**OPERATION OF THE PHILIPS CM-100 TEM**

When not in use, the CM-100 should be in the MICROSCOPE ON configuration with the HIGH TENSION ON (illuminates green when the high tension is on).

. The microscope is normally never turned off.

Preliminary

• Log in (in the hallway)

• Go to vacuum page by pressing button Ready then button Vacuum. Make sure pressure reading of

 IGP is below 20, preferably at 15 before proceeding to the next step.

**1. Specimen Holder Removal, Loading, and Insertion**

Never remove or insert the specimen holder when the red indicator light (on the front of the compustage housing) is on. Do not touch the leading edge of the specimen holder (from the o-ring to the tip) with ungloved hands. This portion resides inside the vacuum and must be kept clean.

There are several types of sample holders. The first type is single tilt (Alpha). The second type is double tilt (Alpha and Beta).

REMOVAL: To remove the specimen holder from the column, carefully pull the round black handle straight out until it stops, and hold it firmly so that it does not get pulled back into the 'scope by the vacuum. Now rotate it clockwise until it stops again; it may now be pulled straight out (carefully), free of the column. The specimen holder should be set down only on its Lucite stand.

**SPECIMEN LOADING:**

(i) Use the pin tool (located in the Lucite stand, under the tip) to lift the grid clamping device at the tip of the specimen holder.

(ii) Transfer your grid to the specimen holder using forceps. To make scanning the grid easier, you ma y wish to orient one set of grid bars parallel to the long axis of the specimen holder.

(iii) Use the pin tool to carefully lower the clamping device onto the grid and lock it in place.

**INSERTING THE SPECIMEN HOLDER INTO THE COMPUSTAGE:**

(i) Touch the sample holder tip to one of the aperture handle to discharge the sample holder.

(ii) Using the small pin near the holder tip as your reference, carefully insert the specimen holder into the airlock entryway at the center of the compustage, with the pin at the 4 O’clock position. Insertion of the holder will initiate the pre-pumping sequence, and the red indicator light on the front of the compustage will come on. Slide the holder in until it stops; at this point it will not go all the way in. (The data monitor screen will automatically open to the HOLDER SELECTION PAGE. Press the appropriate key (in most cases you'll choose NO COMPUSTAGE B-TILT) and then press the READY button (below the data monitor screen). The data monitor screen will return to the previously selected page (Vacuum).

(iii) After the red indicator light goes out, grip the specimen holder firmly by its black plastic handle and rotate it counterclockwise so that the pin on the handle lines up at the 6:00 o'clock position. When it reaches the limit of its rotation, the vacuum will begin to pull the holder deeper into the column. \*Maintain a firm grip on the handle as the holder enters the column so that it does not get drawn in too quickly. Once the holder appears to be all the way in, jiggle it very gently to ensure that it is indeed inserted completely into the column.

**2. Initiating Operation**

When the CM-100 is ON, the white STAND BY and red MICROSCOPE OFF buttons will be illuminated; the ON button will be dark. The lit buttons indicate their availability as emergency functions while the microscope is running.

Depress the PANEL DIM knob to illuminate the data monitor screen and emission gauge. Clockwise rotation of this knob increases the intensity of the panel lighting and the light on the flexible stalk. Clockwise rotation of the DATA DIM knob increases the brightness of the data monitor screen.

Ensure that the UHV and HIVAC indicator lights on the right side of the panel are lit (green). If they are not it may be necessary to press the VACUUM SYSTEM ON button and wait (20 to 30 minutes) until the two lights come on, indicating that operational vacuum status has been attained. The Vacuum Page will display the vacuum status. It should be in the READY state.

The data monitor screen will display the CM-100 PHILIPS MICROSCOPE STATUS startup page

or, more likely, one of the MODES or MODE SELECTION pages. Pressing the READY light (the pushbutton directly below the data monitor screen; to the right), will move the screen selection back in the hierarchy of pages. Press the MODES key to obtain the MODE SELECTION page.

For transmission electron microscopy, press the TEM key on the MODE SELECTION page. The screen should now display the TEM BRIGHTFIELD page.

Press the VACUUM key to check the vacuum status of the instrument. It should read READY at the top center of the data monitor screen. If it reads START-UP the operator must wait for the vacuum to improve before the scope can be used. Do not use the microscope unless the ion getter pump (IGP) reading is lower than 10.

To return to the TEM BRIGHTFIELD page press the READY button.

