Physics 7230  
Laboratory 3: High Resolution SEM Imaging

1. What is meant by the term “resolution”? How does this differ from other image variables, such as signal to noise ratios and contrast/brightness?

2. Compare the images at a WD of 20mm and 5mm with the upper and lower detectors. Explain why you think the difference exists and whether resolution is affected.

3. What do you observe in the images taken at different accelerating voltages (Vacc)? Discuss your observations in terms of resolution.

4. What did you observe in terms of resolution in the images taken at working distances of 5 and 20 mm? Discuss any differences you see and why they may have occurred.

5. What did you observe in the images taken at the two Cond Lens 1 settings? Define “spot size” and relate this idea to any differences you might have observed.
INTRODUCTION:
This lab explores the necessary conditions to obtain high quality, high resolution images. These include working distance, spot size and accelerating voltage.

SAMPLE:
Evaporated Gold on Carbon Resolution Standard

OBJECTIVES:
High magnification imaging with a cold cathode FESEM.
**INSTRUMENT PARAMETERS:** 5-30 keV, 10 μamps, Ultra High Resolution setting

**A. SET-UP and OBTAIN IMAGES: Working Distance and Upper/Lower Detectors**

1. Log in.

2. Check VACUUM conditions. See CHAMBER VACUUM panel. Both SC and SEC lights should be green.

3. The sample is already in the specimen chamber. See TV monitor

4. Set the Vacc (kV) to 10 and the le (emission current) to 10. Turn HV on.

5. Click on the H/L button. This puts you in the low magnification [LM] mode.

6. Set the mode to NORMAL (SETUP-COLUMN).

7. Set the CON LENS 1 to 8.

8. An image of the holder should be present at ~25-30X with the hole in the middle. If not, check CONTRAST and BRIGHTNESS.

9. Set your scan speed to FAST1. This is the slower of the two fast scan modes and is less noisy.

10. Switch back to HIGH MAG mode.

11. Make sure the UPPER SE detector is on (SETUP-COLUMN).

12. Set sample working distance to 5mm. (Change WD to 5mm with Coarse Focus, then use Z-axis to focus sample on image screen.

13. Change mag to 200Kx or higher and focus and check stigmation.

14. Change mag to 100kx, set scan speed to SLOW1, adjust Contrast and Brightness, and take an image. **Do not refocus after zooming out!** Label image 10SEU_WD5.

15. Switch to Lower Detector (SETUP-COLUMN). Take a second image after adjusting contrast and brightness. Label image 10SEL_WD5.

16. Decrease mag to around 300x.

17. Set the WD to 20mm with the coarse focus. With the STAGE Z control, lower the sample into focus.

18. Increase mag to 200kX or higher, focus and stigmate image.
19. Decrease mag to 100kX and take image as before. Label it 10SEL_WD20.

20. Switch to Upper Detector and take a second image, as before. Label it 10SEU_WD20.

B. Obtain Images: Spot Size

1. Keep Vacc at 10KV, WD to 10, Cond 1 to 3 (Set-up-Column). Set Detector to Mixed.
2. Set mag to 200KX.
3. Adjust Contrast/Brightness
4. Focus and align/stigmate the image.
5. Decrease mag down to 100KX. Do not refocus.
6. Set scan speed to Slow1, do final adjustment of Contrast/Brightness.
7. Obtain image and label it 10SEM_SS3_WD10.
8. Change Cond 1 to 8.
9. Increase mag to 200KX, Focus, align the aperture and correct for astigmatism if needed.
10. Decrease mag to 100KX, go to Slow1 and obtain an image. Label it 10SEU_SS8_WD10.

C. Obtain Images: Accelerating Voltage

1. Set Cond 1 to 8 and Vacc to 5KV. Obtain an image on the screen and go to a working distance of 10 mm. (Adjust the coarse focus until WD=10, then bring specimen into focus with Z-axis control. Watch the image on the TV screen so nothing touches the final lens polepiece!). Set Detector to Mixed.
2. Set mag to 200KX. Align, focus and stigmate the image.
3. Reduce mag to 100KX. Do not refocus.

4. Set scan speed to Slow1, correct contrast/brightness and obtain an image. Label it 5SEM-WD10.

5. Set Vacc to 30KV.

6. Increase mag to 200KX and repeat aperture centering and astigmatism correction.

7. Reduce mag to 100KX. Do not refocus.

8. Slow scan speed to Slow1, adjust brightness/contrast. Record an image and label it 30SEM_WD10.

*When finished, please leave sample in microscope.*