

Arizona State University NanoFab

OXFORD PECVD STANDARD OPERATION PROCEDURE

Rev F



Title: Oxford PECVD Standard Operating Procedure

Table of Contents

1.0 Purpose/Scope.....3
2.0 Reference Documents 3
3.0 Safety 3
4.0 Approved PECVD Recipes 3
5.0 Tool Reservation Policies 4
6.0 PECVD Tool Protocols 4
7.0 Setup of PECVD tool..... 4
8.0 PECVD processing on samples 6
9.0 Oxford PECVD Process Data 9
10.0 Revision History 9

Title: Oxford PECVD Standard Operating Procedure

1. Purpose / Scope

- 1.1 This document covers the procedure that should be followed for normal operation of the Oxford Plasmalab 100 PECVD tool.
- 1.2 Substrate sizes from 3” to 8” wafers. Pieces can be ran on a carrier wafer.

2. Reference Documents

- 2.1 Oxford Plasma lab System100 System Manual.

3. Safety

- 3.1 Follow all safety procedures outlined in the NanoFab Handbook.
- 3.2 Follow safety procedures for RF energy.
- 3.3 Follow safety and handling procedures when working with high pressure or toxic gases.
 - 3.3.1 SiH₄(5%) / N₂(95%) gas
 - 3.3.2 N₂O gas
 - 3.3.3 NH₃ gas
 - 3.3.4 N₂ gas
 - 3.3.5 CF₄ gas

<p>WARNING</p> <p>CONTACT WITH TOXIC GASES CAN CAUSE DEATH OR SERIOUS INJURY.</p> <p>WHERE ANY PROCESS GAS IS TOXIC, DO NOT TRANSFER A WAFER FROM THE PROCESS CHAMBER TO THE LOAD LOCK UNTIL ALL PROCESS GAS HAS BEEN PUMPED OUT.</p> <p>ENSURE THAT THE AUTOMATIC VENT SEQUENCE IS ALLOWED TO COMPLETE.</p> <p>IF THESE PRECAUTIONS ARE NOT CARRIED OUT, THERE COULD BE A HAZARD IN THE LOAD LOCK.</p>
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- 3.4 Do not attempt to repair the tool under any circumstances. Submit a service request and contact ASU NanoFab staff.
- 3.5 Red EMO Button can be pressed at any time an emergency situation arises. Contact ASU Nanofab Staff.

4. Approved PECVD Recipes

- 4.1 ASU - SiO₂ 350C
- 4.2 ASU - SiN_x 350C
- 4.3 ASU - SiN_x 250C
- 4.4 ASU - SiO₂ LDR 350C
- 4.5 ASU - SiON Low Stress 350C

Title: Oxford PECVD Standard Operating Procedure

5.0 Tool Reservation Policies

- 5.1 Only trained users will be allowed to use this equipment.
- 5.2 Our NanoFab 15-Minute rule.
 - 5.2.1 Please start within 15 minutes of your equipment scheduled time or the tool becomes available to anyone. Please place a 'Tool in Use' tag when you arrive to indicate use.
 - 5.2.2 Please have the equipment available for the next user within 15 minutes after your scheduled time.
- 5.3 Cancellations.
 - 5.3.1 If you cannot meet the equipment schedule, please cancel your iLabs schedule to allow other users to utilize the equipment.
 - 5.3.2 Scheduling on iLabs allows cancellation within 24 hours of your scheduled time. Please email staff if cancellation within 24 hours.
 - 5.3.3 We discourage last second cancellations.
 - 5.3.4 We discourage scheduled equipment no-shows.

6.0 PECVD Tool Protocols.

- 6.1 It is recommended to run a chamber conditioning run before you load your samples.
- 6.2 Film thickness restrictions for SiN_x is 1µm and for SiO₂ is 2µm per wafer.
- 6.3 No photoresist, polymers, gold, silver or copper are allowed in the PECVD. Kapton tape not recommended.
- 6.4 Placing samples with existing aluminum material is not recommended to higher heats.
- 6.5 Carriers are available when loading smaller pieces or when processing fragile materials subject to thermal shock. Please don't risk placing pieces on flat wafers.
- 6.6 After changing the robot paddle stops to different wafer size, please leave the tool in 4" mode for the next user. Running in incorrect mode could result in the wafer stuck in chamber.
- 6.6 Yellow Alert: Depressing Accept in Automatic mode when wafer still in chamber will result in a stuck wafer in the chamber.

