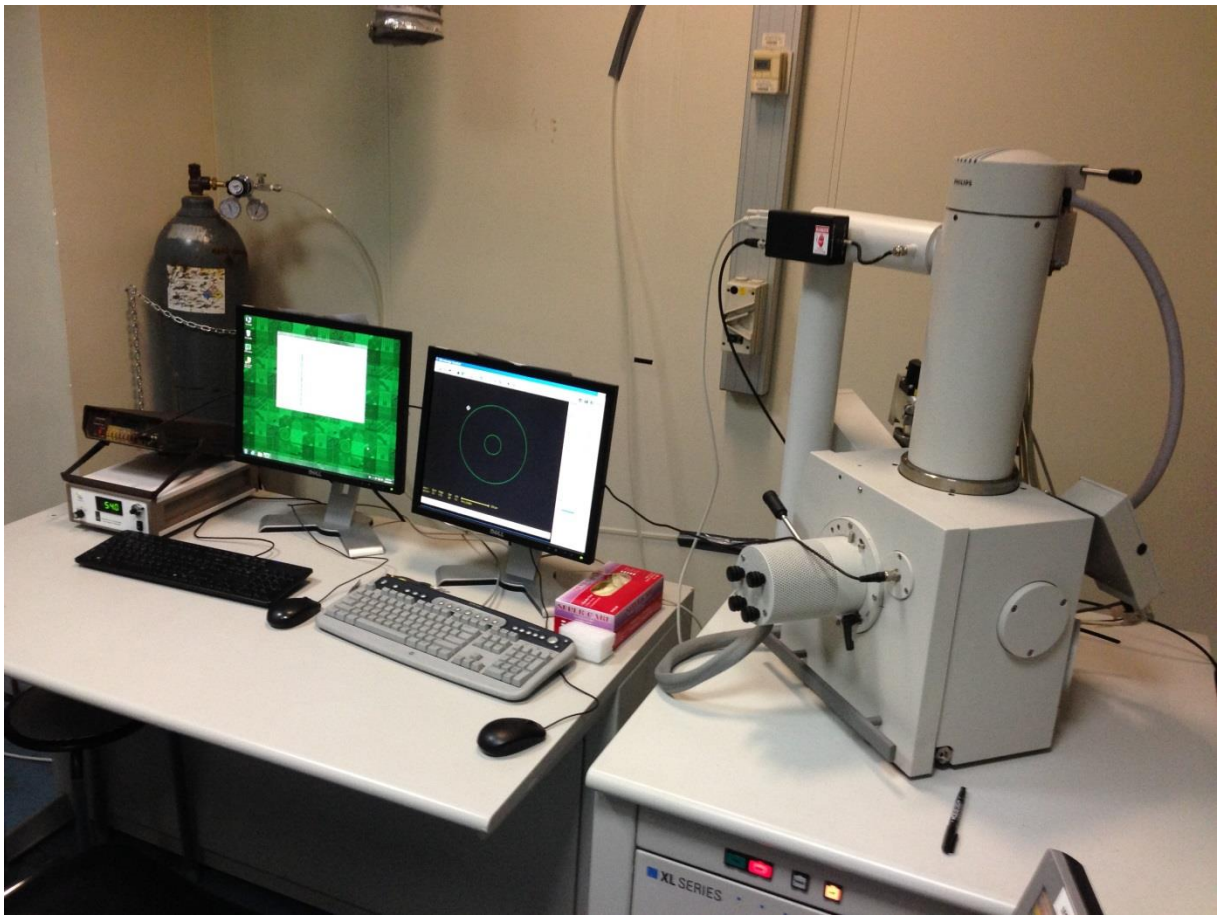
XL30 ESEM with NPGS SOP

This is a shortened version that focuses mainly on routine operation.

For more detailed instructions, please refer to the

user manual "XL-30" and "Nanometer Pattern Generation System"



1. Scope

1.1 This document provides operating procedures and requirements to take SEM image with FEI XL30 scanning electron microscope. Please refer to "Nanometer Pattern Generation System" manual for electron beam writing procedure.

1.2 System description

The FEI XL30 SEM uses the Nanometer Pattern Generation System for Electron Beam Lithography Writing. An SEM lithography system is a tool which can be used in a wide variety of applications. The basic lithography process allows patterns to be defined on a flat surface. The subsequent processing, such as metal evaporation or etching, will determine the final structure. NPGS is unique in that it provides a very flexible system which is ideally suited to the wide range of activities in basic research and R&D activities.

