

University of Minnesota Nano Fabrication Center

Standard Operating Procedure

Equipment Name: RAITH Operation

Coral Name:	raith	Revision Number:	5.0
Model:	150 ver. 5 sp 12.0	Revisionist:	K. Roberts
Location:	Bay 4	Date:	9/16/09

1 Description

The RAITH is an E-beam writing system that can also be used as a SEM. This SOP will address E-beaming writing operation.

2 Safety

a Safety glasses are mandatory when using this system.

3 Restrictions/Requirements

- a Log in/out of CORAL with each use.
- b Fill all logbooks.

4 Required Facilities

- a 120 Volt Power
- b Exhaust
- c Nitrogen

5 Definitions

- a **Write Field:** The write field is the part of the pattern that is written without moving the stage. The size of the write field is controlled by the magnification
- b **Working Area:** The work area is the part of the pattern that you want to expose. This may include one or several write fields.
- c **3 Point Adjust:** This is where you align your wafer with your pattern on your sample to where the stage says your wafer is located.
- d **Align Write Field:** This is where you align the write field (where the beam is scanning) to the correct orientation to the wafer.
- e **Faraday Cup:** The Raith has two. One on the stage and the other on the holder. It is used to measure the beam current starting your exposure.
- f **Working Distance:** The Distance from the ebeam source to the focusing point of your image.

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Button clicked with **middle** mouse button:

This toggles the automatic control for one B/C stage on or off. This is the B/C stage which is found in the Control Panel. When one B/C stage is in automatic mode the other B/C stage is available for control by the mouse. This stage is called **Offset A** and **Gain A** in the information area at the bottom of the screen. When the pointer is in the image area the **left** mouse button adjusts brightness of this B/C stage (Offset A) and the **middle** mouse button adjusts the contrast (Gain A). Fine-tuning the "extra" B/C stage (Offset A/Gain A) can be useful if constant image brightness is important during long zooming operations.



Toggle between **In-Lens** detector and **SE2** detector. When using <20 KEV use the **In-Lens** detector if you are using >20KEV the **SE2** detector is recommended.



Left mouse button controls magnification and the middle mouse button controls focus.



Burn a contamination dot, left mouse button gives a couple of second exposure. The middle mouse exposes for varying seconds. Start it with a mouse click and end it with a mouse click for the time desired. **Note!** it is not possible to move the cross indicating the spot position during burn.




Left mouse-button: Show vacuum status tab in SEM-control window (see below).
Middle mouse-button: Pops up Airlock Control window.

6 Setup/Loading

- a Enable the **Raith** in **CORAL**.
- b Log onto the **LEO** computer (on the left).
- c Log onto the **RAITH** computer (on the right).
- d Load sample in the load lock. If a whole wafer is being loaded, the flat should be facing toward the **RAITH**.



- e Click on  to display the Load/Unload page. Click on the Load Sample button.



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- f Hold down lid while turbo pump initiates pump-down of load lock.
- g Answer questions as to home position (yes), reset coordinate system (yes), voltage, aperture, WD (though WD isn't actually set on LEO computer from Raith side, so can type in any value).

7 Operating Instructions

- a **Decrease mag. (52X usu.), set focus (WD = 12.5 usu. on LEO comp.), look at your sample.**


Un-blank the beam (from the RAITH computer).




Click on  or  to start scanning.

Click on one of the numbers to select a scan speed. Usually level '2' (scan speed 3) to begin with.



Click on  to adjust the focus and magnification using the mouse

buttons. Lower the magnification to the lowest level and focus the image to start obtaining a image.

Click on  to select detector and adjust contrast and brightness in the

Signal Adjust section as needed. You can also adjust the wobble and stigmation. Adjust the stigmation until you can make out the small particles on the sample at least 30K magnification.

- b **Adjust scan rotation/tilt if bothersome; i.e. cosmetic, doesn't matter to Raith Computer.** [\[you do this on the LEO side under the Scanning menu heading\]](#)

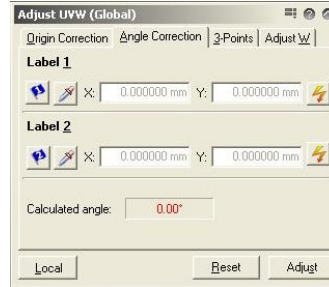
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- c **Set up angle correction (2 pt; i.e 'ideal' u-v coordinate system--very orthogonal, with u-v scaling factors =1).**

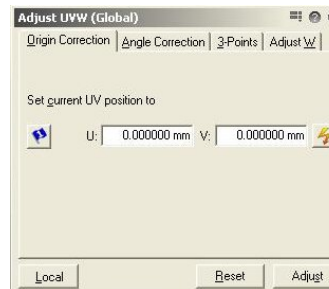


Click on the Adjustments Page Icon



Select Angle Correction tab.

- d **Set up origin u,v = 0,0**



Select Origin Correction tab.

