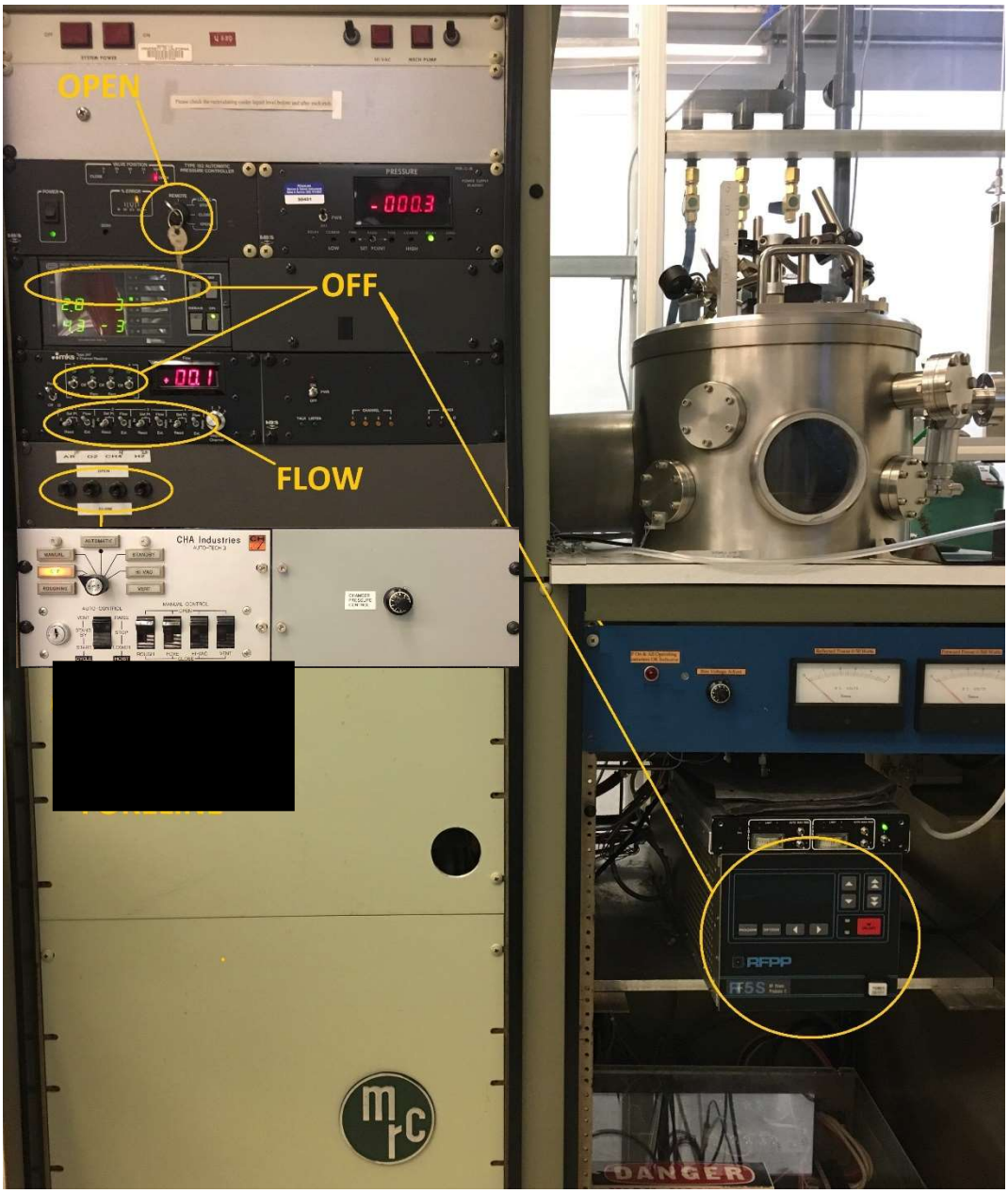
RIE #2 Operation

Pre-Operation Checks

- The chiller display is reading approximately 50°C.
- RF power supply is off.
- All four gas channel switches on the MKS Type 247 4 Channel Readout are in the Flow position.
- All four gas flow switches on the MKS Type 247 4 Channel Readout are in the Off (middle) position.
- All four gas flow isolation switches are in the CLOSE position.
- Throttle valve key is set to OPEN (fully clockwise).
- The IG is off on the 307 VACUUM GAUGE CONTROLLER.
- The CHA AUTO-TECH II vacuum controller is in MANUAL mode.
- HI-VAC and FORE switches are in OPEN, ROUGH and VENT are in the CLOSE position.