2. Before starting: Important note

2.1 You have to be authorized by Dr. Tang and properly trained by Dr. Tang's group member before operate the system.

2.2 This system is dedicated for electron beam writing system, which could be used to create sub 100nm fine structure. Although it can also be used for routine structure checking, no wet, biological or other contaminating sample allowed inside the chamber.

2.3 In order to keep efficient system cooling, the back panel is opened, which leads to potential electrical shock hazard. The backside of the SEM table area is restricted to authorized person only, which contain 10 kV power line.

3. General Control of SEM

Focus: **Right press mouse and drag left and right**

Stigmation adjustment: **Hold Shift and Right press mouse and drag left and right**

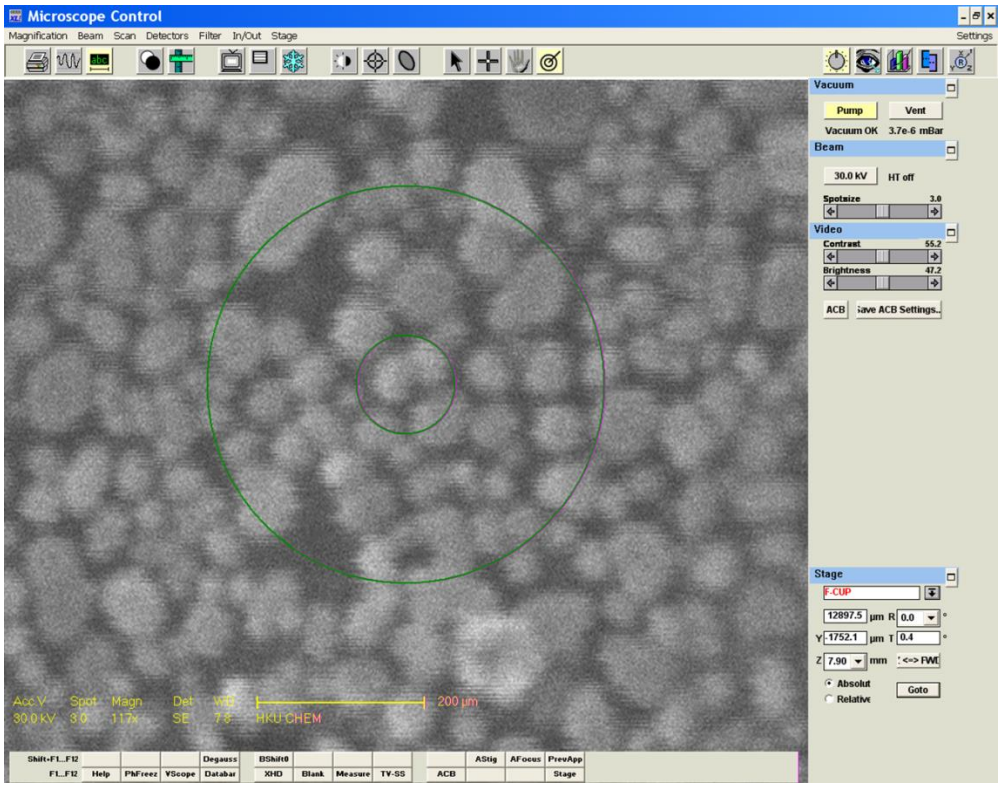
Magnify/De-magnify: **+/- on Numeric Pad**

Move sample: **Mouse left click in tracking ring**

Save image: **In menu In/Out → IMAGE. Please save under user folder only.**

Contrast and Brightness: **Under Video control zone, Contrast and Brightness can be adjusted separately. "ACB" button is for Auto contrast and brightness**

4. Software user interface



Magnification: Select and set specific magnification

Beam: Select beam accelerating voltage and spot size. (Spot size 1 is smallest)

Scan: Select scan speed and scan mode

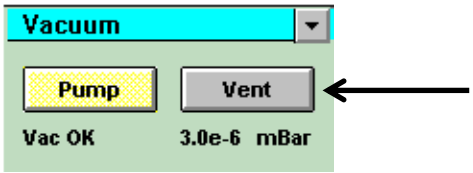
Detectors:	Select detector (only SE detector is available in this machine)
Filter:	Select Filter of image. Integration or Average is available for imaging
In/Out:	Input or output image or stage data.
Stage:	Stage control, which can align X or Y into specific direction of sample.

