Usage Policies Notebook for Plasma-Therm 790

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INRF UCIrvine

Emergency Plan for Plasma-Therm 790

Standard Operating Procedures for Emergencies

Contact information

Person	Phone number
Lab Manager	Jake Hes, 949-824-8239 (day), 562-522-8328 (alternate)
Director	G.P. Li: 949-824-4194 (day), 949-824-2047 (alternate)
Staff	Mo Kebaili: 949-824-8239 (day), 949-494-5892 (alternate)
Super User	Carlos Ruiz (818) 527-6349 (Anytime, voicemail or text only)

Hazardous chemicals, gases, and conditions

Hazard name	Description of hazard
Vacuum	Implosion
High temperature	Burn or ignition source
High voltage	Electrical shock, ignition source
Isopropyl alcohol	Flammable solvent
CF_4	Toxic fumes
CHF_3	Toxic fumes
SF_6	Toxic fumes
N_2O	Asphyxiant
NH_3 (ammonia) gas	Toxic fumes
Cl_2 (chlorine) gas	Corrosive, toxic fumes
SiH_4 (silane) gas	Pyrophoric (explodes on contact with air)
O_2 (oxygen) gas	Oxidizer gas
H_2 (hydrogen) gas	Flammable gas
N_2 (nitrogen) gas	Asphyxiant

Alarms or indications of danger

Alarm type	Condition and response
Alarm on the scrubber in the utility room	Problem with scrubber. Halt any running process. Correct the problem or notify the staff or the lab manager before continuing.
Alarm on the console	Problem with process state. Halt the process. Correct the problem or notify the staff or the lab manager before continuing.
Pungent or foul smell	Gas leak. Shutdown the machine at once and evacuate the area. Contact the staff and the lab manager.

Emergency shutdown plan #1

In the event of an emergency, when there is very little time, *press the large red emergency shut-off button at the front of the machine*. This will shutdown the system and will stop the gas flow into the system. Leave the facility at once. Then contact the lab manager or the staff.

Emergency shutdown plan #2

In the event of an emergency, when there are a few minutes available, *press the large red emergency shut-off button at the front of the machine*. This will shutdown the system, and stop gas flow into the system. Next, check the gases in the utility room w2331, adjacent to the Plasma-therm room. If there is no fire, and no smell of gases, enter the room and shut off all gas cylinders valves by turning them fully clockwise. Check the oxygen tank in room w2336, feel the door for possible fire, and if safe, close the oxygen tank by turning fully clockwise. Leave the facility at once, then, contact the staff and the lab manager.

Usage Policies for Plasma-Therm 790 RIE/PECVD

Standard policies for usage

The Plasma-Therm 790 RIE/PECVD performs reactive ion etching (Si_3N_4, SiO_2, and GaAs) and plasma enhanced chemical vapor deposition (SiO_2 and Si_3N_4). It uses inductively coupled RF plasma in two vacuum systems. The PECVD chamber side contains a heated base plate.

Contact information

The INRF staff or the lab manager may be reached at 824-8239 or 824-9831.

Authorized users

Only INRF registered users who have completed the training and passed the certification may use this equipment. Users may only use the portion of the system for which they have been trained.

Training

Users must have received direct training from the staff in order to use this equipment. Training is different for PECVD and RIE. Users are expected to understand the nature of the system, as well as the proper control and use of the gases. Training varies slightly, depending on the process to be performed. Contact the staff for details and to arrange for a training session.

Usage logs

Users are required to log all activity in the log sheets provided. All users must log in when they used the Plasma-Therm (date and time), which gases they used and quantity, and when they completed their process in the user log sheets. If users notice anything unusual, they should record it in the user log sheets, and add details in the maintenance log sheets. Any maintenance to the machine must be logged in the maintenance log sheets (maintenance staff only).

Safety equipment

There is no specific safety equipment for use on this tool, however, cleanroom gloves and tweezers should be used when handling pieces in the chambers. Care should be taken to avoid burns when working near the PECVD hot plate.

Standard equipment and materials

The laboratory provides the following gases: SF_6, CF_4, CHF_3, O_2, SiH_4, N_2O, NH_3, N_2, BCl_3, Cl_2, He. Other gases must be cleared with the lab manager.

