MARCH PX-250 PLASMA ASHER

STANDARD OPERATING PROCEDURE

Purpose of this Instrument: This instrument is for cleaning substrates using oxygen plasma.

Location: Engineering Sciences Building (ESB) G75C1 Cleanroom

Primary Staff  Secondary Staff Contact:
Harley Hart                    Dr. Weiqiang Ding
(412) 443-1514 (M)            (304) 293-9683 (O)
(304) 293-5847 (O)                (304) 685-1938 (M)
Office: White Hall 409          Office: ESB G75D
harley.hart@mail.wvu.edu        weiqiang.ding@mail.wvu.edu

The Shared Research Facilities are operated for the benefit of all researchers. If you encounter any problems with this piece of equipment, please contact the staff member listed above immediately. There is never a penalty for asking questions. If the equipment is not behaving exactly the way it should, contact a staff member.
1. Reserve the instrument in CORES and login using the CORES kiosk in the cleanroom gowning room.

2. Before gowning and entering the cleanroom, go to the chase area and locate the oxygen cylinder with “Oxygen Plasma Asher Gas” marked on the wall. Ensure that the cylinder is open.

**NOTE:** If the cylinder is closed, open the oxygen bottle by turning on the main valve of the oxygen gas tank and the needle valve on the pressure gauge. Do NOT change the pressure gauge setting, which should be at 30 psi.

3. Sign into the logbook at the instrument.

4. Write down your name and process information on the log book.

5. Turn on the unit by pressing the large green button labeled **ON** located on the Process Control Panel of the instrument.

6. Make sure that the RF generator (on top of the plasma asher) powers up with the system. If it does not, find the breaker located on the back panel of the RF generator unit and turn it on.

7. Turn on the purging nitrogen gas valve on the wall next to the oxygen plasma asher (Figure 1) if it is turned off. The valve is shown in the close position in Figure 1. The valve handle will be parallel to the pipe when opened.
8. The chamber should be under vacuum when idle. To open the asher, vent the chamber by pressing the MAN OP switch (LED illuminated) and then the BLEED switch (LED illuminated). The chamber will be pumped down to a preset base pressure (see Step 9 in next section for more information about base pressure) and then be vented to atmosphere with the nitrogen purge gas. A loud venting noise will be heard when the BLEED process starts. All the button placements are shown in the Figure 2.

![Figure 2: Process control panel of the plasma asher](image)

9. When the chamber is vented to air, the loud venting noise becomes louder. Press the MAN OP switch again (LEDs extinguished) to stop the BLEED process. The bleed process will automatically stop after 30 seconds if the MAN OP switch is not pushed.

10. Unlock the locking hook. Open the process chamber door.

**WARNING:** Do not open the door until the bleed process has stopped. The chamber is under high pressure during the bleed. Prematurely unlocking may result in the door flying open and causing injury.
11. Load your specimen into the process chamber on the center shelf. The instrument is configured so that the center shelf acts as the cathode, where the samples should be loaded. Lock the chamber door.

**SET PROCESS PARAMETERS**

**NOTE:** The process parameters are dictated by the desired user process. If you need help in determining the appropriate process parameters, please see a Shared Research Facilities staff member. Values shown here in parentheses are recommended values that will create an oxygen plasma for instrument operation verification.

1. Toggle the PROGRAM button to select the program number in which you wish to enter your desired process parameters (generally program #1). There are 9 program channels available.

2. Press the MAN OP (LED extinguished) switch to select Automatic mode of operation (LED extinguished).

3. Program the Gas Settings:
   a. Toggle the R DISP switch to read the GAS1 (gas channel 1, the oxygen gas channel).
   b. Toggle the gas SET/READ switch to the SET position (LED illuminated).
   c. Adjust the gas set point (e.g., 49 sccm for a process pressure of ~ 300 mTorr) by using the INCR/DECR switches.

**NOTE:** The required flow to achieve a set pressure will change with time as the level of oxygen in the cylinder changes.

   d. Toggle the gas SET/READ switch to the READ position (LED extinguished) to save the parameter.

4. Program the Process Pressure:
   a. Toggle the L DISP switch to read PRESS.
   b. Toggle the SET/READ switch to the SET position (LED illuminated).
   c. Adjust PRESS to 0 using INCR/DECR switches because this system does not have an independent pressure control option installed.
d. Toggle the gas SET/READ switch to the READ position (LED extinguished) to save the parameter.

5. Program the Process Power:
   a. Toggle the L DISP switch to the PWR position.
   b. Toggle the SET/READ switch to the SET position (LED illuminated).
   c. Adjust the PWR to desired level (e.g., 50 W for surface cleaning) using INCR/DECR. The maximum power of the system is 300 W.

6. Set the End Point:
   a. Toggle the L DISP switch to the ENDPT position.
   b. Toggle the SET/READ switch to the READ position to check if the ENDPT value is set at 100. If not, toggle the SET/READ switch to SET position. Use the INCR/DECR switches to set the ENDPT to 100, which deactivates the ENDPT option because this system does not have an Endpoint Detection option installed.
   c. Toggle the gas SET/READ switch to the READ position (LED extinguished) to save the parameter.

7. Set the Process Time:
   a. Toggle the L DISP switch to the TIME position.
   b. Set the process time to the desired length in seconds (e.g., 120 seconds) using the DECR/INCR switches.

8. Set the DC Bias:
   a. Toggle the L DISP switch to the DCBIAS position.
   b. Adjust the DC bias to the desired setting (e.g., 5 for thin samples) using the DECR/INCR switches.