5. Operation instruction

I Load sample

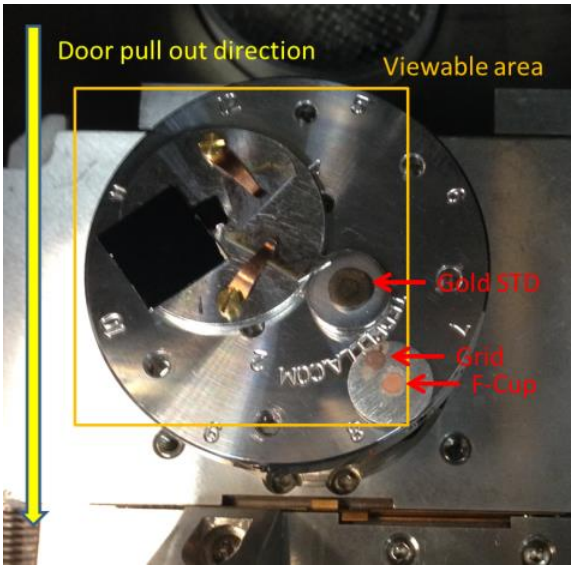
1. Check the system status. (1) Beam should be off; (2) The chamber pressure should be in 10^{-6} or 10^{-5} mbar region (ultimate pressure 3.0x10^{-6} mbar); (3) stage position is at F-cup. (4) The "HT" button on the main console is lighted. (5) The pico-ampmeter is ON(6) the Beam Blanker is switched to "ON" position.

2. Under VACUUM control area (upper right screen), click on VENT.



3. Click on YES (to ensure question), this will stop pumps and allow pressurized air to bleed into the instrument and bring up to atmospheric pressure (about 1.5 minutes).
4. Wear clean gloves. Gently open SEM door by pull the handle, and take out the sample holder with copper clips. Load the sample on the holder and secure it with copper clip, do not over tighten the screw.
5. Load the sample holder back to sample stage. Make sure the screw 1 and 2

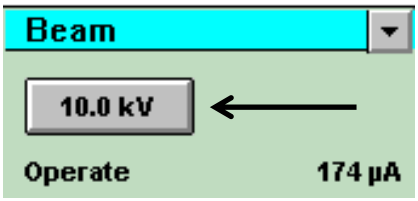
are in correct position and your sample are inside viewable area. Do not touch other standard samples on the stage.



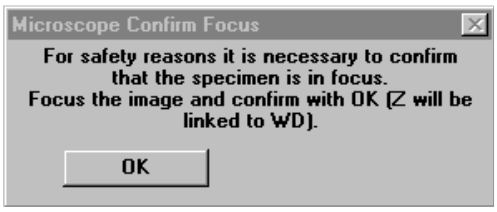
6. Close the chamber door carefully. DO NOT slam it or you may damage the O-ring of door. Note: Minimize the time that specimen chamber is at room pressure, which can speed pumping significantly.
7. Push the door firmly against the seal while clicking PUMP from VACUUM sub-manual.
8. Wait for about 3-5 minutes to evacuate the specimen chamber. The message VAC OK will be displayed, and wait for the another 3-5min for vacuum to be lower than $5x10^{-5}$ mbar.

II Obtaining an image and set working distance

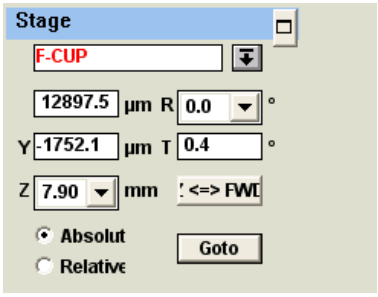
1. Choose a suitable accelerating voltage for sample from BEAM pull-down menu. 30kV is default.
2. Select spot size 3 from BEAM menu for general usage.
3. Click on the accelerating voltage button (30 kV) to start accelerating potential.



