

3-25-2019

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Oxford PlasmaPro 100 PECVD Standard Operating Procedure

PROCEDURE OVERVIEW

1. Checking tool condition
2. Loading the wafer
3. Running deposition recipe
4. Running chamber cleaning recipe

APPENDIX 1 – Aborting the Process

APPENDIX 2 – Checking Process Logs

CRITICAL PRECAUTIONS AND COMMON MISTAKES

NEMO login controls the monitor power

MATERIALS restrictions:

- No exposed metal, photoresist, Kapton tape, or other organics; Exceptions to this must be explicitly approved by the PRISM Cleanroom staff

SAMPLE restrictions:

- All samples must be placed on a 4" wafer. User must ensure that samples do not slide off of carrier during loading (may require creation of custom holder)

PROCESS restrictions:

- If loading/unloading by hand, put clean gloves immediately before touching part to go inside the chamber
- If operating at a temperature higher than 70°C, perform processing afternoons/evenings only or reserve the tool at least two days in advance

Before you start:

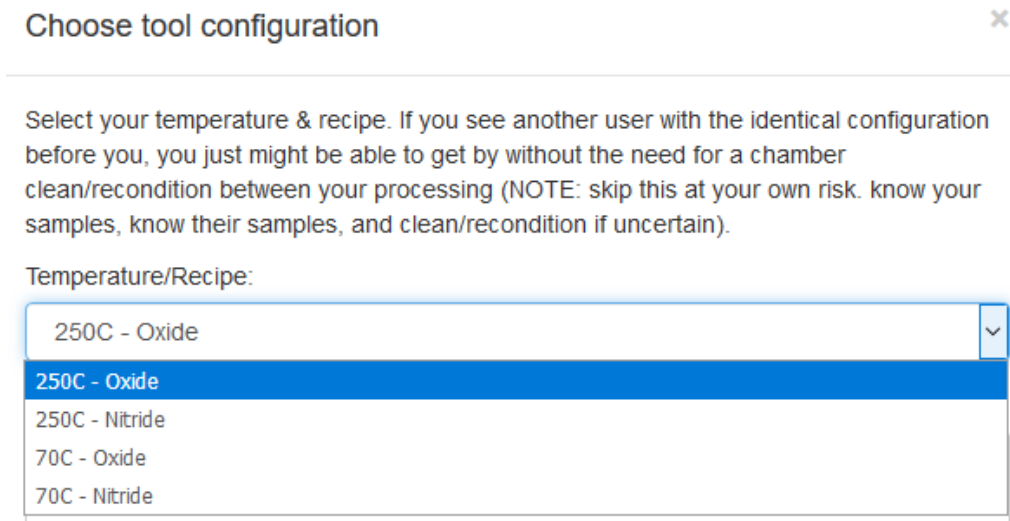
- Log into the tool using NEMO system
- Check wafer status in software, and visually (both chamber and loadlock)
- The loadlock should be pumped down, a wafer should be inside
- Oxford PC2000 (tool) Software should be running
- The user "USER" should be logged in

Tool condition for next user:

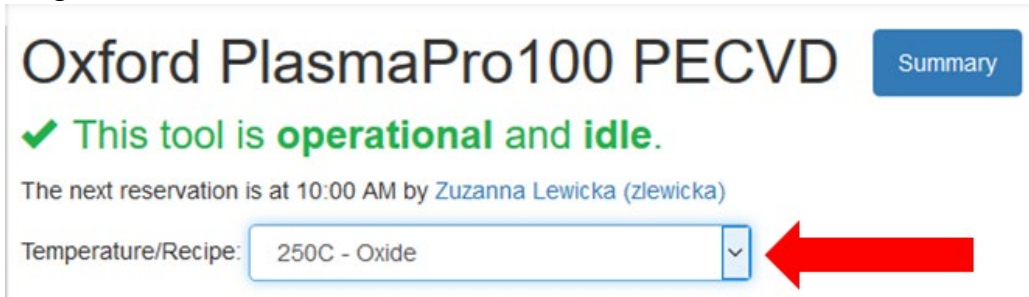
- Ensure cleaning recipe has started, **wait for plasma to ignite** and Logout
- Clean up after yourself, do not leave your items on the bench