7. Setup of PECVD tool

- 7.1 System setup.
 - 7.1.1 Select System/Pumping display screen.
 - 7.1.1.1 Ensure the interlocks at bottom of the page are all Green.
 - 7.1.1.2 Insure both the Loadlock and the process chamber are pumped down.
 - 7.1.2 Log-in to system by selecting System/System log. Enter the tool username and password. Depress Verify. Then depress OK to exit the Log-In screen.

Title: Oxford PECVD Standard Operating Procedure

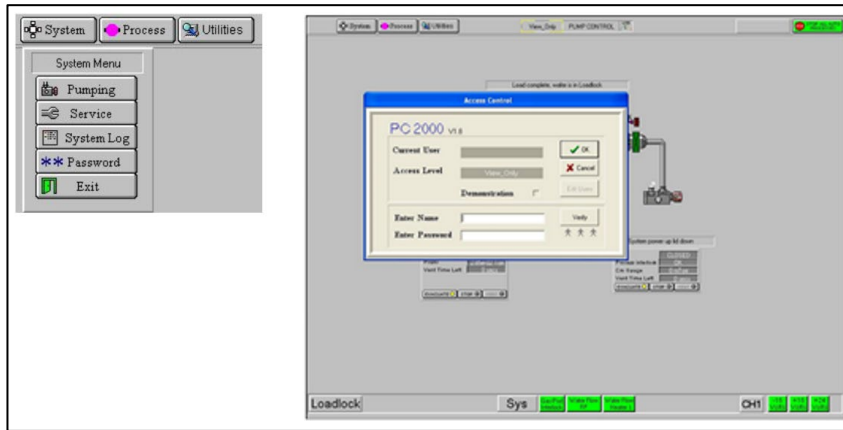


Fig-1 System Tab & Log-in.

- 7.1.3 Log-in to the iPad Kiosk and setup your intended recipe. This will establish your recipe and your upcoming deposition times.
 - 7.1.3.1 Please enter all relevant information pertaining including conditioning thickness plus number of wafers.
 - 7.1.3.2 **Please enter time in (xx-xx-xx) (hr/min/secs) format including hours.**

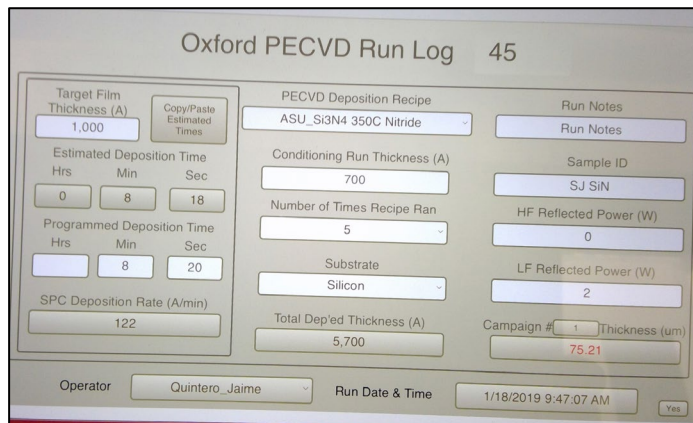


Fig-2 iPad run log.

- 7.1.4 Select Process/Recipe to display Recipe screen.

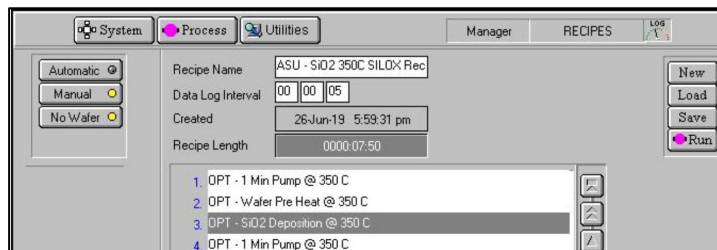


Fig-3 Recipe display in Manual/no wafer mode

Title: Oxford PECVD Standard Operating Procedure

7.1.5 Performing chamber conditioning run.

Note: Recommended to use 5-minute conditioning run using the same recipe.