To select the operating voltage, press the PARAMETERS key to open the PARAMETERS pages. On the first of these pages the kV may be modified by pressing the left (lower kV) or right (higher kV) key adjacent to the HIGH TENSION kV notation on the screen. Most TEM users in this laboratory work at 100 kV.

Slowly increase the filament heating with the control knob on the panel. As a rule of thumb, rotate the knob until you hear a click; wait a few seconds; rotate again for one click; wait another few seconds; repeat until you hear a beeping sound which indicates the end.

Now you should see the beam on the main screen. Otherwise, make sure to remove all the apertures, Lower Magnification, and move sample around to make sure the beam is not blocked by the sample.

Move sample feature to the middle of the viewing area.

**3. Beam Alignment**

Using the MAGNIFICATION knob, select 16,000x.

Defocus the electron beam by turning the INTENSITY knob clockwise to strongly overfocus the

C2 lens. Bring the beam back to crossover (the smallest image of the beam) and center it using the

Beam SHIFT X/Y knobs on panel.

Choose a C2 aperture (usually position 3, which is a 100-micron aperture) by rotating the largest knurled knob on the topmost aperture control on the column to the desired position.

Using the INTENSITY knob, bring the beam to cross-over (smallest beam size). Center the beam (with Beam Shifts X/Y) to the small identifier mark on the screen. Now over focus the beam using the Intensity Knob (turning clockwise), until it is few inches in diameter. If the beam is not properly centered around the identifier mark on the screen, adjust its position using the Aperture Mechanism. The knob on the side of the mechanism (right side) and the middle knob on the front of it.

DO NOT TOUCH THE SMALLEST, INNERMOST KNOB BECAUSE IT UNSCREWS THE APERTURE ROD. Repeat these steps (3 and 5) until the beam spreads uniformly around the reference circle while being over focused (INTENSITY knob).

**Condenser Stigmation Correction:**

Press the STIG button, on the right-hand instrument panel, to open the STIGMATOR CONTROL

Page.

Press the COND key on the data monitor screen to select the Condenser lens stigmator. Use the MULTIFUNCTION X/Y knobs to correct the stigmation of the beam. When properly corrected, the beam should spread concentrically and not pulling directionally.

Press the STIG button to return back to the previous page.

**Adjusting Binoculars to view image on Focusing screen:**

Using the lever to the left of the viewing chamber, lower the small phosphorescent screen into

place. Insert the beam stop (at the right-hand side top of the viewing chamber) so that it will be visible across the small screen. Use the binoculars to observe the beam m stop. To adjust the binoculars for your eyes, first adjust the interpupillary distance so that you can see through them

with both eyes; then adjust each eyepiece so that the rough edges of the beam stop are in focus for

each eye. When you are done, retract the beam stop and lift the small screen back out of view.

**4. Eucentric Height Adjustment**

Set the MAGNIFICATION to about 4,000x and use the X/Y JOYSTICK to center a small notable feature of your specimen.

Focus the image with the Focus knob. The outer knob changes the

focus; the inner knob (the step size adjustment) modifies the a mount of focus change per 'click' of the outer knob.

From the TEM BRIGHTFIELD page, press COMPUSTAGE once; the COMPUSTAGE REGISTER CONTROL page will appear.

Press A-WOBBLER; this will initiate back-and-forth tilting of the goniometer.

Use the Z control lever on the JOYSTICK to move the specimen up or down and thus minimize

apparent movement of the centered feature.

When the feature moves only minimally or not at all, press the A-WOBBLER key to inactivate tilting; then press the READY button to return to TEM BRIGHTFIELD.

**5. Pivot Point Alignment**

Ensure that the specimen is eucentric before performing this procedure. For this procedure you ma y work with the OBJECTIVE APERTURE in place to protect your specimen. Center (X/Y JOYSTICK) and focus (concentric knobs under STEP SIZE) an image feature at about 20,000x (MAG knob).

Press the ALGN button to access the ALIGNMENT SELECTION page. (Note that the alignments are divided into PROCEDURES (on the left side of the page) and DIRECT alignments (most of which are on the right side of the page). Most users will not want to access the PROCEDURES, which are long and complicated. For this set of instructions we will be using only the DIRECT alignments.)

Using the INTENSITY knob, adjust the beam to crossover.

Press the beamcoils PIVOT POINT X key, on the right side of the page, so that it is highlighted. Using the MULTIFUNCTION X/Y knobs, bring the two beam spots (the pivot points, on the fluorescent viewing screen) together so that they overlap.

Center the coinciding spots using the SHIFT X/Y knobs. Press the beamcoils PIVOT POINT Y key.