- e1 **Set up w = WD.**



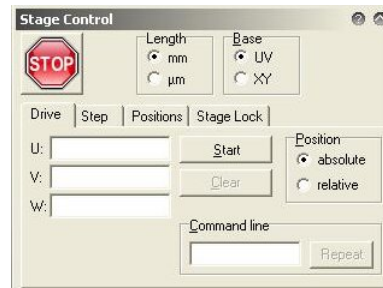
Select Adjust W tab.

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- e2 **Decide WD to be used in processing of sample, go to that height by adjusting w.**

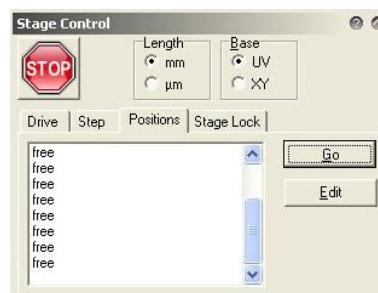
Click on Stage Control Page Icon



Type in value for w in 'absolute' position

- e3 **Optimize beam using hi-res sample at sample height's WD (adjust w or z as necessary). Write down ApX %, ApY %, Stig X %, and Stig Y % for next time.**

Click on Positions Tab and select 'Hi Res Sample' from list



[steps c, d, and e can be done in whatever order the user finds convenient. Steps e1, e2, and e3 should be done in the order they are listed above in relation to each other]

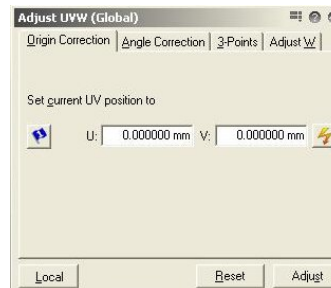
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- f** Go back to sample surface (adjust w or z back to height one wants to process the sample at).



Can use  icon on Origin Correction Tab on XY-UV Page

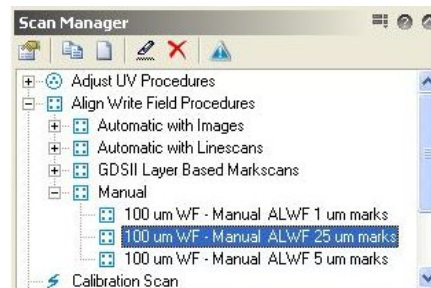


- g** Do write-field alignment (use scratch, particle, alignment mark, contamination dot as a reference point).



Click on Microscope Control Page

Using the Scan Manager Module, run the 25 um WF program, then the 5 um, then the 1um. Highlight program to be run, then initiate using 'F9' key.



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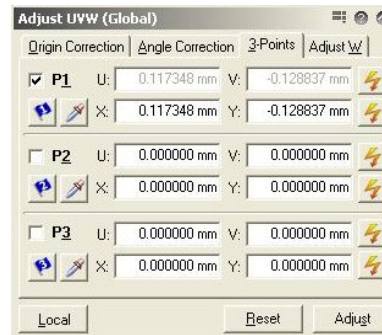
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- h** *Maybe* do 3 pt. alignment (i.e. 'non-ideal' u-v coordinate system; has auto focus capability when turned 'on').

[do 3 pt. only for patterned wafers on which you wish to do an overlay, or large plain or patterned wafers on which you wish to invoke auto focus routines — for small samples, especially plain small samples, step h is skipped]



Click on the Adjustments Page Icon



Select 3-Points Tab

- i** Go to 'faraday cup on holder'. measure current.



Click on Adjustments Page Icon

Select Positions Tab on Stage Control Module. Choose 'Faraday Cup on holder' position.



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Click on Exposure Page Icon

Select '<current position>' for the sake of measuring. Make certain beam is in fact going into the Faraday Cup (use 'spot' mode). Click on 'Measure'.



- j** **Open position list — either blank one that you drag .gds file into, or a complete one that you have saved previously.**



Click on Design Page

Open Design File (.gds) using Open Database file Icon



on the Database GDSII Module



Open New Positionlist by clicking on Positionlist Icon



Drag Design File into Positionlist.

Select Design File in Positionlist (highlight it) and right-click to obtain its 'Properties'.


Program the layer(s) to be exposed, the position (U,V) to do the exposure, and use the 'Calculator' to determine the 'Exposure Parameters'.

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- k **Make sure LEO is in scanning mode and not TV mode. It is okay if the beam is blanked or the scan is paused, but it needs to be in scanning mode.**
- l **Run position list by using pull down menu Scan and choosing ‘All...’)**

8 Unload/Shut Down

- a Click on  to display the Load/Unload page. Click on the Unload Sample button.



- b Hold down lid while turbo pump initiates pump-down of load lock.
- c When sample has been unloaded by the robot, and the load lock chamber is again vented, remove sample.
- d Exit the application on the **RAITH** computer (on the right).
- e Log off the application on the **LEO** computer (on the left).
[do not save SEM settings]
- f Disable the **Raith** in **CORAL**.