

**First Nano LPCVD User Instructions**  
**For the Micro-Electronics Laboratory**  
**At**  
**University of Notre Dame**  
**Department of Electrical Engineering**

## **General Precautions**

### Contacts

For problems, clarifications of procedures, or general information pertaining to this machine, please contact one of the following personnel.

<b>Mark Richmond,</b>	<b>631-6478</b>	<a href="mailto:Richmond.7@nd.edu">Richmond.7@nd.edu</a>
<b>Mike Thomas</b>	<b>631-7493</b>	<a href="mailto:Thomas.20@nd.edu">Thomas.20@nd.edu</a>
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In case of emergency, Please contact the Notre Dame Security at  
**911**

## **General Information**

Tube #1 – This tube is not installed from the manufacturer.

Tube #2 – This tube is for Nitrides and has NH<sub>3</sub> and Dichlorosilane as gases requiring silicon o-rings.

Tube #3 – This tube is for Polysilicon (dopant, Amorphous, and Polycrystal) and uses Phosphine and Silane gases.

Tube #4 – This tube is for Oxides (TEOS and LTO) and uses Oxygen and a TEOS vaporizer for gases.

Alarm “Silence” and “Reset” is located just above the keyboard.

Absolutely no ITO, glass(Quartz is ok), gold, or sodium in this furnace.

All metal use in furnace will need to be authorized through Dr. Snider via email.  
(Snider.7@nd.edu)

Process Control window should be active at all times.

Alarm window should not have any active (RED) alarms.

Always insert wafer side toward pumps or the back of the system.

This system has a maximum processing limit of 500 mTorr.

Maximum temperature ramp is 25 degrees per minute.

Tube #4 Injector line is not on PID control.

On Log and graph displays, right click to zoom the information.

## **Standby Conditions**

All tubes closed and evacuated.

All pumps and exhaust purges should be off and yellow in the Alarms screen.

## **Start Procedure**

1. Enable the system in Coral, please add your process that you will be running in coral reservation and enable. Be sure to add the expected cooldown time in the reservations.
2. Prepare your samples for the LPCVD if not done already.
3. To load a recipe, refer to Figure #10, and double click the appropriate "Tube# CvdWinPrc" icon.
4. Click on the recipe "STD Tube X vent.RCP" .
5. Click "Ok" on the two pop up windows for the data file and the comments. Enter comments if you prefer to have that information entered into the run log.
6. Several windows will load into the bottom screen, see Figure #8.
7. When ready, on the lower screen click "Reset" (Top left window labelled "Tube X Process-CVDWinPrc 2.013....") to start your recipe and then "OK" on the pop up window.
8. When finished the tube should be ready to unload, this recipe will take just a few minutes to run and finish.
9. On the main control screen (Top monitor) and in the top center of the monitor, verify your tube is "Tube #X ready to unload" by the green indicator before you continue. See Figure #6.
10. Close the current recipe by pressing the "X" in the upper right hand of the main program window labelled "Tube X Process-CVDWinPrc 2.013....".
11. Once your tube is ready to unload, press the appropriate black "Unload" button for the tube you are planning to use located above the keyboard. See the bottom of Figure #1. The loader end of the tube display will flash quickly on screen and the lights on the control will switch from "Loaded" to "Running".
12. Please wait for the loader to completely stop before going on. This takes about 1-2 minutes and the lights on the control will switch from "Running" to "Unloaded" when complete.
13. Using the holder tool, located on the table, lift off the sample holder out of the tube holder. Please be careful here as all these items are glass and can be broken easily. The holder tool only needs to be inserted just through the sample holder carrier ports to lift it out. See Figure #2.
14. Set the holder on the quartz plate on the table. See Figure #3.
15. Remove the holder lid carefully using the tool and place it on the quartz plate beside the holder. See Figures #3 and #4.
16. Insert your samples into the holder. Please note the wafer side should always face the pumps or in the direction of the PECVD when inserted into the tube.
17. Carefully place the lid on the sample holder by using the holder tool.
18. Lift sample holder with lid in place and carefully place the sample holder into the tube holder.
19. Replace the holder tool back on the quartz plate.
20. Verify placements of samples and sample holder in the tube lock properly.