User maintenance

Users are requested to clean the chambers after use by first, wiping them down with the isopropanol, then run the required cleaning process. Spray the isopropanol into a lint-free cloth

and wipe the inside of the chamber. (For the PECVD, you must wait until the unit is cool to do this.) Dispose of the cloth in a waste container marked for flammable solid waste.

Pollution Control

Turn on the scrubber when using the following gases: SiH_4, CF_4, CHF_3, BCl_3, Cl_2. Dispose of the alcohol soaked wipes in a waste container marked for flammable solid waste. Purge the gas lines after using corrosive gases.

Scheduling

Reservations can be done online, also, the system can be used on a first come, first served usage if no reservation was made.

Other issues

Users should remain physically present in the cleanroom facility during the entire use of the Plasma-Therm. This includes the time when the PECVD hotplate is warming up.

The vacuum chambers should be left in "low vacuum" mode (typically about 30 mTorr) when not in use. All processes involving corrosive gases should include several purge steps before completion. Gases should be turned off at the cylinders valves when finished. The use of polymers in the RIE is strongly discouraged. Polymers or low melting point materials are forbidden in the PECVD chamber.

Users should not modify any standard recipe in the software. New recipes can be created, but once created, they should stay unedited. A modified recipe should be given a new name. This allows us to track down the history of a problem later, if necessary.

At no time should a user adjust a pressure regulator on a gas line. Gas control should be "on" or "off" only, using only the valves appropriate. For most gases, this is usually the valve at the cylinder head.

Non-standard use

Users may not modify any hardware on this equipment. For use of non-standard processes, gases or materials, contact the staff or the lab manager.

Usage Notes for Plasma-Therm 790

Guide for using the Plasma-Therm 790 correctly

Gas cylinders

All gas cylinders should be turned on or off at the cylinders valves. At no time should a user adjust a pressure regulator. Clockwise for all valves, means CLOSED. The standard off configuration for the system is to close the cylinders valves, but leave all other valves alone.

PECVD procedure for oxide and nitride deposition

Follow these steps for deposition of oxide (SiO_x) or nitrides (Si_3N_4) on a silicon substrate. For oxide processes, SiH_4 and N_2O are used; for nitride, SiH_4 and NH_3 are used.

1. **Verify OK status & log in**
   Turn on the computer monitor, if it is not already on. Make sure that the mechanical pump and the turbo pump are properly on (green), and that there is no alarm. Record the date, the time and your name in the user log sheets. Make sure that the scrubber is on. (The turbo pump should only be on if needed).

2. **Set to PECVD chamber**
   Set `System Status` to ON. Click `Utilities`, then click `select active chamber`, then click `left chamber`.

3. **Set standby temperature**
   Set `System Status` to STANDBY. Click `Utilities` then click `set standby temperatures` up to the process temperature. Be careful, the chamber will be hot!

5. **Insert samples**
   Click `Utilities`, then click `vent`, to open left chamber. Wait for the chamber to open, then carefully (using tweezers) place samples on the hot plate. The first time a deposition process is run, it is a good idea to run dummy samples, since the deposition usually needs a "seasoning" run before working correctly.

6. **Evacuate chamber**
   Click `Utilities`, then click `pump chamber`, then click `low vacuum`. Force the top of the chamber down to help the vacuum seal the chamber (you may need a protective glove to help, since it will be hot). After the vacuum has engaged, let go of the top chamber and wait for it to reach low vacuum.

7. **Load recipe**
   Click `process`, then click `load`. Select the process you want, and click OK. The recipe will show up in the process field at the lower left of the screen.

8. **Turn on gases**
   Open the appropriate gas cylinders in w2331 by turning the main valve on the cylinder head counter-clockwise. The pressure on the regulator should read between 10 and 20 psi. For oxide processes, SiH_4 and N_2O gases are used; for nitride, SiH_4 and NH_3 gases are used.

9. **Run process**
   Set `System Status` to READY. Click `run`. The process will proceed. If a gas flow, vacuum reading, or temperature is out of compliance, the system will alarm. After all the steps have completed, the monitor will show PROCESS COMPLETE, and the chamber will vent then will open.