1. Checking the tool condition

1.1 Reserve the tool using NEMO reservation system and select the recipe that you planning to run.



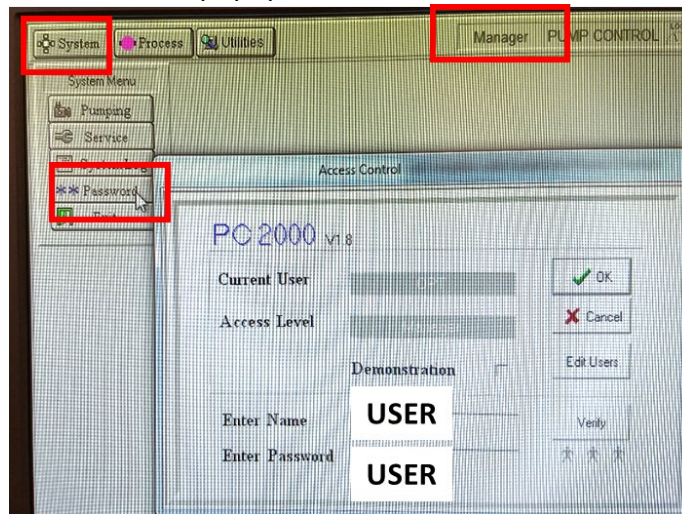
1.2 Enable the tool in NEMO reservation system /Tool Control and select the recipe that you planning to run.



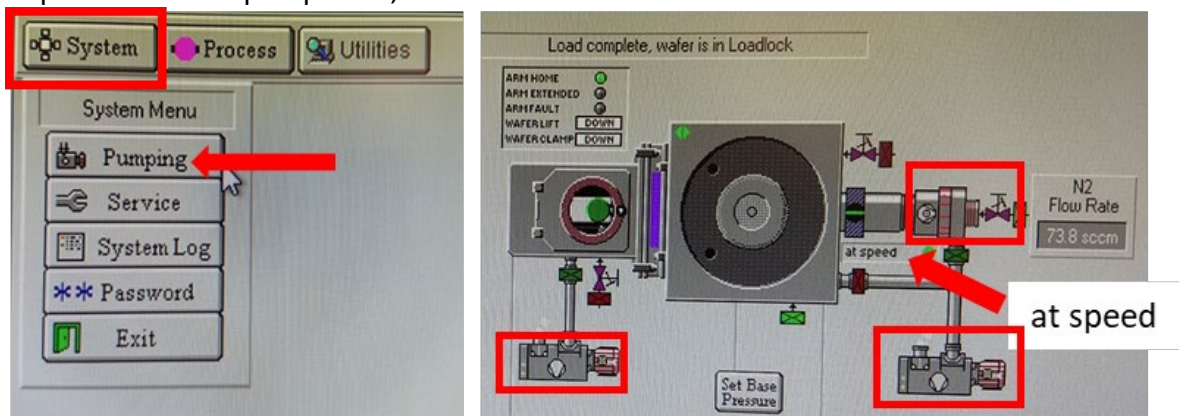
1.3 If "Red Alert" is shown around the screen, **stop and contact** cleanroom staff
If "Yellow Alert" is shown around the screen, press "Continue"



1.4 Check who is login to the system (USER or Manager). If it reads anything other than “USER”, log in as user: Press **System**, then **Password**, and enter USER/USER in the username/password boxes in the popup window.

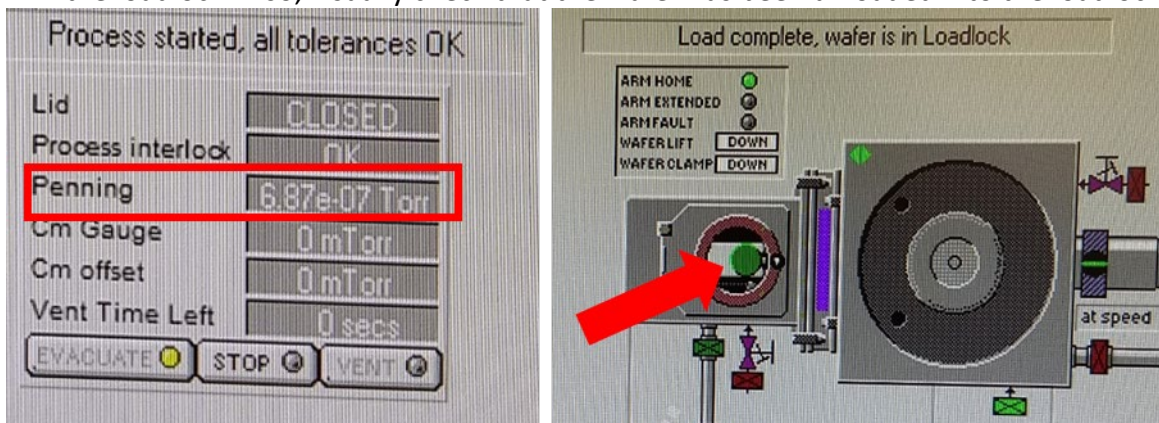


1.5 Check if pumps are running. Go to **Pumping** page, from the **System** menu and check that turbo, backing, and roughing pump are all running (spinning animation) and turbo is “at speed”. If Turbo pump is off, alert PRISM cleanroom staff.



