## PROCEDURE OVERVIEW – NOT FOR CL PROCESSING

1. Login via Mendix
2. Check tool condition
3. Vent the loadlock, Load sample
4. Pump loadlock
5. Transfer sample into chamber
6. Run desired recipe in manual mode
7. Transfer sample into loadlock
8. Vent loadlock, Unload sample
9. Pump loadlock, Run cleaning recipe

## CRITICAL PRECAUTIONS AND COMMON MISTAKES

- Mendix login restricts Monitor power
- MATERIALS restrictions:
  - Exposed metals: Consult MNFL staff for each new process
- SAMPLE restrictions:
  - Samples must be 2”, 3”, or 4” wafers, or mounted onto such wafers
- Procedure restrictions
  - **DO NOT ATTEMPT TO RUN CL-CONTAINING PROCESSES WITHOUT ADDITIONAL TRAINING, THE REQUIRED STEPS ARE NOT COVERED IN THIS SOP**
  - Due to system instability, no new ‘recipes’ are being created. Recipes already in place can be run, but all new processes must be done in manual mode, and recorded by hand.
  - Be **extremely careful** when placing samples onto the loading arm. Lateral movements can result in the arm being knocked off-center, which will cause the wafer load to fail catastrophically, and take the tool down for days.
- Processing:
  - Each user must approve each new process with the MNFL staff. 95% of processes are approved without issue, but occasionally someone wants to “ion mill 1 micron of Au off of wafers”, which would likely compromise the tool for all other users.
  - This tool is not “clean”. Because recipes with exposed metals have been run in this tool, you may be at risk for micromasking. If you see significant micromasking on your samples, notify the MNFL staff
  - If the presence of individual atomic impurities would be detrimental, consider using the Oxford PP80 RIE.

### Before you start
- Chamber & loadlock should be pumped down

### Tool condition for the next user:
- Loadlock pumping down, appropriate cleaning process running in chamber

### Metrology you SHOULD be doing:
- Pre/post-etch measurements of film & mask thickness. Use 2 points (center, 2cm from center) for wafer samples. For small piece-parts, use a larger ‘monitor’ sample (1x1cm), coated with a thicker film w.r.t. your sample, placed close to your part.
- NOTE: films at the bottom of thin trenches will etch more slowly than bulk films
TOOL OVERVIEW

The PlasmaTherm 720 SLR RIE is a load-locked parallel-plate Reactive Ion Etcher. It has a single 500W RF generator, can run processes from 5-1000mTorr, and is plumbed with Cl2, BCl3, H2, O2, CF4, SF6, and O2. Temperatures from 10-50C can be tolerated. Historically it has been used to etch Si, SiO2, SiNx, various resists, and occasionally thin metal films (rare), and thin III-V layers (rare). It is typically run in “manual mode”, giving users the freedom to alter process parameters while the RF is running.

FULL PROCEDURE

Log in via Mendix. Mendix controls PC monitor power.

Check tool condition:
1. Check Pressure of the Lock, and Chamber
   a. Lock: 0.5Torr, Chamber: 0.0mTorr
2. Check Pump status
   a. Turbo: READY, Mech: ON, Lock: ON
3. Check System Status: STANDBY
   a. Click the button under STANDBY, if either ON or READY are selected

NOTE: you may see “Gas Suspected in Chamber” under the Warning section. You can ignore this if the chamber pressure is 0mTorr. If it is not, notify the MNFL staff.

A. Vent the loadlock:

1. Under the Utilities Menu, find Loadlock, then Vent
   b. You may have to pump the system for this option to become available:
      i. Click: Service → Maintenance → Pump → System → Turbo; wait a few seconds
   a. If still unavailable after pumping, can use this same menu to vent the loadlock:
      b. Click: Service → Maintenance → Vent → Loadlock
      c. NOTE: DON’T VENT CHAMBER!!!
2. Wait for 90s, you will see “over-venting loadlock for 15 seconds” displayed
3. Gently open Loadlock lid
   a. If it feels stuck, wait another 20 seconds and try again. It should be very easy to lift

Figure 1. Safest way to vent the loadlock

Figure 2. Loadlock lid open, showing loading arm with carrier wafer in place
B. Load your sample

1. Load your carrier wafer & samples onto transfer arm
   a) Using tweezers, place your wafer into the center of the appropriate-size ring on the loading arm
   b) If using piece-parts, gently place them on the carrier once it’s been loaded. This should make balancing the samples with tweezers less stressful.
   c) If loading by hand, double-glove immediately before handling wafer to be loaded

Figure 3. Wafer loading arm. Note cut-out in center. Lift pedestal in chamber is almost identically-sized

Figure 4. A carrier carefully-placed onto the loading arm

C. Pump down the Loadlock

2. Under the Utilities menu, find Loadlock, then click Pump
   a) If this option is greyed out:
      i) Click: Service → Maintenance → Pump → System → Turbo; wait a few seconds

D. Transfer sample into chamber

3. Open Wafer Handling ribbon
   a) Click: Service → Maintenance → Wafer handling
   b) The ribbon will appear at the bottom of the screen. The only part you should need is Wafer Transfer, on the left