4. A dialogue box appears automatically at this point to remind the operator to link the Z positioning to Free Working Distance and prevent damage to either sample or lens. Click OK to continue



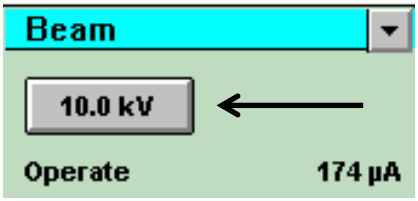
5. Use right mouse to focus the image on the edge of Faraday cup, get good focus at least 10000X and click Z->Fwd to transfer the focus position to sample position. **(This step is very important, and will tell the machine where your sample is. Skip this step could result crashing the stage into lens and severely damage the microscope!! Every time after stage move to a sample with different Z height, it is crucial to do another Z->Fwd to prevent crashing!!)**
6. Move to position of first or second screw by selecting it from stage menu and click Goto.



7. Image your sample, and properly focus and adjust stigmator to get good image. Save image into your folder (under user folder). To get clear image, slow scan 3/4 should be used.
8. **(Optional and dangerous)** If you want to select another z height of your sample, make sure carefully focus at least 10000X and click z->fwd before change Z height. Z height can be changed by input number into stage control and click Goto. **Z <7mm is not allowed** to normal user and offer no resolution advantage.
9. Save image in menu In/Out→IMAGE

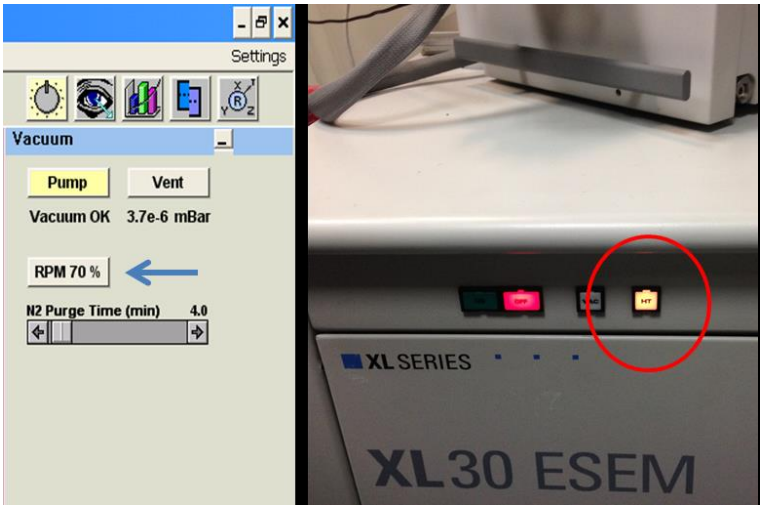
III Finish and Overnight Mode

1. Select F-Cup in stage control and click Goto
2. Turn-off Beam by click x kV (30 kV by default) in Beam control area.



3. Wait 5min for filament cooling down before vent the chamber and retrieve your sample.
4. Pump system back to vacuum, wait for “Vacuum OK” before leave the room. If you are the last person who uses the SEM today, expand Vaccum control

zone, and click “RPM 70%” to put pump into low speed mode. Press HT button on the SEM main console to put system into overnight mode.



IV Record your usage status on Log book.

V Copy image

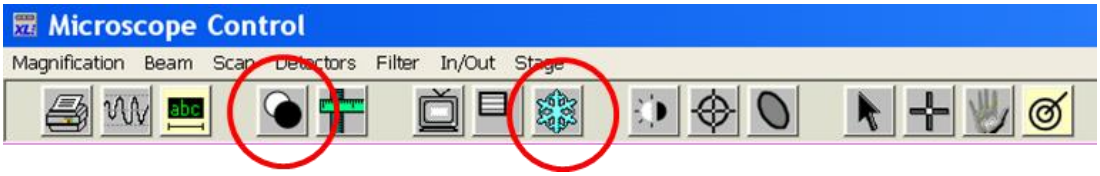
Image can be copy to USB stick through USB port on left (NPGS) monitor. Double click shortcut on the desktop can access to user folder and copy image to your USB flash drive.

Direct insert flash drive into SEM computer is **not allowed!!**

6. Trouble Shooting

A. I cannot get image

a) Check Beam is ON?
b) Beam Blanker is switched to “ON” position?
c) Video is not freezed



d) Magnification is not too high?
e) Contrast and Brightness too low?