1.6 Check chamber vacuum (Penning $\sim 3e-07$ Torr)

1.7 Check that no wafer is shown in the process chamber, and that there is a wafer (green circle) in the loadlock. Also, visually check that the wafer has been unloaded into the loadlock.

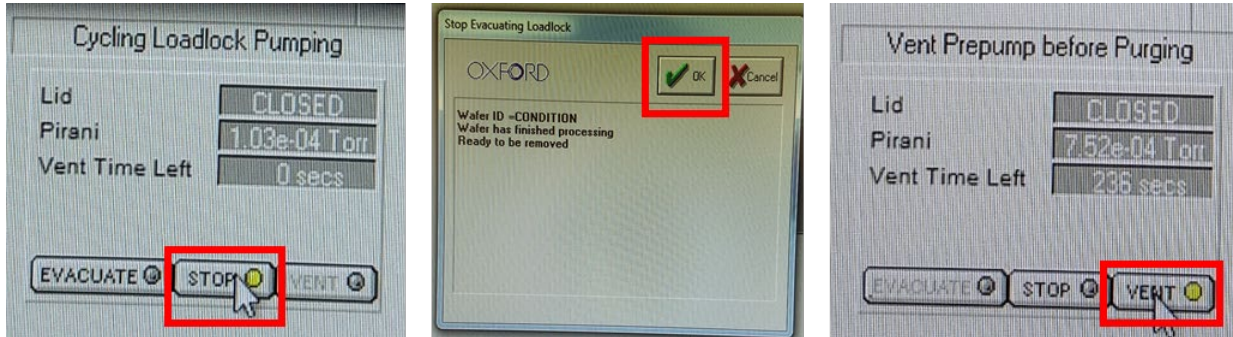


2. Loading the wafer

2.1 Visually check that the wafer has been unloaded into the loadlock

2.2 Vent the loadlock. Under the loadlock interface, click **Stop**. For popup, "Wafer ... has finished processing" click **OK**. Then, under the loadlock interface, click **Vent**.

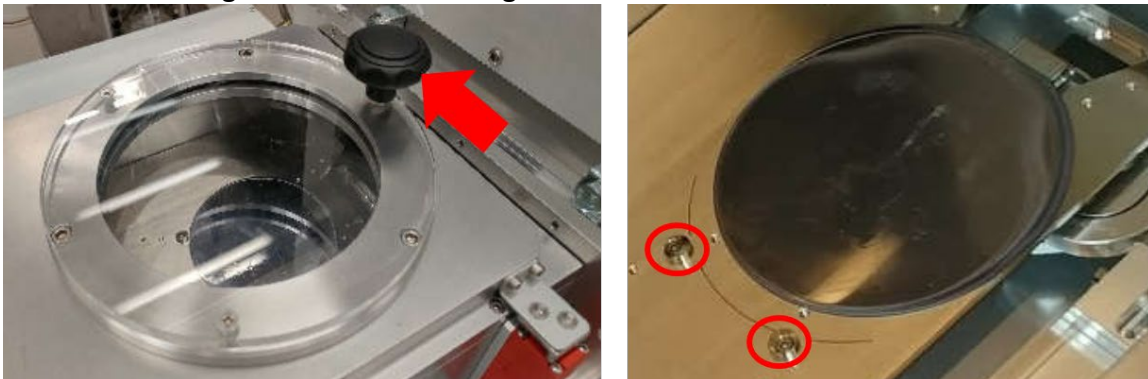
2.3 Wait until "Vent Time Left" countdown reaches 0. This will take 4 minutes.



2.4 Open the loadlock by pulling upwards on the black knob on the loadlock door (no twisting).

2.5 Gently place 4" wafer on the loadlock tray, up against the round cams (circled), with the flat facing towards the process chamber. Make sure the edge of your sample lines up with marker line.

NOTE: Put on clean gloves before handling wafer.



2.6 Close the loadlock door and Click "**Stop**", then "**Evacuate**" under the loadlock interface.

2.7 In the popup, enter a sample name and press "**OK**" to indicate a wafer in the loadlock.

2.8 When "Cycling Loadlock Pumping" is displayed under the loadlock interface, the vacuum is good enough for your recipe to be run.