21. Press the appropriate green load button on the loader controls of the tube you are using located above the keyboard. The lights will switch from “Unloaded” to “Running”.
22. Wait for the loader to finish moving before continuing. Also be careful of the loader and the precautions listed on the machine regarding pinch points. If there are problems then immediately press the red stop button on the tube that is moving. Remove the problem or contact help before you continue.
23. To load a recipe, refer to Figure #10, and double click the appropriate “Tube# CvdWinPrc” icon.
24. Click on the appropriate recipe to load using for your deposition.
25. Click “Ok” on the two pop up windows for the data file and the comments.
26. Several windows will load into the bottom screen, see Figure #8.
27. When ready, on the lower screen click “Reset” (Top left window labelled “Tube X Process-CVDWinPrc 2.013....”) to start your recipe. Users are required to be at the machine through all process steps to keep an eye on the system and make sure no problems arise during the run.
28. While process is running, on the Graph screen users can left/right click on the screen to scroll/zoom the display.
29. When finished the tube should be ready to unload.
30. Close the current recipe by pressing the “X” in the upper right hand of the main program window labelled “Tube X Process-CVDWinPrc 2.013....”.
31. Once your tube is ready to unload, press the appropriate black “Unload” button for the tube you are planning to use. See the bottom of Figure #1. The loader end of the tube display will flash quickly on screen and the lights on the control will switch from “Loaded” to “Running”.
32. Please wait for the loader to completely stop before going on. This takes about 1-2 minutes and the lights on the control will switch from “Running” to “Unloaded” when complete.
33. Using the holder tool, located on the table, lift off the sample holder out of the tube holder. Please be careful here as all these items are glass and broken easily. The holder tool only needs to be inserted just through the sample holder carrier ports to lift it out. See Figure #2.
34. Set the holder on the quartz plate on the table. See Figure #3.
35. Remove the holder lid carefully using the tool and place it on the quartz plate beside the holder. See Figures #3 and #4.
36. Remove your samples from the holder. Please note the wafer side should always face the pumps or in the direction of the PECVD when inserted into the tube.
37. Carefully place the lid on the sample holder by using the holder tool.
38. Lift sample holder with lid in place and carefully place the sample holder into the tube holder.
39. Replace the holder tool back on the quartz plate.
40. Verify placements of samples and sample holder in the tube look proper.
41. Press the appropriate green load button on the loader controls of the tube you are using. The lights will switch from “Unloaded” to “Running”.
42. Wait for the loader to finish moving before continuing. Also be careful of the loader and the precautions listed on the machine regarding pinch points. If there

- are problems then immediately press the black stop button on the tube that is moving. Fix problem or contact help and then continue.
43. To load a recipe, refer to Figure #10, and double click the appropriate “Tube# CvdWinPrc” icon.
  44. Click on the “STD Tube X pump down.RCP” .
  45. Click “Ok” on the two pop up windows for the data file and the comments.
  46. Several windows will load into the bottom screen, see Figure #8.
  47. When ready, on the lower screen click “Reset” (Top left window labelled “Tube X Process-CVDWinPrc 2.013....”) to start your recipe and then “OK” on the pop up window.
  48. When finished the tube should be in vacuum shutdown.
  49. Close the current recipe by pressing the “X” in the upper right hand of the main program window labelled “Tube X Process-CVDWinPrc 2.013....”.
  50. Verify the machine is in standby.
  51. Disable the system in Coral and complete the Run Data Logger.



Figure #1: Main LPCVD Controls with monitors on the top and in the middle with loading controls on the bottom.

