

# **Precision Ion Polishing System (PIPS)**

The Precision Ion Polishing System (PIPS) is a user friendly bench top, precision ion polisher designed to produce high quality TEM specimens. Ion polishing is done by two miniature Penning ion guns (PIGs) aimed at glancing angles of incidence to the specimen. Low sputtering angles have the advantage of minimizing radiation damage and beam heating while at the same time producing specimens having exceptionally large, clean electron transparent areas.

## **Beam Alignment of PIPS**

The procedure mentioned below should be followed for aligning the left and right ion beams of PIPS:

1. Start with no specimen on stage.
2. Place air-lock chamber cover.
3. Press Vacuum till the green LED glows.
4. Lower the air-lock controller button.
5. Set both the gun angles at TOP 10°
7. Set ion beam energy at 4 keV.
8. Set the timer for 10-15 minutes.
9. Toggle beam modulation switch to “Off”.
10. Close both the gas flow knobs completely.
11. Switch off the left and right gun switches.
12. Ultimate vacuum without gas flow should be noted. Check for good vacuum with a chamber pressure (e.g. 2 to 3e-06 Torr). (If vacuum pressure goes beyond 5e-06 Torr, the problem needs to be checked).

13. Turn on toggle switch of left and right gun. Check that the pressure will still remain at 2 to 3e-06 Torr.
14. Turn off the right gun switch and keep the left gun switch on.
15. Start the timer and slowly open the left gas flow knob and check that the pressure will decrease and Left gun current will increase up to a peak value.
16. Start optimizing the current for left gun first. Open left gas flow knob slowly and check the left gun current.
17. At the peak point, just rotate the knob so that current value is reduced to 10% of peak value (e.g. 10% of 77uA is approx. 70uA). Then switch off Left gun toggle switch.
18. Repeat the same process for right gun current setting. Check that the optimum current displayed for both the guns will be nearly same.
19. Switch off the Timer and gas toggle switch.
20. Raise air-lock chamber (wait till it is fully raised).
21. Press Vent twice and open air-lock chamber cover
22. Place the white screen on specimen holder and cover the air lock chamber. Hold the Air lock cover and press VAC switch till the green LED glows.
23. Lower the Air-lock chamber and keep the modulation in OFF mode.
24. Start the Timer and check the ion-beams on the white screen, for both left and right guns. Both the beams should be narrow, focused and aligned, passing through the centre.
25. If the beams are not focused, then rotate the gas knob slowly and adjust the beam width.
26. If beam is not lying at the centre of the screen, then adjust the x-y direction stage by using multi tool kit.
27. Align both the beams at the centre of the screen properly.
28. Switch OFF the Timer.

29. Raise the air-lock chamber.
30. Vent the chamber by press the VENT switch.
31. Remove Air-lock cover and screen.
32. Re-place Air-lock cover and create vacuum by pressing VAC switch.
33. Note down the ion-milling currents of both the guns in the log book, before loading your sample.

### **Checking the Beam Alignment of PIPS**

The procedure mentioned below should be followed for checking the Beam Alignment of PIPS before loading every sample:

1. Raise the specimen mount holder in air-lock chamber (wait till it is fully raised).
2. Press Vent twice and open air-lock chamber cover (If air-lock cover is out for a long time, clean it with dry tissue paper).
3. Place white screen on specimen stage.
4. Again place the air-lock cover.
5. Press Vacuum (VAC) button till the green LED glows.
6. Press Air-Lock switch to lower specimen.
7. Set both the gun angles at TOP 10°.
8. Set rotation speed at 3 rpm.
9. Set ion beam energy at 4 keV.
10. Set the timer for few minutes.

11. Toggle beam modulation switch to “Off”.
12. Start the timer and check the ion-beams on the white screen, for both left and right guns.  
Both the beams should be narrow, focussed and aligned, passing through the centre.
13. If the beams are not sharp and are not passing through the centre, then align them using x-y direction screws which are located on Ion Beam Guns.
14. Stop the timer and repeat steps 1 and 2 to remove the white screen.
15. Repeat steps 4, 5 and 6 to check optimized currents in both the guns without any specimen on stage.
16. Start the timer and check that both the gun-currents will be very close, e.g. Left gun current =  $44\mu\text{A}$  and Right gun current =  $45\mu\text{A}$ .
17. Note down the ion-milling currents of both the guns in the log book, before loading your sample.

## **Operation:**

### **Filling the Dewar:**

1. Raise the stage into the airlock.
2. Fill the dewar with liquid nitrogen.
3. After about ten minutes the boil off rate will have slowly dramatically. Top off dewar
4. Placed supplied lid on dewar.

Note that the liquid nitrogen last 3-4 hours if the heater is not being used.

### **Loading sample:**

1. Raise air lock chamber.
2. Wait 10 minutes.
3. Vent the airlock by holding down the vent button, and remove the air lock cover.
4. Insert sample.
5. Replace the air lock cover. Hold down the Vac button.
6. When Vac light illuminates, press the airlock control switch.

7. After the stage is lowered and being to rotate, wait ten minutes for the sample to cool down.
8. Begin milling.

### **Removing Sample:**

1. Raise the stage into the airlock.
2. Wait ten minutes.
3. Vent the airlock by holding down the Vent button, then remove the airlock cover.
4. Remove specimen post.

### **Raising the LN Dewar Temperature:**

1. Remove the sample.
2. On the PIPs cold stage controller, switch the toggle switch to the Dewar Heater position.
3. Wait until the display reads 23 0 C and Dewar Heater LED switches from orange to green.  
This typically takes less than one hour.
4. Switch the PIPS cold Stage Controller toggle switch to the *OFF* position.

### **Setting the sample Temperature:**

1. Raise the stage into the airlock.
2. Fill the Dewar.
3. On the PIPS Cold Stage Controller,
  - Set the set-point knob. The current set-point should be displayed.
  - Rotate the set point knob until desired set- point displayed.
  - Release the set point knob.
4. On the PIPIS Cold Stage Controller switch the toggle switch to conductor heater position.
5. Lower the stage.
6. Wait ten minutes for the sample temperature to stabilize.

## **PIPS – Operating Procedure**

1. Raise air-lock chamber using air-lock switch (wait till it is fully raised)
2. Press Vent once (an LED will glow, air-lock chamber cover cannot be opened now)
3. Press Vent again
4. Open air-lock chamber cover
5. Load your sample in sample-holder and mount it inside the air-lock chamber
6. Replace air-lock cover
7. Press Vacuum button and continue pressing it for few seconds until the LED glows
8. Lower the air-lock chamber
9. Set the gun angles for each gun
10. Set rotation speed at 3 rpm
11. Set ion beam energy at 4 keV
12. Set desired time interval on the timer
13. Toggle beam modulation switch to „Single“ or „Double“ (preferred)
14. Press „Start“ button on timer and close the shutter
15. After ion milling is complete, repeat steps 1, 2, 3 and 4 sequentially, to unload the sample holder from the air-lock chamber
16. If no more samples are to be loaded, repeat steps 6, 7 and 8 sequentially, to keep the system in vacuum.