3. Running deposition recipe

NOTE: For reproducible results, before deposition on a real sample, it is recommended to condition the clean chamber by depositing > 100 nm of SiO₂ or SiN film on conditioning wafer.

3.1 To load the desired deposition recipe, click **Process Menu**, then **Recipes**.

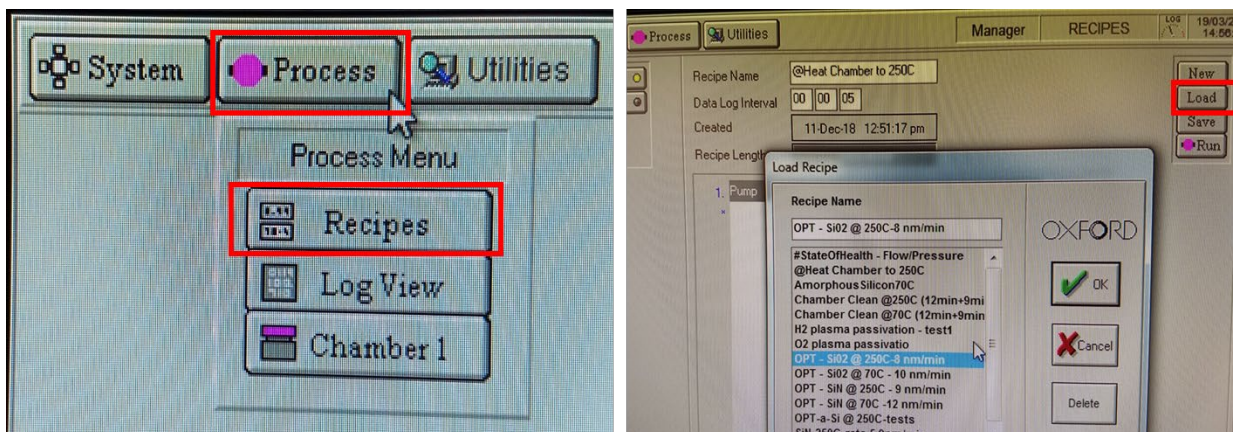
3.2 Select desired recipe and click **Load**.

3.3 For a popup reading: "Currently loaded recipe contains unsaved changes." click **Yes**.

This will restore the recipe to the staff programmed defaults.

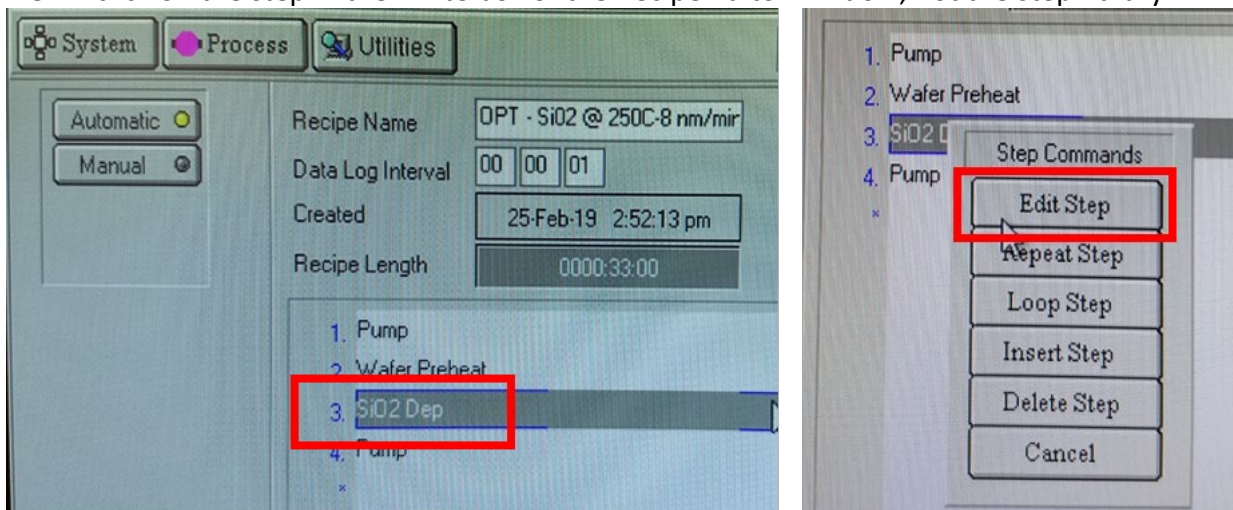
3.4 Find your desired recipe from the pop-up list and click **OK**.

NOTE: If heating the chamber from 70 °C to 250 °C, run the "@Heat Chamber to 250C" process before running your conditioning and deposition processes. This will take ~25 minutes.