- 7.1.5.1 On the Recipe display, select Manual and the No Wafer buttons on screen and then depress Load.
- 7.1.5.2 Select and Load your recipe.
- 7.1.5.3 Left-click the deposition step and select Edit Step command to view parameters.
- 7.1.5.4 Update correct Step Time is xx-xx-xx (hr/min/secs). Depress Enter.
- 7.1.5.5 Depress Run button to start the conditioning recipe.
- 7.1.2.1 The Process/Chamber1 screen will display your process recipe.
- 7.1.5.6 The screen will display a Yellow Alert message when the process is complete.
- 7.1.5.7 Yellow Alert in Manual/No Wafer recipe mode. You may depress Accept at any time.



Fig-4 Yellow Alert

8.0 PECVD Processing on Samples

8.1 Loading your substrates.

8.1.1 Loading substrates into Loadlock chamber.

- 8.1.1.1 Select System/Pumping.
- 7.1.2.2 Using Loadlock Evacuate/Vent controls, depress Stop then depress Vent.
- 8.1.1.2 When Loadlock is at atmosphere pressure, Open the Loadlock lid.
- 8.1.1.3 Note the location of the wafer size stops on robot paddle. Adjust stops based on your wafer/carrier size if required. Please leave wafer stops in 4” mode when completed.

Title: Oxford PECVD Standard Operating Procedure

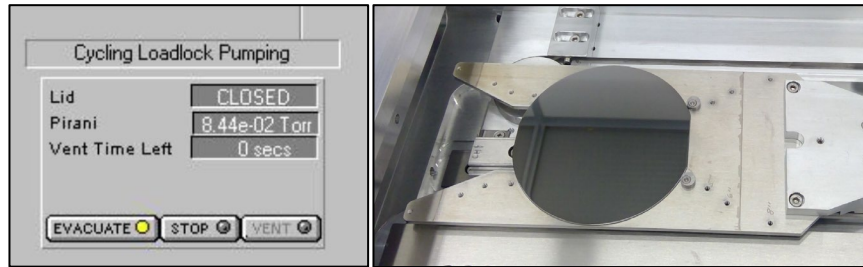


Fig-5 Pumping/Loadlock controls & Wafer loading

- 8.1.2 Load your substrate on the robot arm.
 - 8.1.2.1 Recommended to load wafer flat to the rear of the paddle. Center substrate to the width of the paddle.
 - 8.1.2.2 Use silicon carriers to load smaller pieces or fragile wafer materials to help reduce thermal shock.
 - 8.1.2.3 Including silicon witness samples is recommended.
- 8.1.3 Close Loadlock lid.
- 8.1.4 Using Loadlock Evacuate/Vent controls, depress Stop then depress Evacuate.
 - 8.1.4.1 You will be prompted to load a wafer ID.

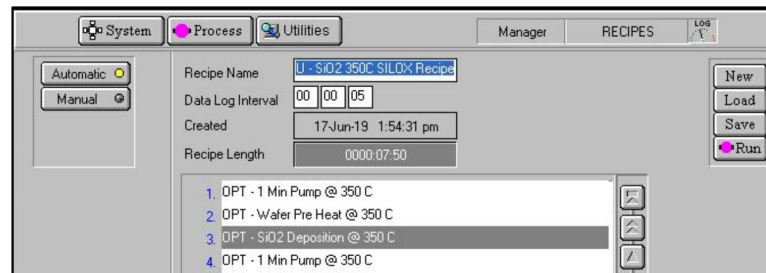


Fig-6 Recipe in Automatic mode

- 8.2 Start deposition on your substrates.
 - 8.2.1 Select Process/Recipe to display the Recipe screen.
 - 8.2.2 Select the Automatic button on left margin and then depress Load.
 - 8.2.3 Load recipe and enter your updated dep time to meet your thickness.
 - 8.2.3.1 Left-click the deposition step and select Edit Step command to view parameters.
 - 8.2.3.2 Update step time is in (xx-xx-xx) (hr/min/secs). Depress Enter.
 - 8.2.4 Depress Run button page to start the recipe.
 - 8.2.5 System will switch to Chamber1 display. Monitor your deposition process.
 - 8.2.6 Insure your plasma starts. Monitor through chamber viewport.