10. **Remove samples**
    Carefully remove the samples from the hot plate. At this point, you may continue with other samples by returning to step 5.

11. **Evacuate chamber**
    Click `Utilities`, then click `pump chamber`, then click `low vacuum`. Force the top of the chamber down to help the vacuum seal the chamber (you may need a protective glove to help, since it will be hot). After the vacuum has engaged, let go of the top chamber and wait for it to reach low vacuum.

12. **Reset standby temperature**
    Set `System Status` to STANDBY. Click `Utilities`, then click `set standby temperatures`, then set the temperature to 25° C. The hot plate on the PECVD side will begin to cool down. (Before proceeding to step 13 check with staff for evacuating reactive gas lines if needed).

13. **Turn off gasses**
    Close the gas cylinders in w2331, by turning the main valves on the cylinder heads clockwise.

14. **Log out**
    Record the date and time in the user log sheets. Also record your process recipe and any problems encountered during your session.

RIE procedure for oxide and nitride etch

Follow these steps for reactive ion etch of oxide (SiO_2) or nitride (Si_3N_4). The oxygen is used for all etch recipes. Fluorine based gases are also used, depending if the etch is to be anisotropic (CHF_3), isotropic (CF_4), or selective to oxide (SF_6).

1. **Verify OK status & log in**
   Turn on the computer monitor, if it is not already on. Make sure that the mechanical pump and the turbo pump are properly on (green), and that there is no alarm. Record the date, the time and your name in the user log sheets. Make sure that the scrubber is on. (Turbo pump should only be on if needed).

2. **Set to RIE chamber**
   Set `System Status` to ON. Click `Utilities`, then click `select active chamber`, then click `right chamber`.

3. **Insert samples**
   Click `Utilities`, then click `vent`, to open right chamber. Wait for the chamber to open, and then place your samples on the plate. If the `vent` menu item is unavailable (gray), then pump to low vacuum first to activate the vent feature (see next step).

4. **Evacuate chamber**
   Click `Utilities`, then click `pump chamber`, then click `low vacuum`. Force the top of the chamber down to help the vacuum seal the chamber. After the vacuum has engaged, let go of the top chamber and wait for it to reach low vacuum.

5. **Load recipe**
   Click `process`, then click `load`. Select the process you want, and click OK. The recipe will show up in the process field at the lower left of the screen. Standard recipes are labeled as:

   - `nesXXm` for SiO_2 or Si_3N_4 anisotropic etch at 400–500 Å/min. CHF_3 and O_2
   - `nehXXm` for SiO_2 or Si_3N_4 isotropic etch at 1000–2000 Å/min. CF_4 and O_2
   - `nepXXm` for Si_3N_4 isotropic etch, selective to SiO_2 at ~1000 Å/min. SF_6 and O_2

6. **Turn on gases**
   Open the appropriate gas cylinders in w2331 by turning the main valves on the cylinder heads counter-clockwise. The pressure on the regulators should read between 10 and 20 psi. The oxygen in room w2336 is on by default but users should check to make sure that it is on.

7 **Run process**
   Set `System Status` to READY. Click `run`. The process will proceed. If a gas flow, or the vacuum reading is out of compliance, the system will alarm. After all the steps have completed, the monitor will show PROCESS COMPLETE, the chamber will vent, and then will open.

8. **Remove samples**
   Remove your samples from the chamber, at this point you may continue with another sample run by returning to step 5.

9. **Evacuate chamber**
   Click `Utilities`, then click `pump chamber`, then click `low vacuum`. Force the top of the chamber down to help the vacuum seal the chamber. After the vacuum has engaged, let go of the top chamber and wait for it to reach low vacuum. (Before proceeding to step 10 check with staff to evacuate reactive gas lines if needed).

10. **Turn off gasses**
    Close gas cylinders in w2331 by turning the main valves on cylinder head clockwise. No need to close the oxygen cylinder.

11. **Log out**
    Record the date and time in the user log sheets. Also record your process recipe and any problems encountered during your process session.