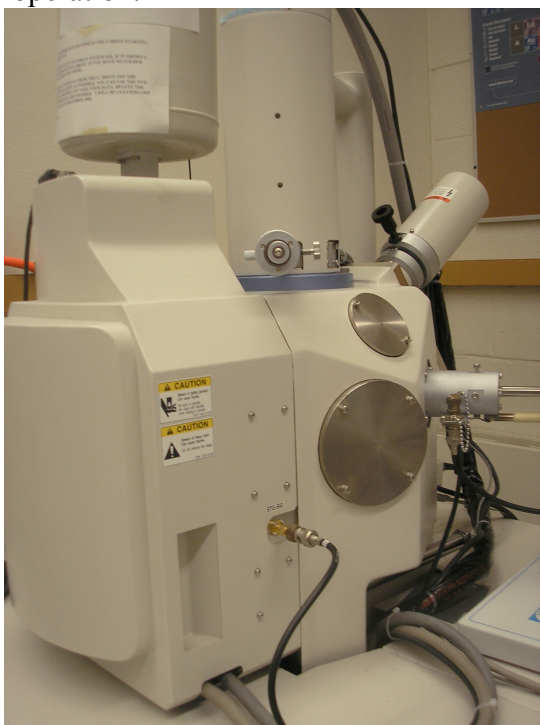


## G777 Lab 1: Introduction to SEM and Hitachi S3400N operation

For the next several weeks you will be learning about the proper operation of the Hitachi Variable Pressure S3400N Scanning Electron Microscope in Weeks 308. Each student will have various opportunities, from “cold start up” to alignment and focusing and then imaging with the various detectors. Today we will set up and run in “normal” high vacuum mode.

I have distributed a 2 page “Quick Start” synopsis of key SEM operation information. However, the main point in lab is to pay attention and ask questions. I will be demonstrating a variety of operations, and then each one of you will be involved in doing some activities that will mainly be aimed at getting you “up to speed” for acquiring images. This week we will focus on setting up the column for “normal” high vacuum operation.



1. Orientation: On the picture to left, locate/label: Apertures, Faraday Cup, Environmental Secondary Electron Detector (ESED)

On the picture to right, locate/label:  
EDS detector assembly, CL Detector, Apertures





In picture to left, locate/label: EBSD Detector, EDS, CL detector, Aperture

## 2. Gun: Learning about the Wehnelt and W filament

We will now go into some detail with some specific features, starting with the Gun: filament, Wehnelt cap. After venting the instrument (and waiting for the filament to cool down if it has been in operation!), we can “open the gun” and examine the Wehnelt and W filament inside it. This is all done with gloves on. This is not something most users do.

## 3. Sample insertion

- a. Protection – software: measure sample+holder; position in machine; enter in correct height; raise sample to final height; check sample passes under gauge; close door.
- b. Vacuum setting = high vacuum; the Pump (evacuate)
- c. Turn on chamberscope
- d. Check that raster rotation off

## 4. Set up column:

- a. Set HV
- b. Brightness/contrast ABCC and focus AFC
- c. Saturation of filament
  - i. Filament image, with guideline max value on whiteboard
- d. Gun Bias
- e. Probe Current

## 5. Apertures

- a. Aperture should be set to Zero. If not, ask experienced user how to set to Zero. Do not adjust any of the knobs without permission.
- b. As a general rule, and for new users, do not use any apertures.
- c. And if you ever do, do not adjust more than 5-10 degrees (fraction of a turn)

6. Stage controls: Height vs X-Y

a. Height:

- i. When you insert the sample, it is located at a “working distance of 5 mm”. However this is TOO short for 98% of all users. You should drop the stage to 10 mm working distance. What is the ‘code word’ on the screen for this? \_\_\_\_\_
- ii. You can drop the stage lower, all the way to ~50 mm working distance. You can see a much wider field of view, though lose spatial resolution. Depends what you need.
- iii. To do CL , you need to be VERY careful with stage height. Start with working distance of 15 mm.
- iv. NOTE: Very stupid Hitachi confused panel: on Left side under the column conditions, there is “working distance”. This is NOT working distance. This is objective lens adjustment.

b. X-Y: There are several ways to move in X and Y:

- i. Manual controls (trackball)
- ii. Click On Stage Image
- iii. Jog arrows on Stage Controls (you can set the ‘jumps’)

7. Imaging

a. Types

- i. SE
- ii. BSE
- iii. CL (not this week)
- iv. ESED (not this week)

b. Files

c. Histogram:

- i. 8 bit images (256 gray scales)

8. Student imaging exercise: the instructor will provide a sample, and each student should spend ~10 minutes acquiring several SE and BSE images of the material, and save those images to a class folder.

9. Shutdown: Turn off HV, wait 3-5 minutes; vent; remove sample; set vac to VP mode (our default standby mode); pump.

Turn in next week:

Labeled images

1 short paragraph on instrument and detectors

1 short paragraph on column setup and alignment

1 short paragraph on imaging (demonstrate you understand how a rastered image is acquired, and difference between SE and BSE images)