

PhysLAB

Operational Manual for PE-50 Plasma Etcher

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Setup of the PE-50 Plasma Etcher

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PE-50 Plasma Etcher

The plasma etching is a dry etching process whereby the surface material is removed by plasma processes at low pressure. The PE-50 plasma cleaning system can use up to two gases simultaneously to clean and modify the surface. The type of the active gasses and their ratio is selected depending on the type of material to be etched. The optimum and uniform processing results are obtained when the gas flow rates are selected to maintain the vacuum in the plasma processing chamber in the range of 0.15 to 0.30 Torr. The RF power capability of the plasma etcher is 100 watts which is carefully chosen to avoid the excessive temperature rise in the sample being etched. Active ion species are accelerated towards the sample surface where the adsorption and desorption reaction takes place and the volatile reaction products are exhausted by the vacuum pump.



PE-50 Plasma Etcher

Simplified System Operation

1. Set the POWER circuit breaker to the ON (Up) position at the rear of the etcher.
2. Press the “Enter” key  3-times. Plasma will start for 10 minutes and end automatically. When “chamber vent” completes, open the door to remove the processed sample.
3. Set the POWER circuit breaker to the OFF (Down) position.

Plasma Processing Parameters

Specific plasma processing parameters are uniquely defined by the application and should be determined experimentally.

Setup Menu	Parameter Range	Description
Vacuum Set Point	1.0 to 1000.0 mtorr	Vacuum level set point required before gases are introduced into the chamber.
Gas Stab	0-59 seconds	Delay before RF Power is applied after process gases are on.
Plasma Time	0-59.59 minutes	The amount of required plasma process time.
Auto Cycle-Off	Off/On	Automatically goes into Cycle Off mode (shuts off pump and vents the chamber)
Purge Vent	0-59 seconds	Time allowed for purge air to be introduced in the chamber at the completion of a cycle.
Atmospheric Vent	0-59.59 minutes	Time allowed for chamber to vent to atmosphere when "CYCLE STOP" is initiated.
Vacuum Alarm	0-59.59 minutes	Amount of time required to pump the system down to vacuum set point before initiating an alarm.

RF Power

1. The maximum RF power capability of the Model PE-50 is 100 watts.
2. Higher RF power levels cause process temperatures to rise. Care must be taken that the RF power level does not cause excessive temperature rise in the materials being processed.
3. Excessive RF power levels do not contribute measurably to processing rates and should be avoided.

Gas Flow

1. Optimum processing results are obtained when gas flow rates are selected to maintain the vacuum level in the range of 0.15-0.30 Torr. Higher vacuum levels (higher pressures) will result in process non-uniformity.
2. Excessively high levels of gas flow do not contribute measurably to processing rates and should be avoided.

Plasma Commands

Command Menu	Description
Plasma	Select the " Plasma " command from the Commands menu to initiate the plasma cycle
Cycle-off	Actuate the Cycle-off Commands for chamber vent after plasma cycle is completed.

Detailed System Operation

1. At the gas sources, slowly open the gas cylinder valves (fully CCW). Sudden opening of the valves may damage the gas regulators (it should be a two stage brass regulator 0 ~ 30 PSIG). Maintain gas pressure at approximately 15 PSIG.
2. Set the POWER circuit breaker to the ON (Up) position at the rear of the etcher. Once the system is powered ON, the screen will display the startup screen.

**Plasma Etch Inc.
PE-25 Ver 10002**

3. Press the “Enter” key to proceed to the menu items.
 - a. Use the left ◀ and right ▶ arrow keys to find a menu item within a menu area.
 - b. Use the up ▲ arrow key to go to the previous menu area.
 - c. Use the down ▼ arrow key to go to the next menu area.
 - d. Use the enter ↵ key to select a menu item.



4. Pushing the left or right arrow key from the menu to select the **Setup menu** or the **Commands menu**. Press the “Enter” key to proceed the selected menu.
5. Select the **Commands menu** and Press the “Enter” key.