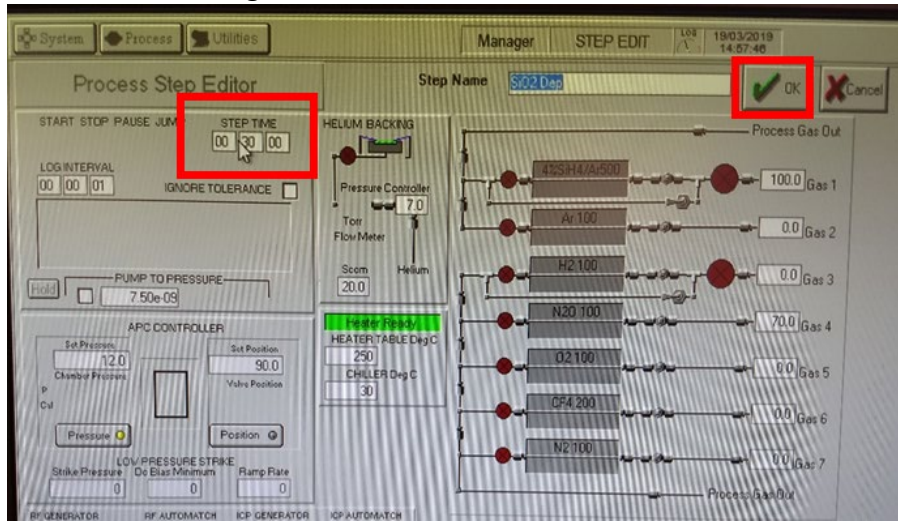


3.5 To adjust deposition time, left-click on the "Dep" step in the recipe, then click "Edit Step"

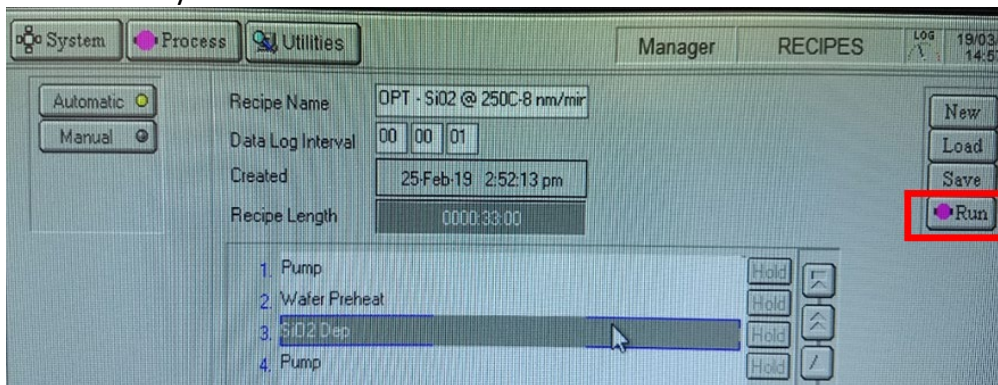
NOTE: click on the step in the white box of the Recipe Editor window, not the step library.



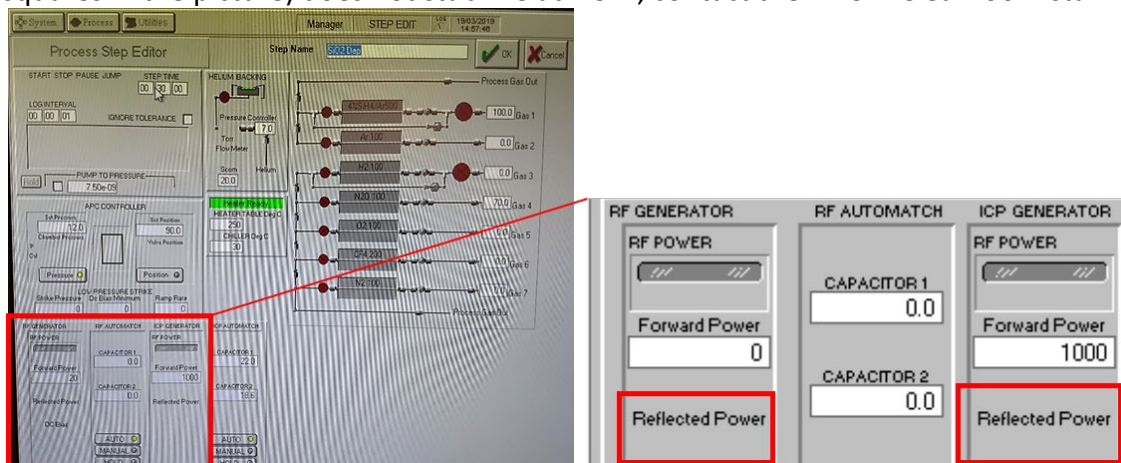
3.6 Change the step time (circled) to deposit desired thickness of material.
 NOTE: you can only change step time, not other parameters.
 3.7 Click “OK” to exit the editing screen.