9. Set the Base Pressure:
   a. Toggle the L DISP switch to the BP/RP (Base Pressure/Reflected Power) position.
   b. Adjust the chamber evacuation pressure (base pressure) to 80 (i.e., 80 mTorr) using the DECR/INCR switches. The base pressure is a pressure level that must be reached before the oxygen gas flow can be activated. Setting a lower base pressure will result in a longer pumping down time in the process.
10. When you have finished setting all parameters in the program (e.g., program #1), advance to the next program number (e.g., program #2) by toggling the L DISP switch to the TIME position. Use the INCR/DECR switches to adjust this program’s TIME value to zero.

**NOTE:** If the TIME value of the next program (program #2) is greater than zero, the program controller will automatically start the next program (program #2) after the current program (program #1) finishes.

11. Save the parameters by depressing SET/READ to READ (LED extinguished). The parameters will be stored in the Process Controller memory.

**NOTE:** You should record all process parameters in the log book and in your laboratory notebook for future reference. The WVU Shared Research Facilities Cleanroom is a multi-user facility, and cannot guarantee that program parameters are not modified by other users.

---

**RUN THE PROGRAM**

1. Toggle PROGRAM to your programmed program number (e.g., program #1).

2. Press the START switch. The system will run the process in Automatic mode as follow:
   a. The chamber will be pumped down to the preset base pressure (VAC ON and PRESS LED illuminated);
   b. Gas flow will then be turned on (GAS ON LED illuminated);
   c. RF power will be turned on (RF ON LED illuminated);
   d. The sample will be processed until the programmed time has elapsed.

3. You can monitor the amount of time remaining and the actual conditions of power, pressure, reflected power and gas flow in the chamber at any time during the process as follow:
   a. Toggle the SET/READ to READ position (LED extinguished);
b. Toggle the L DISP for PRESS, POWER, TIME and RP parameter reading. The POWER reading can also be seen on the RF generator display during the process.

c. NOTE: If the POWER reading during the process is different from the set POWER value in the program, contact a Shared Research Facilities staff member for help.

d. Toggle the R DISP for GAS1 percent flow readings while the SET/READ is at READ position (LED extinguished).

**NOTE:** The outer door to the chamber can be opened during the process to check the oxygen plasma. This door should not be left open the entire time.

**WARNING:** If you see any arcs, bright, flashing lights, or flickering in the plasma during the process, stop the process immediately by pressing the STOP switch or by pressing the RED emergency off button next to the green start button. Notify a Shared Research Facilities Cleanroom staff member immediately.

4. You can terminate an uncompleted process anytime by pressing the STOP switch. The gas flow will be stopped, the RF generator will be turned off, and the chamber will be isolated from the vacuum pump. The system is reset to a ready state with Program #1 selected. Pressing the START button at this point will start the process from the beginning.

5. When the process finishes, the program controller will automatically turn off the RF power and gas flow (RF ON and GAS ON LED extinguished). Afterwards, it will pump down the chamber to the preset base pressure and then start venting to the atmospheric pressure (BLEED LED illuminated, a loud venting noise can be heard).

6. When the chamber is at the atmospheric pressure, the BLEED LED will be extinguished.

**WARNING:** Do not open the door until the bleed process has stopped. The chamber is under high pressure during the bleed. Prematurely unlocking may result in the door flying open and causing injury.

**TURNING OFF THE SYSTEM**
1. Unlock the locking hook. Unload the specimen from the process chamber.

2. Close and lock the chamber door.

3. Manually pump down the process chamber by pressing the MAN OP switch (LED illuminated) and then the VAC ON switch (LED illuminated).

4. Press the PRESS switch to monitor the chamber pressure.

5. When the chamber pressure reading is below 100 mTorr, depress the PRESS, VAC and MAN OP switches (LEDs extinguished). Leave the system on.

   NOTE: If you need to shut down the system, push the big red button on the front panel.

   Sign out of the CORES using the kiosk in the gowning room.


7. Clean up the working area before leaving the room.

8. Go to the chase area. Close the main valve of the oxygen gas tank and the needle valve on the pressure gauge.
**EMERGENCY SHUT-DOWN PROCEDURES**

If, at any time, the user needs to contact someone for help, call or locate the following staff of the Shared Research Facilities (SRF):

**Primary Staff Contact:**
Harley Hart  
(412) 443-1514 (M)  
(304) 293-5847 (O)  
Office: White Hall 409  
harley.hart@mail.wvu.edu

**Secondary Staff Contact:**
Dr. Weiqiang Ding  
(304) 293-9683 (M)  
(304) 685-1938 (O)  
Office: ESB G75D  
weiqiang.ding@mail.wvu.edu

If no one is available and the instrument is not acting as expected, the user should do the following:

- Shut OFF the nitrogen before shutdown, which will disable the pneumatic valves and may leave things stuck open. There is no harm in leaving this off.
- Shut OFF the plasma asher by pushing the red emergency button on the front panel.
- Shut OFF the oxygen tank valve outside the cleanroom

Then, if possible, the user should stay by the instrument while trying to contact a Shared Research Facilities staff member. If it becomes necessary to leave the instrument then the user should leave a large, legible note on the **OXYGEN PLASMA ASHER** stating:

- The problem (describe what happened and steps taken)
- When it occurred (date and time)
- User name and phone number

If it becomes necessary to leave the instrument then the user should leave a large, legible note at the **OXYGEN PLASMA ASHER** stating the instrument is **DOWN**.

If a dangerous situation is evident (smoke, fire, sparks, etc.), ONLY if it is safe to do so, the user should turn off system, unplug the instrument and leave the cleanroom immediately. The user should notify all other cleanroom persons within the cleanroom to evacuate. The user should then contact proper emergency personnel. The contact numbers can be found posted outside of the cleanroom or on the cover of the instrument log book.