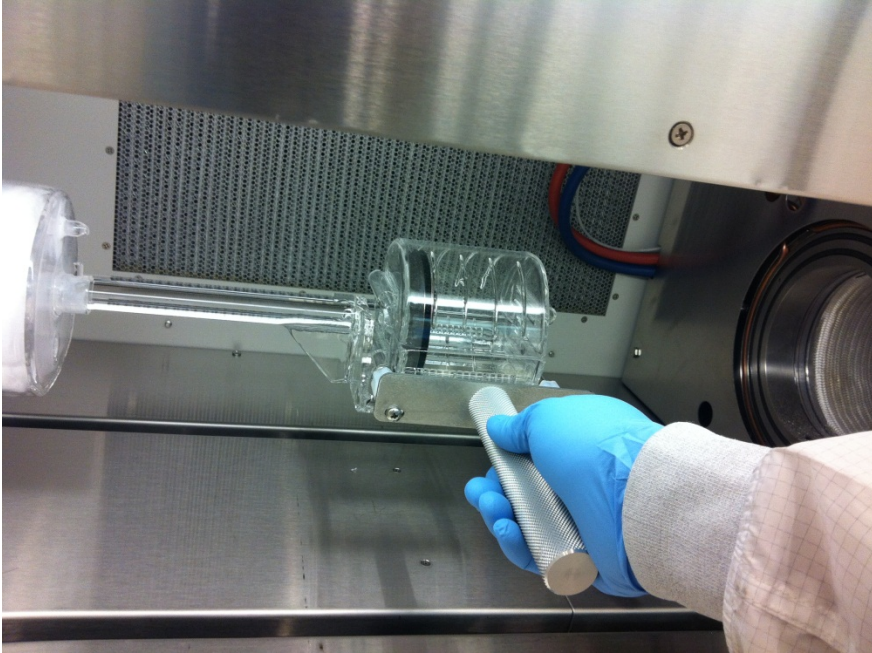


Figure #2: Inserting or removing sample holders.

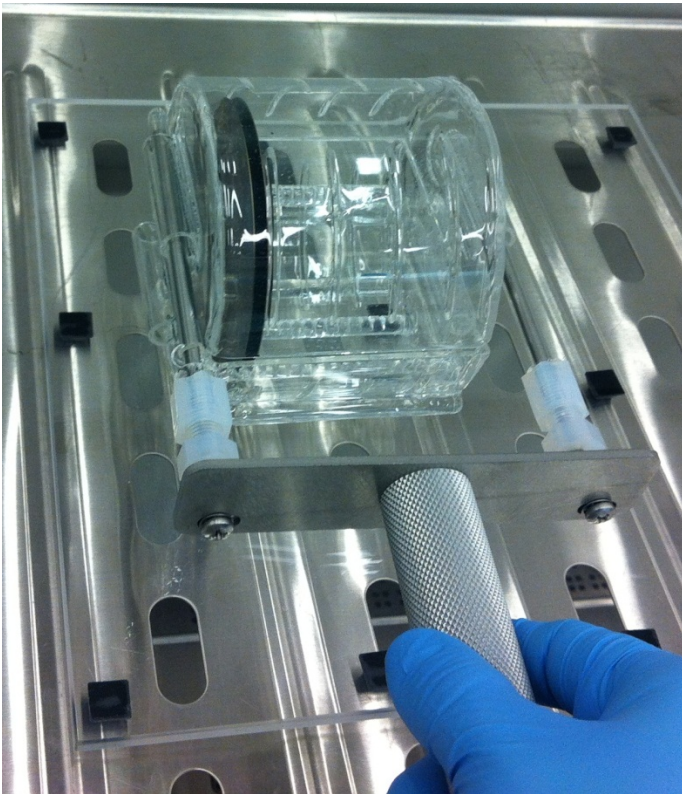


Figure #3: Lifting top lid of sample holder.



Figure #4: Lid of sample holder is off so samples can be inserted or removed from holder.

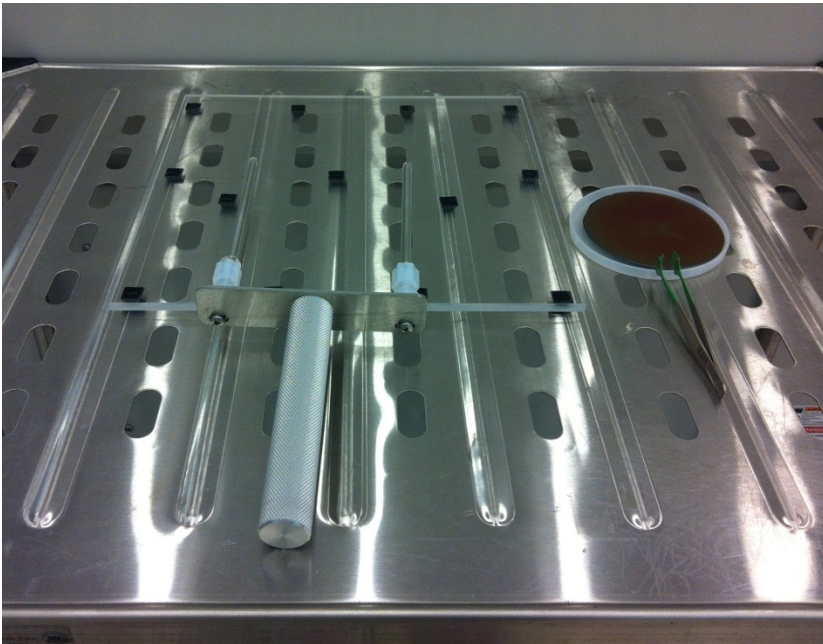


Figure #5: Samples and tools on quartz plate.