3.8 From Recipes page, click “Run”, will hear pump whirring get louder.
 NOTE: sample will be loaded from loadlock into chamber automatically and process page will come up automatically.



3.9 Monitor deposition process. Wait through “Pump”, “Purge” and/or “Preheat” steps.
 3.10 Once “Dep” step begins, watch if RF power stabilize on screen. If Reflected Power (red squares in the picture) does not stabilize at < 5W, contact the PRISM Cleanroom staff.



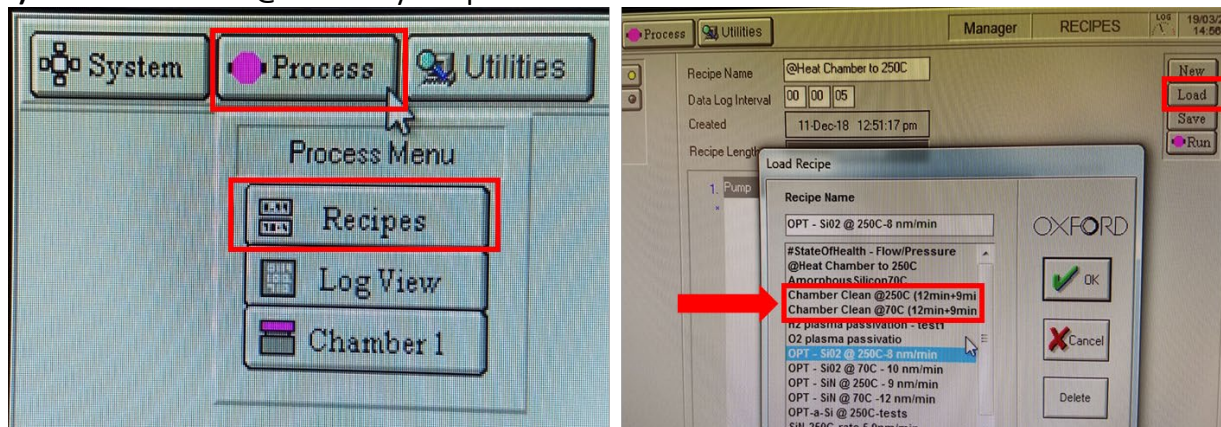
- 3.11 Watch for plasma to ignite and stabilize in chamber. If plasma is not visible once RF power has stabilized, abort the process and inform the staff.
- 3.12 Once process is complete, a “Yellow Alert” pop-up will appear. Click “Continue” and wait ~30s for wafer unload sequence to finish.



4. Running chamber cleaning recipe

4.1. Load cleaning recipe by clicking **Process Menu**, then **Recipes** then **Load**, and choose appropriate cleaning recipe:

- i) “Chamber Clean @70C” if you deposited at 70C
- ii) “Chamber Clean @250C” if you operated at 250C

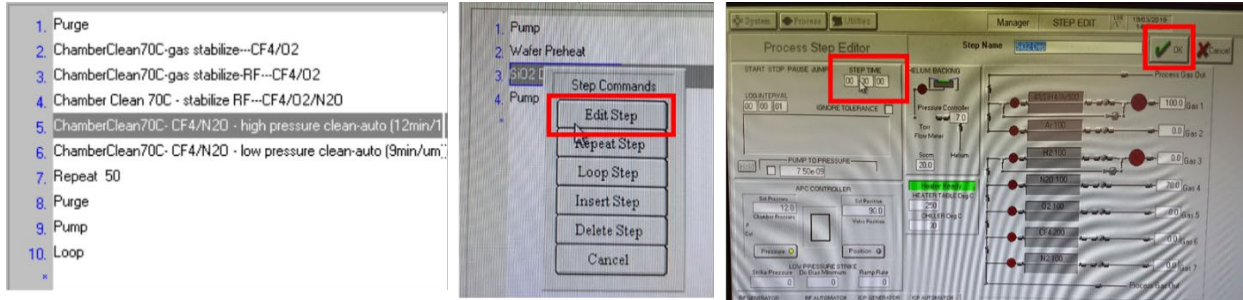


3.13 Adjust cleaning time in both steps: **high pressure clean-auto** and **low pressure clean-auto** by editing the step time in Process Step Editor.