Using the MULTIFUNCTION X/Y knobs, bring the two beam spots together so that they overlap.

Center the coinciding spots using the SHIFT X/Y knobs.

Press the ALGN button to exit the ALIGNMENT SELECTION page.

**6. Rotation Center Alignment**

This procedure may be performed with the OBJECTIVE APERTURE in place to protect the specimen and add contrast to the image.

Focus and center a feature of the specimen at 100,000x.

Press ALGN to open the ALIGNMENT SELECTION page. On the upper right-hand side of the page, press ROT CENTER so that it becomes highlighted.

(i) If the chosen feature shifts off center laterally, the beam is not aligned along the optical axis of the microscope and must be corrected.

(ii) Use the MULTIFUNCTION X/Y knobs to stabilize the feature at the center of the screen, eliminating all lateral movement. The feature should appear to be pulsating.

(iii) Press the ALGN button to return to the TEM BRIGHTFIELD page.

**7. Centering the Objective Lens Aperture**

For this procedure a specimen must be in place. Choose an area for which it is acceptable to sustain beam da mage. With the OBJECTIVE APERTURE out, set the magnification to about

3000x and overfocus the beam by turning the INTENSITY knob clockwise from crossover till it’s the size of the large viewing screen. Press the “D” button to put the 'scope in diffraction mode.

If necessary, adjust the CAMERA LENGTH to 470 mm using the MAG knob. Center the diffraction spot using the MULTIFUNCTION X/Y knobs.

Using the INTENSITY knob, refocus the bea m to the smallest, brightest spot.

Insert the OBJECTIVE APERTURE by rotating the aperture displacement lever below it to the left.

Apertures may be selected by rotating the largest knurled knob on the objective aperture assembly to any one of four numbered positions. (The APERTURE MEMO lists the dia meters and

positions of the apertures currently installed in the 'scope. It may be accessed from the TEM

BRIGHTFIELD page by clicking MODES and then CONFIGURATION.) Focus the shadow of the aperture with the FOCUS knob.

Once the aperture has been selected, center it using both the middle knurled knob in the series on the aperture assembly and the small knurled knob to the right side. Remember not to manipulate the smallest, inner most knob, which will unscrew the aperture rod.

Press “D” to exit diffraction mode.

**8. Objective Lens Astigmatism Correction**

Select an area that may be ima ged at high magnification without harming any desirable portions of the specimen. Increase the magnification to about 100,000x or higher and adjust the

illlumination so that the substructure or background grain of the specimen may be observed easily. The INTENSITY will have to be modified and the beam will have to be recentered using the SHIFT X/Y knobs (Deflectors) as the magnification is increased.

Set the focus step size to 2 and obtain a slightly underfocused image for maximum contrast. Press the STIG button to open the STIGMATOR CONTROL page. If it is not already highlighted, press the OBJ key on this page.

Use the MULTIFUNCTION X/Y knobs, one at a time, to obtain the sharpest possible image of the grain substructure.

Confirm that any astigmatism has been corrected by varying the focus (back and forth through

focus, from underfocus to overfocus) and watching to see if a "streaking" pattern emerges and changes direction between under- and overfocus. If the astigmatism has been corrected, the specimen will vary only in focus, with no pattern evident. Repeat steps 4 and 5 until no pattern is apparent.

Press the STIG button again to return to the TEM BRIGHTFIELD page.

**9. Condense Lens Astigmatism Correction**

This procedure is necessary if the bea m spot is not a symmetric circle when the intensity knob is rotated.

Press STIG button to open the STIGMATOR CONTROL page. Select Condense Aperture.

Use the MULTIFUNCTION X/Y knobs, one at a time, such that the bea m spot circle has a fixed center when the bea m intensity is changed.

**10. High Resolution Images**

Bring in the small screen into viewing cha mber. Looking through the binoculars, you can finely adjust focus and stigmation of your sample. Conversely, you can use the Digital Camera to correct focus and objective stigmation. Objective stigmation can be corrected using the FFT function of the camera control to make the Fourier image round.

 **11. Acquiring Digital Image**

Insert camera with toggle switch underneath camera block.

Log into PC (User name - .\cm100, password - cm100user).

Start camera software (icon - AMT capture Engine).

Click button "Click for Live Image".

Adjust intensity on microscope for correct exposure of digital image.

Click button "Click for Final Image" to acquire an image.

Save Image - select "File Tab", then "Save As...", then create a folder in the C:/Image folder.

Download images to your thumb drive using port on left side of monitor.