Title: Oxford PECVD Standard Operating Procedure

- 8.2.7 Update iPad entries for RF reflected power entries.
- 8.3 Completion of Deposition recipe.
 - 8.3.1 When your recipe is completed, the screen will display a Yellow Alert message as well as a Process complete popup window.
 - 7.1.3 Yellow Alert in Automatic mode. **Please verify the wafer has exited the chamber before depressing Accept.** Otherwise wafer will remain stuck in the chamber.

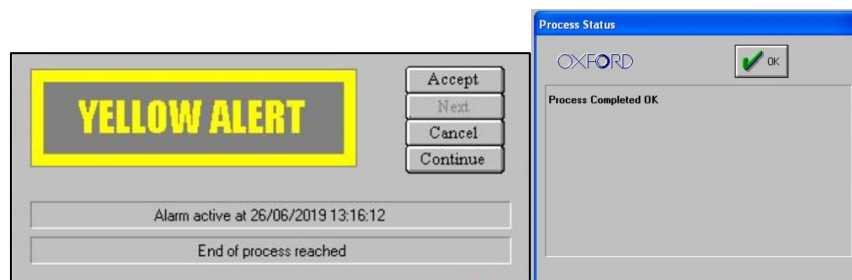


Fig-7 Yellow Alert and Process Completed window

- 8.3.2 Vent Loadlock chamber,
 - 8.3.2.1 Select **System/Pumping**.
 - 7.1.3.1 Using Loadlock Evacuate/Vent controls, depress Stop then depress Vent.
 - 8.3.2.2 When at atmosphere pressure, Open the Loadlock lid.
 - 8.3.2.3 You may load another wafer into the Loadlock for deposition.
 - 8.3.2.4 Please insure the wafer size stops remain at 4” after your completed.
- 8.3.3 Pumpdown Loadlock chamber.
 - 8.3.3.1 Using Loadlock Evacuate/Vent controls, depress Stop then depress Evacuate.
- 8.4 If your performing another deposition, proceed back to step 6.2.
- 8.5 If completed with processing, please log-out of the PECVD tool system by selecting SYSTEM/PASSWORD. Leave Name and password fields empty and depress Verify.
- 8.6 Completion of the iPad Kiosk run log.
 - 8.6.1.1 Open the Tools in-Use display.
 - 8.6.1.2 Selecting the Change Tool Status and depress the Run Completed button.

Title: Oxford PECVD Standard Operating Procedure

9. Oxford PECVD Process Data

- 9.1 ASU 350C SiO₂ PECVD film properties.
 - 9.1.1 Film Deposition Rate @69.0nm/min.
 - 9.1.2 Woollam Ellipsometer film Index (*n*) 1.479 (@632.8nm.
 - 9.1.3 Woollam Ellipsometer 21pt. non-uniformity on 4" wafer (4.71%).
 - 9.1.4 Wafer Stress -268 MPa (compressive).

- 9.2 ASU 350C SiN_x PECVD film properties.
 - 9.2.1 Film Deposition Rate @12.3nm/min.
 - 9.2.2 Woollam Ellipsometer film Index (*n*) 1.978 (@632.8nm.
 - 9.2.3 Woollam Ellipsometer 21pt. non-uniformity on 4" wafer (4.59%).
 - 9.2.4 Wafer stress 178.7 MPa (Tensile).

- 9.3 ASU 350C SiON PECVD Low Stress film properties.
 - 9.3.1 Film Deposition Rate @19.5nm/min.
 - 9.3.2 Woollam Ellipsometer film Index (*n*) 1.716 (@632.8nm.
 - 9.3.3 Woollam Ellipsometer 21pt. non-uniformity on 4" wafer (1.62%).
 - 9.3.4 Wafer Stress 136.1 MPa (Tensile).

10. Revision History

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
01/12/2011	Carrie Sinclair/ Paul Boland	New Tool	A
09/18/12	Carrie Sinclair	Gas Configuration change	B
06/16/17	Carrie Sinclair	Minor Updates	C
06/21/17	Carrie Sinclair	Removal of BC13 & NH3 on/off procedures	D
2/23/18	Carrie Sinclair	Added sect. 5.2 restrictions to SiN _x and SiO ₂ thicknesses.	E
07/01/19	Jaime Quintero	Checklist format. Film data	F