Note: To etch back 1um of deposited material: the “high pressure clean” step must run for 12 minutes, and the “low pressure clean” step must run for 9 minutes. A high pressure and a low-pressure CF4/N2O steps are designed to chemically etch the deposited SiO₂/SiN_x:

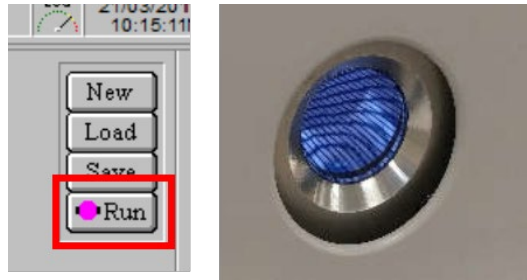
- The high-pressure step is designed to remove the bulk of the deposited material, using a relatively low ion-bombardment strength
- The low-pressure step is designed to remove any remaining deposited material, using a high ion-bombardment strength

In the cleaning recipe, there is also a set of 50 pump/purge cycles after these plasma steps, designed to induce flaking of any thick material that was only partially-attacked during the plasma steps.



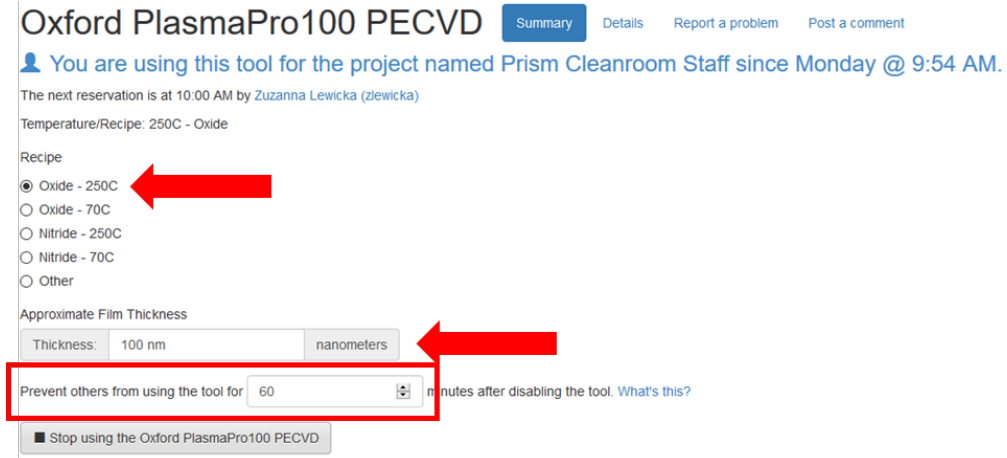
3.14 Press the “Run” button and run the cleaning recipe.

3.15 Wait for the plasma to ignite and stabilize before leaving the tool. This should happen after about 1 minute.



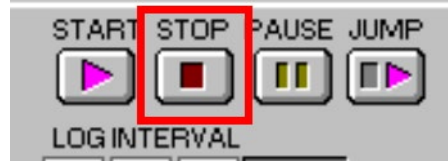
3.16 Sign out of the tool in NEMO

NOTE: Fill Logbook page in NEMO: Recipe and Approximate Film Thickness; If you running chamber cleaning recipe, “prevent others from using the tool for 60 min”.



APPENDIX 1 – Aborting the process

1. To abort a process, click the STOP button, on the process page.



NOTE: If you stop a process, or it aborts due to a hardware fault, a dialog box will pop up asking if you want your sample moved to the loadlock. ***Always click yes!!!*** If you click no, the staff will have to assist you to unload your sample manually. A successfully-aborted process will result in your wafer being returned to the loadlock, where you'll see the "Yellow alert", and a "Process Failed" popup. Remove your wafer, and contact the MNFL staff.