**Commands
Menu**

6. Select the “Plasma” command.

**Commands
PLASMA**

7. Load material to be processed. Close the chamber door.
8. Actuate the “Enter” key to start the cycle. Observe the following:
 - a. The vacuum pump turns on to start evacuating the chamber.
 - b. The chamber vacuum reading will be displayed. The following system status message will be displayed:

Plasma: Pumpdown

S:****.*A:****.*

- c. The chamber will pump down to the setting programmed in the “Vacuum Set Point” parameter in the **setup menu**.
9. Once vacuum set point has been reached the following will occur:
 - a. The process gases will be introduced into the chamber.
 - b. The gases will stabilize for a period defined in the “**Gas Stab**” setting in the **setup menu**. The following system status message will be displayed:

Gas Stabilize

S: ** A: **

10. After the process gases are stabilized RF power is enabled. The wattage is determined by the “**RF Power**” setting on the front panel. The following will be observed:
 - a. A plasma glow will occur in the chamber.
 - b. The plasma process is started and the plasma process timer will start. The process time is determined by the “**Plasma Time**” setting in the **Setup menu**. The time is in minutes and seconds. The maximum time is 59:59 minutes. The following system status messages are available for viewing:

Plasma Time

S: **.**. A: **.**.

- c. “**Plasma Time**” is the default message to be displayed. The vacuum reading can be viewed by actuating the left arrow button.
11. When the Plasma timer completes, observe the following:
 - a. RF power is disabled.
 - b. Plasma glow is extinguished.
 - c. Process gas valves are shut off.
 - d. Vacuum Pump is shut off.
 - e. Chamber vent valve is opened for time set in “**Purge Vent**” timer. The following system status messages will be observed:

Purge Time

S: ** A: **

- f. At the completion of the timer, the chamber vent valve is shut and the blank-off valve is opened.
- g. The chamber is pumped down to vacuum set point programmed in the “Vacuum Set” parameter in the **setup menu** section. The following system status messages will be observed:

Purge: Pumpdown

S:****.*A:****.*

12. When the vacuum set point is reached the process is complete. Observe the followings:
 - a. If the Auto Cycle-Off is selected as **on** in the setup menu the plasma etcher will start the step 13 automatically to vent the chamber.
 - b. If the Auto Cycle-Off is selected as **off** in the setup menu. The rotary pump will remain at the on position to continue evacuating the chamber. The following system status messages will be displayed.

Plasma Cycle Complete

Proceed the step 13 to vent the chamber and remove the sample.

13. Actuate the CYCLE OFF Command under the **Commands menu**. The chamber is vented for a time programmed in the “**Atmospheric Vent**” timer setting in the **setup menu** or until the chamber door is opened. The following system status messages will be observed:

Chamber Vent

S:**.**A:**.**

14. When chamber is vented, open the door to remove processed material. Proceed back to step 9.
15. When **CYCLE OFF** command has been actuated and the chamber vent has timed out or door is opened it is safe to shut down the system. Set the POWER circuit breaker to the OFF (Down) position.

System Alarms

The following is a list of possible alarms with a corresponding system alarm message displayed:

Vacuum set point alarm: When the cycle is started and the vacuum doesn't reach the configured vacuum set point within the configured time the system will initiate an error aborting any running process. The system will vent to atmosphere.

Error: Vac Set

Venting: **.**

Door open during cycle: If the door switch failed or the door was opened during cycle an error will occur aborting the cycle.

Door Open During Cycle

Danger RF on Door Open: If the chamber door is opened and the RF power supply is on an error will be displayed

**DANGER: RF ON
Door Open**

Vacuum sensor voltage failure: Indicates a problem with the output voltage from the vacuum transducer. The system will initiate an error aborting any running process.

**Vacuum Sensor
Error:*****.***

Troubleshooting

Symptoms	Possible Cause	Remedy
Vacuum level increasing or not achieving set point.	Chamber door seal faulty.	Inspect and replace as necessary.
	View port O-ring faulty.	Inspect and replace as necessary.
	Chamber vent valve or blank-off valve faulty.	Verify proper power input and replace as necessary.
	Vacuum pump system faulty.	Blank off Vacuum system to verify vacuum level (< 50mtorr), refer to Vacuum system manual.
Vacuum Reading error.	Recorder output on vacuum gauge is < 50mv.	Repair bad connection on recorder output connection on rear of vacuum gauge.
System process results degraded.	Bad vacuum.	Verify system vacuum.
	Chamber and/or electrodes contaminated.	Inspect chamber and electrodes, clean as necessary.