- The middle of collar on the top of the anode plate feedthrough is in line with the arrow on the scale and the top of the collar is pretty much even with the top of the rod. It should look as pictured here:

Pre-Operation Chamber Configuration and Conditioning

1. Before running any samples in the system, you must make sure the correct anode plate and quartz plasma confinement cylinder are in the chamber.
2. You can verify this by checking the set that is out on the table next to the system. The quartz cylinder should be sitting on the black rubber mat with matching anode plate next to it. The backside of the anode plate is engraved with either InP or ITO.
    - **The InP plate and cylinder must only be used for etching InP, InGaAs, and other like materials.**
    - **The ITO plate and cylinder must only be used for etching ITO and II-VI compounds.**
    - If you are unsure which set you should use, please contact Staff.
3. If you need to swap the set out, perform the following:
    a. Vent the chamber per Steps 1 – 3 of the Operation Section.
    b. Open the chamber lid and carefully remove the quartz cylinder. Gently place it on the table, preferably on some wipes.
    c. While holding the anode feedthrough standoff, unscrew the anode plate. Take care not to allow the standoff to twist/turn while loosening the plate.

d. Screw in the other anode plate until it is snug, again take care not to allow the standoff to twist/turn while tightening the plate.
e. Install the other quartz cylinder and close the chamber lid. Place the cylinder you removed on the black rubber mat.
f. Pump down the chamber per Steps 6 – 9 of the Operation Section.

4. Run an Initial O_2 Clean run followed by a Seasoning run. Refer to Steps 9 – 18 of the Operation Section for instructions. Run conditions are as follows:
   - Initial O_2 Clean: 0_2 at 20 SCCM, Chamber Pressure= 125 mT, Bias Voltage= -500V, Time= 30 min
   - Seasoning: (MHA Etch) $CH_4/H_2/Ar$ at 4/20/10 SCCM, Chamber Pressure= 75 mT, Bias Voltage= -500V, Time= Longer than your first etch

Operation

1. Move the HI-VAC switch down to the CLOSE position and wait until you hear the valve close.
2. Move the FORE switch down to the CLOSE position
3. Move the VENT switch up to the OPEN position.
4. Once the chamber is vented (you will hear air escaping from the chamber), Move the VENT switch down to the CLOSE position.
5. Open the chamber lid, change the tooling if needed (Pre-Operation Step 3), load your sample on the stage, and carefully close the chamber lid.
6. Move the ROUGH switch up to the OPEN position.
7. Wait for a reading of 40 – 50 mT on the PRESSURE display and then move the ROUGH switch down to the CLOSE position.

8. Move FORE switch up to the OPEN position, wait 2 seconds and then move the HI-VAC switch up to the OPEN position.

9. The reading on the PRESSURE display should zero out. Once it does, turn on the ion gauge by pressing the IG1 button on the 307 VACUUM GAUGE CONTROLLER and wait for a pressure of 3.0E-5 or below (next to IG) before proceeding.

NOTE: If the pressure is slow to drop, make sure the throttle valve key is turned to the OPEN position (fully clockwise).

10. Using the MKS Type 247 4 Channel Readout, select the required gas channel by using the Display Channel dial. Check the current gas flow rate setting (SCCM) by holding up the Set Pt. switch for the selected channel. If you need to adjust, turn the small set screw underneath the Set Pt. label (for the selected channel) and then verify the actual value in the following step. Repeat as needed for additional channels.

11. Set the CHAMBER PRESSURE CONTROL dial to zero, fully counterclockwise.
12. Turn off the ion gauge by pressing the IG1 button on the 307 VACUUM GAUGE CONTROLLER.
13. Begin flowing gas into the chamber:
    a. Starting with the gas that has the highest flow rate (H_2 for the MHA etch), move the gas isolation switch up to the OPEN position. If you see a pressure burst, allow the chamber pressure to drop and stabilize before proceeding.
    b. Turn on the gas channel by moving the appropriate switch on the MKS Type 247 4 Channel Readout up to the On position (green LED should illuminate). Make sure the displayed flow rate is set at the correct set point for the process. The above picture shows a 02 run at 20 SCCM. Allow the chamber pressure to drop and stabilize before proceeding.
    c. Repeat the above steps for any other gases, going in order of highest flow rate to lowest flow rate (Ar then CH_4 for the MHA etch).