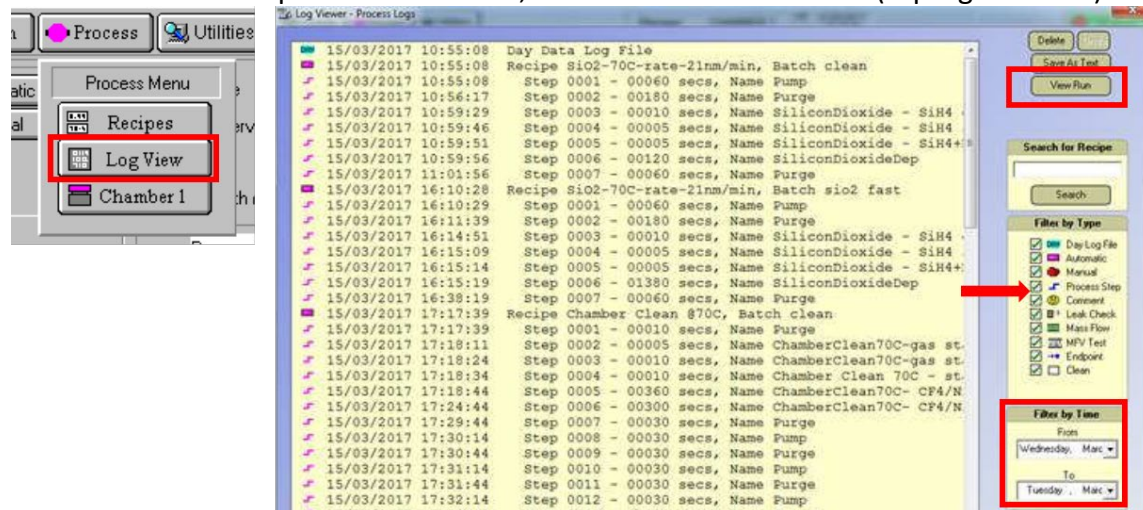
APPENDIX 2 - Checking Process Logs

1. To check Process Logs: Click **Process**, then **Log View**.

2. In the Log Viewer screen find your process.

NOTE: It is easier to find your process if you first, uncheck the “Process Step” box under “Filter by Type”. Next, select your desired date range (2-3 weeks is usually enough to find the recipe of interest).

3. Left-Click on the process of interest, then left-click “View Run” (top-right corner)



4. Now you’re viewing all of the sensor readings taken during the particular step of the process. Time is displayed as a countdown, in seconds. Scroll right to see further into each process step.

5. You can move forward/backwards by step, clicking the “Prev” and “Next” buttons (right side of screen), and see the current step name under “Recipe Step Details” (top of the screen)

The screenshot shows the 'Recipe Step Details' window for 'Recipe Chamber Clean @70C' on Wednesday, March 15, 2017 at 17:24:44. The table below shows parameter demands and readbacks over five time intervals.

Parameter	Demand	Readback 1	Readback 2	Readback 3	Readback 4	Readback 5
Step Time	00:05:00	300	294	289	284	279
Pump Pressure	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09
Pump Time	00:00:01	0	0	0	0	0
S&SiH4/Ar500	0.0	0.0	0.0	0.0	0.0	0.0
Ar 100	0.0	0.0	0.0	0.0	0.0	0.0
H2 100	0.0	0.0	0.0	0.0	0.0	0.0
N2O 100	20.0	20.2	20.3	20.4	20.2	20.3
O2 100	0.0	0.0	0.0	0.0	0.0	0.0
CF4 200	80.0	81.0	81.0	81.1	81.0	81.1
N2 100	0.0	0.0	0.0	0.0	0.0	0.0
Rf Power	100	100	100	100	100	100
Rf Reflected Power	0	1	1	1	1	1
DC Bias	367	336	336	336	335	335
Rf Cap 1 Position	0.0	75.9	75.9	75.9	75.9	75.9
Rf Cap 2 Position	0.0	62.6	62.3	62.3	62.3	62.3
Rf AMU Mode	1	0	1	1	1	1
ICP Forward Power	1500	1507	1507	1507	1507	1506
ICP Reflected	0.0	1	2	2	2	2
ICP Cap 1 Position	0.0	18.5	19.9	19.9	19.9	19.9
ICP Cap 2 Position	0.0	18.3	18.3	18.3	18.3	18.3
ICP AMU Mode	1	0	1	1	1	1
Heater Temperature	70	70	70	70	70	70
Chiller Temperature	30	25	25	25	25	25
Set Pressure	10.0	30.1	10.1	10.1	10.1	10.1
Set Position	90.0	28.7	41.6	41.5	41.4	41.3
Position	off	0.0	0.0	0.0	0.0	0.0
CM Gauge Offset	0	0.0	0.0	0.0	0.0	0.0
LPS Strike Pressure	0	0.0	0.0	0.0	0.0	0.0
LPS Dc Bias	0	0.0	0.0	0.0	0.0	0.0
LPS Ramp Rate	0	0.0	0.0	0.0	0.0	0.0
Helium Pressure	0.0	0.0	0.0	0.0	0.0	0.0
Helium Flow	0.0	0.0	0.0	0.0	0.0	0.0

6. To exit the Log Viewer, click “x” in the upper right corner.

