

TEGAL PLASMALINE PLASMA ETCH



Center for High Technology Materials
University of New Mexico



No person may operate this equipment without having been certified on its use. Only those persons whose names appear on the qualified user list posted near the equipment are considered to be certified. All past certifications are void.

On the pages following this introduction is the operations specification for this equipment. It details procedures that must be followed in their proper order for the safety and repeatability of the equipment and the process. All other procedures must be proposed to and agreed to by the cleanroom manager before their use. Failure to follow these rules will result in disciplinary action.

All proposed changes and problems should be reported directly to the cleanroom manager as well as being listed on the white board of the gowning area. Proposed changes must be in written format and must refer to specific sections of the specification or log sheet.

The run log sheet must be filled in completely for every run made, even if it is a conditioning run. This data will be analyzed by the cleanroom manager to 1) provide more accurate estimates of etch time 2) better processes 3) improved equipment reliability. To the present, and even more to the future cleanroom user, this log will provide a detailed history of the process and equipment. Hopefully, your pains can be avoided by someone in the future. In the comments section, please describe what you are trying to accomplish in your run. Also, include your mask thickness, photoresist type, hard bakes or flood exposures and any other information you feel is pertinent. After etching, you are also required to calculate and enter your etch rate. This is mandatory and should also extend to comments, suggestions and other notes. Help someone else; they may someday help you.

Under no circumstances should you write on the procedure. Only fill out the log sheets. Suggestions for notes or better explanations must be submitted in writing to the cleanroom manager. Such suggestions will be taken into consideration for inclusion in the next revision of the operating procedure.

Copies of this operation specification are highly discouraged. Any copy must have the same modification date as indicated on the master copy. The reason for this is to prevent an outdated copy of the procedure from being used. Before using a piece of equipment, you should always look for changes. These changes will be detailed on the following page.

1.0 Purpose

- 1.1 The purpose of this specification is to describe the operating procedures for the Tegal Plasmaline 415 Silicon Nitride etch.

2.0 Pertinent Documents

- 2.1 Tegal Plasmaline 415 Operation and Maintenance Manual.

3.0 Safety

- 3.1 Follow standard safety practices as outlined in this document and in cleanroom orientation.
- 3.2 Use common sense.

4.0 Materials

- 4.1 Nitrogen (N₂)
- 4.2 Freon 14 (CF₄) also known as H-14, R-14 and tetrafluoromethane
- 4.3 Oxygen (O₂)
- 4.4 Silicon sample holder
- 4.5 Wafers to be etched

5.0 Equipment

- 5.1 Tegal Plasmaline 415

6.0 Preliminary Checks

- 6.1 Turn on the mechanical pump. The switch is located on the wall next to the Tegal Plasmaline 415.
- 6.2 Open the valve for CF₄. Only one gas valve can be open at one time. No exceptions!

7.0 Operation

7.1 Setup etch conditions

- 7.1.1 Set the MODE switch to the MANUAL position.
- 7.1.2 Press the AC ON switch. The white lamp should light.
- 7.1.3 Press the START/COMPLETE button. The start lamp might light.
- 7.1.4 Wait for the chamber to pump down to less than 0.100 torr as displayed on the digital meter located on the top left control panel.
- 7.1.5 Switch the MODE switch momentarily to RF ON/GAS ON. The RF will come on and the RF ON/PROCESS red light will come on) and gas will begin to flow.
- 7.1.6 Slowly adjust the gas flow, using the rotameter knob, so that the chamber pressure is approximately 0.340 torr.
- 7.1.7 Press and hold the black REF/FWD button (located between the power meter and the rotameter) to read the forward power. Adjust the RF POWER knob until the meter reads 100 W (forward).
- 7.1.8 If necessary, adjust the reflected power to read less than 5W with the following procedure:
 - 7.1.8.1 Set the TUNING switch to MANUAL.
 - 7.1.8.2 Momentarily press the FWD button (located above the tuning switch) several times until the reflected power is minimized. This should be a small

number of presses. Do not be alarmed if you miss the minimum.

7.1.8.3 Momentarily press the REV button (located above the tuning switch) several times until the reflected power is minimized. Again, this should only be a small number of presses. Do not be concerned about missing the minimum.

7.1.8.4 Continue to repeat the above two steps until the reflected power is below 5W.

7.1.8.5 Adjust the forward RF power if needed.

7.1.9 Repeat the 7.1.7 and 7.1.8 as needed.

7.1.10 Press the COMPLETE button to end the set up and vent the chamber to atmosphere.

7.2 Etching Silicon Nitride

7.2.1 Open the chamber door by twisting the handle 90 and pulling the door open.

7.2.2 Load your sample onto the silicon wafer located in the chamber.

7.2.3 Close the door and rotate the handle so it points down.

7.2.4 Set the MODE switch to AUTO.

7.2.5 Set the TIMESET thumbwheels to the desired etch time. The time is in the format 00.0 minutes. Be aware of the decimal point; it is faded and hard to see.

7.2.6 Set the PROCESS switch to TIMER.

7.2.7 Set the HEATER to OFF and the TEMP ALERT to MUTE.

7.2.8 Press the start button. The process will run automatically to completion.

7.2.9 When the green COMPLETE button lights, open the chamber and remove your sample.

7.2.10 Close the chamber door.

7.2.11 Record your run in the logbook.

7.3 Shutdown

7.3.1 Press the AC OFF button.

7.3.2 Close the H-14 valve. Closed is perpendicular to the gas line.

7.3.3 Turn off the pump.

8.0 Troubleshooting

8.1 No gas flow.

8.1.1 Check that the bottle is turned on and has pressure.

8.1.2 Check the regulator setting (under flow on conditions only). It should read 15psig on the delivery side.

8.1.3 Let the cleanroom manager know about this condition as soon as possible. Do not attempt to correct this condition by yourself.

8.2 System does not pump down

8.2.1 Check that the pump is plugged in, turned on and working.

8.2.2 Check that the door has been properly closed.

8.2.3 Check that the start switch has been pressed and the start light is on.

8.2.4 Check that there are no particles in the door seal.

9.0 Supplemental information

9.1 The etch rate of silicon nitride can be strongly affected by the conditions under which it is obtained as a film. In general, etch rate decreases with respect to an increase in deposition temperature for thermally deposited silicon nitrides. PECVD films typically etch much faster than LPCVD films.

9.1.1 Etch rates for the silicon nitride deposited in CHTM's PECVD reactor are typically 200Å/min.

9.2 Loading also affects the observed etch rate in plasma systems. The loading effect is due to the total amount of area to be etched. This total area is directly related to the size and number of the substrates minus the area masked with photoresist or other masking films.

10.0 Suggested reading

10.1 Tegal Plasmaline 415 Operation and Maintenance Manual

11.0 Tables and figures

11.1 Run Log

12.0 Operation Specification History

12.1 Rev 1. New Specification based on F. Matunis original dated 11/15/94. Author B. Fuchs Date: 6/17/02