4. Click Load, under Wafer Transfer

5. Watch the transfer operation
   a) You’ll see animations on the screen, and “Loading chamber 1” in the center

6. When the Load is complete, click Exit, at the right of the Wafer Handling ribbon

Figure 5. Opening the Wafer Handling dialog

Figure 6. Wafer Transfer portion of Wafer Handling ribbon. Left-hand side, bottom of screen

Figure 7. Exit button on Wafer Handling ribbon
E. Run Desired Etch recipe

1. Enter Manual Mode:
   a) Click Service → Maintenance → Manual Mode
   b) Manual mode window will open

2. In Manual Mode screen, set recipe parameters. Click in the desired cell and enter your value
   a) Temperature, in ºC (20 is default, takes a long time to adjust)
   b) Flowrates, in sccm
   c) Pressure, in mTorr
   d) RF power, in W
   e) Time, in minutes & seconds

3. Under Gas, click ON, wait for flowrates to equilibrate

4. Under Pressure, click ON, wait for pressure to equilibrate

5. Under RF, click ON, wait for RF power to stabilize (7-10s)
   a) If operating at >300W, watch the Ref. Power for 1 minute; if it goes >16W, adjust the power slightly, by 20W in either direction. These adjustments may decrease Ref. Power significantly

6. Look at the chamber windows to verify that the plasma has struck

7. Record RF power information in logbook
   a) Incident & Reflected power

8. All processes will stop after the time entered.
   a) This time cannot be altered after the RF has been turned on.
   b) To end a process early, click All Off, in the upper-right corner of the Manual Mode screen

   a) Click Exit, in the upper-right corner of the Manual Mode screen
F. Transfer sample into loadlock

7. Open Wafer Handling ribbon
   a) Click: Service → Maintenance → Wafer Handling
   b) The ribbon will appear at the bottom of the screen. The only part you should need is Wafer Transfer, on the left

8. Click Unload, under Wafer Transfer

9. Watch the transfer operation
   a) You’ll see animations on the screen, and “Unloading chamber 1” in the center

10. When the Unload is complete, click Exit, at the right of the Wafer Handling ribbon

G. Vent Loadlock, Unload sample

11. Vent Loadlock:
   a) Click Utilities → Loadlock → Vent
   b) Wait 90s, attempt to open lid. If still closed, wait 30 more seconds

12. Unload sample
   a) Carefully remove carrier from loading arm, being careful not to knock it sideways
   b) Close Loadlock lid when finished

H. Pump Loadlock, run cleaning recipe

10. Pump Loadlock
    a) Click Utilities → Loadlock → Pump

11. Run cleaning recipe
    a) Enter Manual Mode
       i) Service → Maintenance → Manual Mode
    b) Enter parameters & run recipe, as in earlier section
       i) Parameters outlined in Appendix A
Appendix A: Appropriate Cleaning Recipes

1) Resist (from O2-based processes): 20sccm O2, 100mTorr, 100W, 5 minutes; no wafer required in chamber
2) SiO2, SiNx, Si (from CF4- or SF6-based processes): 30/6sccm SF6/O2, 100mTorr, 100W, 2/3 of your etch time; no wafer required in chamber
3) III-V or metals (from Cl2/BCl3-based processes): 10/20sccm Cl2/Ar, 100mTorr, 100W, 2/3 of your etch time, wafer required in chamber

Appendix B: chiller reset

Chiller temperature does not equilibrate to process (usually it is visible when you walk up to the tool)
- Occasionally, power glitches will cause the tool to not communicate correctly with the chiller.

To resolve, flip the ON/OFF switch on the chiller to OFF. Wait 5s. Flip it back ON, then flick the START switch upwards. You will hear the chiller turn on.

Turning the chiller off will cause the tool to go into alarm. Once the chiller is running again, press the button under HOLD to attempt to clear it.

Appendix C: Summary of steps for Cl processing

This is not an acceptable substitute for staff training using Cl processing, this is a review for users who have already received training

3) Load a dummy wafer into the loadlock and pump down. Wait for >60s after pressure hits 0.5Torr.
4) Load the dummy wafer into the chamber. Enter Manual Mode.
5) Click ON under PURGE. Set the pressure for 500mTorr. Wait 2 minutes, then click OFF under PURGE (this sequence is referred to as ‘purge for x minutes’)
6) Run the Cl2/Ar cleaning process (Appendix A) for 10 minutes
7) Run your desired process for 2 minutes
8) Purge for 1 minute
9) Unload the dummy wafer, vent the loadlock
10) Load sample into loadlock, pump down. Wait for >60s after pressure hits 0.5Torr.
11) Transfer sample into chamber, Enter Manual Mode
12) Purge for 2 minutes
13) Run your desired process
14) Purge for 1 minute
15) Unload sample, vent loadlock. If strong Cl smell, notify MNFL staff immediately
16) Load dummy wafer, pump loadlock, transfer into chamber
17) Run Cl-based cleaning process for appropriate time (see Appendix A)
18) Unload wafer into loadlock
19) Run F-based cleaning process (see Appendix A) for 15 minutes, to recondition chamber for other users

When you leave the tool, the last process run should have been the SF6/O2 cleaning, and there should be a wafer in the loadlock.

Version history

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<th>Draft</th>
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<th>Notes on changes</th>
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<td>4/8/18</td>
<td>Eric Mills</td>
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