**HD-2700 Operating Procedure (updated by Mengkun March 23rd, 2020)**

1. **Check necessary softwares opened and turn on HV:**
   1. Check Hitachi STEM Control software open. **Those following windows** should be open in the **main monitor (left one)**:
      1. Scanning image
      2. Column setup
      3. HV control
      4. Pneumatic control
      5. Stage control
      6. Raster rotation
      7. Lens control
   2. Those windows should be open in the **aberration correction monitor** **(second left one)**:
      1. Hitachi Cs corrector control (software)
      2. Degauss
      3. History
      4. CCD operation
      5. Transmission image
   3. Check **Digital Micrograph** for image acquisition is opened.
   4. If HV is off, you are starting from cold: perform High Flash (Flashing, are you sure?” -> click “execute”) one time or a few times **until flash current >0.5mA**, and then turn on 200 KV
2. **Loading standard holder and finding SiNx membrane**
3. Check the cold trap on the left side of the instrument; if empty, fill with liquid N2.
4. Check whether the standard holder(single tilt, marked ‘1’ at the end of the holder) is in the STEM. Load it if not:
   * Wear gloves
   * Remove holder from Zone station, insert holder (straight in, **no rotation!**) into STEM airlock & pump. Then flip the switch up to pump the airlock.
   * Wait for audible indicator, as well as green light
   * Rotate holder 45o to right (clockwise), to mid-position, then 10oleft (counter-clockwise), to fully insert.
   * In the software, Stage control: holder -> standard
5. Open IP3 valve when column vac is below 2x10-5Pa.
6. Open GV when column vac is **below 7x10-6Pa** (even higher vacuum is better).
7. Find sample:
   1. Low mag mode: go to low mag mode by click ‘H/L’. The right tag will show ‘LM’ after the mag. Find your sample in low mag, center it with increasing the mag to highest (1K). Note: use **‘obj’** for focusing at low mag mode.
   2. High mag mode: focus with **Z**, mag set to at least 1000Kx. Reset obj. **Do not focus using obj unless the sample is closed to focus using Z**.
8. **Aberration correction:**
9. Check the operation mode is Ultra High Resolution (highest resolution) or High resolution mode (high resolution + high current)
10. Hitachi STEM Control: Press Ronchiagram button (blue hexagon button) in STEM GUI
11. Degauss: click Start twice
12. (optional: Use coarse focus to align current center using DEAL. Turn off DEAL and switch to aperture when done)
13. Align A1/B2
    * To align A1, you need to use focus to find a point where the distortion at the center of the image **starts to** change from one direction to another 90 degree perpendicular to previous one. Then use up and down, left and right to make the center of image as large as possible. Then, you might need to refocus, find this point and repeat the correction again.
    * To align B2, you need to use focus to make the aberration **only at one side, and do not allow aberration showing at the center!** Then use up and down to correct B2 aberration at up and down sites, and use left and right to correct B2 aberration at left and right sides.
    * Repeat to correct A1 and B2 until you see a large and flat aberration free zone (like a membrane) at the center of the image.
14. Reset Obj and then focus using Z. Make sure mag >1300Kx. Check ‘fine’ and ‘all’ are selected, and click ‘start’. High order aberration will be corrected automatically.

Auto Correction if the aberrations are too bad (not recommended to use it in other cases): Reset Obj and then focus using Z. Make sure mag >1300Kx. Check coarse and all, and click ‘start’.

1. (optional) After high order aberrations are corrected, normally there are very small residual A1/B2. The software can finely tune them. Select ‘Fine’ and switch ‘all’ to ‘A1/B2’. Put aperture 2 in and center it, and the click ‘start’. Do not forget to switch back to ‘all’ after the correction finished.
2. Align aperture 3 and 5 in center using x and y knobs. Make sure you select the **aperture alignment**.
3. Turn off Ronchiagram and now you can image your sample.
4. **Loading your sample holder and starting to image**
   1. close GV **(very important!)**
   2. Reset sample holder **(very important!)**
   3. Wear gloves
   4. change IP3 switch to CLOSE
   5. Pull sample holder straight out about 1 inch, until it catches, then
   6. Rotate sample holder 10o to right, (this is mid position) then
   7. pull straight out until it catches again, and
   8. rotate holder 45o to left; **release your hand** (**Do not further take the sample straight out!**)
   9. change airlock switch to AIR; wait the light turns red and then turns off, retract it to remove holder completely
   10. Take clean holder from Zone station, insert it into STEM airlock & pump (switch in up position)
   11. Wait for audible indicator, as well as green light
   12. Rotate holder 45o to right, to mid-position, then 10oleft, to fully insert
   13. when column vac is below 2x10-5Pa., open IP3, then open GV when below 7x10-6Pa
5. Align crystal zone axis if necessary.
6. Lens Reset – focus with Z axis.
7. Hitachi Cs corrector control use A1/B2 on small settings to adjust astigmatism on sample. HD stigmators can be used after the image is as good as possible, with A1 on middle setting.

Note:

* when the Ie is less than 6µA, close the gun valve. Click ‘Flash’ (Flashing, are you sure?” -> click “execute”). After flashing is finished, open the gun valve.
* If you would like to do EDS, contact me (Mengkun Tian) for training. EDS experiment might require you to tilt the sample 15 degrees.

**Daily Shutdown:**

HV Control:  Emission Control Off

HV off

Reset holder

            Close GV

            Close IP3

Remove sample from column (repeat a-i in section 4 ‘Switch the alignment grid to the holder loaded your sample’)

Insert the standard sample in (repeat a-b in section 2 ‘Loading standard holder and finding SiNx membrane’)