Week of September 21, 2009 Name _____

G777 Lab 2: Imaging large 3D objects and very small objects

Today we will set up and run in "normal" high vacuum mode, on conductive materials. We will be using at least 3 "test subjects" in this week's lab

(1) SEM high resolution calibration standard (Au sputtered on carbon)
(2) Relatively large metal machine parts
(3) "Au-coated" forams

The objective this week is 3-fold:

(1) Gain further experience with the controls of the S3400
(2) Gain further experience fine focusing at high mag
(3) Learn about the parameters which control depth of field and field of view

Procedure:

I. Au sputtered on carbon calibration standard:

Set up the instrument at 15 kV, high AFS, Gun Bias 0, Probe Current 60, Sample Height (Z/WD) 10 mm, Aperture 0. What can you image at the highest magnification that something is distinct? (Take an image. Save all images in F:/ G777 folder)
Can you see the ~50 nm Au balls?

What can you do to improve the image?
Start making adjustments, and list what you do, and what the results are

Take an image when you have acquired the highest resolution ("best") image and record the conditions you are using:
E0 ___ Probe Current __ Aperture __ Z/Working Distance __ and anything else work noting
_____

II. Imaging larger machine parts. A stub has been prepared with 4 metal machine parts, simulating a piece of machinery you are trying to image. Your mission is to first acquire one image of the whole thing (or most of it) with everything in focus, and then some closeups. (Note: the metal sit on carbon tape, which can be focuses on to see the little bubbles in it, to give you the maximum depth of the sample.)

Start at the "nominal settings" of 15 kV, Probe Current 60, Aperture 0, Z/WD 10 mm. Can you see the whole thing? ____ What is the field of view? _____ What is the mag?___ What do you need to do to increase the field of view? _____ This is the same thing you need to do to increase the depth of field -- there is an equation that shows that depth of field is reversely proportional to the mag.

Acquire and save 2-3 wide angle images with the most depth of field.

Now focus on the flat bottom of the smallest screw that is facing up, and increase the magnification to around 750x and get the best image you can. What is the field of view now? _____ Is the image somewhat fuzzy? _____ What would you do to now improve the sharpness of this image? _____ OK, do it.

Acquire a sharper image. What is the magnification? ____Field of View? ____ Save it. What does this tell you about the relationship between "sharp images", "field of view", and "depth of field"?

III. Au-coated Paleogene forams: these are small fossils that have both a large scale shape as well as fine scale detail.

Do you see anything that suggests the coating is not fully sufficient? ____ Do you see effects of charging? ____

If so, what can be done?

Using what you learned as a group in the first exercise, acquire a series of images at both low and high magnification. In particular you need to acquire an image with the whole body in focus. What parameter do you need to adjust to do this? _____

Take a series of images at different depths of field.
Take notes of what is done:

Turn in next week: A brief report, with images if appropriate, explaining (1) how one optimizes the spatial resolution of an image (note: we are specifically referring to 'normal' high vacuum SEM of conductive materials, and (2) how one creates an image with different depths of field.