14. In order to see a correct chamber pressure, turn the throttle valve key counterclockwise to the CLOSE position until the VALVE POSITION gauge gets to approximately 25% then turn the key counterclockwise to the REMOTE position. This chokes down the orifice valve between the chamber and the turbo pump and allows the chamber to build up pressure.

15. Use the CHAMBER PRESSURE CONTROL dial to <u>slowly</u> adjust the chamber pressure (PRESSURE display) to the desired value. The scale on the dial is fairly accurate, 1/10th of a turn is ~10 mT and a full turn is ~ 100 mT.

NOTE: If you adjust the chamber pressure up too fast, you may exceed the upper pressure set point of 150 mT and cause the HI-VAC valve to close. Decreasing the chamber pressure at this point will do nothing as there is no pumping on the chamber occurring. To rectify this, do the following:

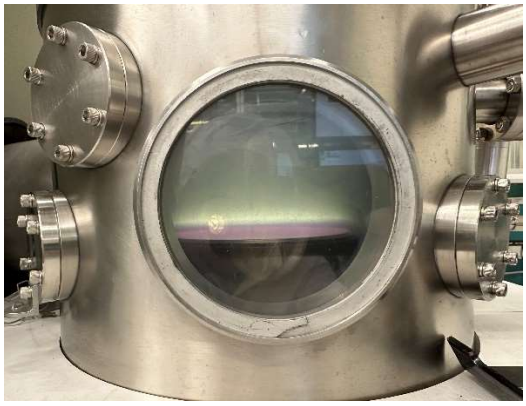
a. Turn the throttle valve key fully clockwise from REMOTE to OPEN.
b. Turn off all the gas channels in use by moving the switches down to the Off (center) position.
c. Move all the gas isolation switches in use down to the CLOSE position.
d. Move the HI-VAC switch down to the CLOSE position.
e. Move the FORE switch down to the CLOSE position.
f. Return to Step 6.

16. Verify that the RF matching network (located on top of the RF power supply) is ON (switch is up, green LED on) and both toggle switches on are set to AUTO (left position).

17. Turn on the RF power supply by pressing the white POWER ON/OFF button, the power supply will perform a brief start-up, and then you can set your voltage with the Bias Voltage Adjust dial. When adjusting the bias voltage, verify your setting on the RF power supply display (next to Set), not on the dial's scale.

18. Using the up and down arrow keys on the RF ON timer, set the etch time (mm:ss). The longer you hold down an arrow key the faster the display will change.

19. Press the START/STOP button on the RF ON timer to start your etch (strike a plasma). The red light should turn on indicating the RF is operating properly (you should also see a plasma in the chamber viewport) and the timer will begin to count down.



20. On the RF power supply display, check to make sure there is little to no reading for reflected power (R) and that the forward power (F) reading is similar to recent like-runs (reference the logbook for this value).

21. When the timer reaches zero, the RF power will turn off. Perform the following:
    a. If you are venting the chamber, power off the RF power supply by pressing the white POWER ON/OFF button.
    b. Turn the throttle valve key fully clockwise from REMOTE to OPEN.
    c. Turn off all the gas channels in use by moving the gas flow switches down to the Off (middle) position.
    d. Move all gas isolation switches in use down to the CLOSE position.
22. Vent the chamber per Steps 1 – 4, remove your sample, and pump the system back down per Steps 6 – 8.

Wet Clean of Chamber Components

A wet clean of the quartz cylinder and anode plate are recommended in the following instances:

- If your samples are coming out contaminated/dirty.
- If the anode plate or quartz cylinder appear especially dirty (brownish yellow color), a wet clean is recommended.

A wet clean is performed as follows:

1. Get green Scotchbrite, wipes, and isopropyl alcohol (or acetone). There are pre-cut pieces of Scotchbrite at the system.
2. Carefully remove the quartz cylinder from the chamber and place it on some wipes on a table.
3. Wet wipes with isopropyl alcohol (or acetone) and wipe the interior of the quartz cylinder. **! DO NOT USE SCOTCHBRITE ON THE QUARTZ CYLINDER, IT WILL SCRATCH IT!**
4. Wet the Scotchbrite with isopropyl alcohol (or acetone) and scrub the surface of the anode plate.
5. After scrubbing, wipe the cleaned surfaces with wipes and isopropyl alcohol to remove any particles left behind from the Scotchbrite.
6. Blow off the cleaned surfaces with an N2 gun.
7. Reinstall the anode plate and carefully return the quartz cylinder to the chamber.