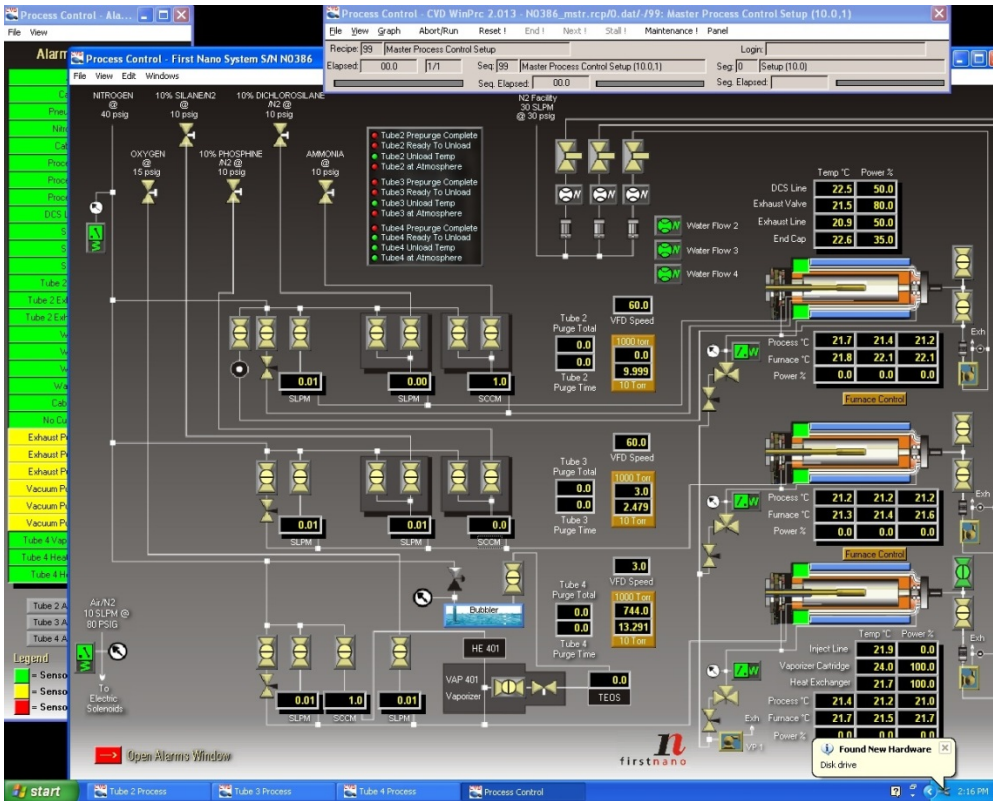


Figure #6: Main control window of the LPCVD.

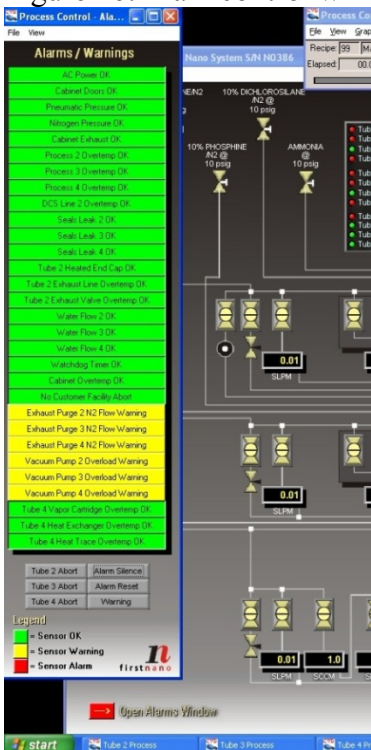


Figure #7: LPCVD Alarms Window on top monitor.

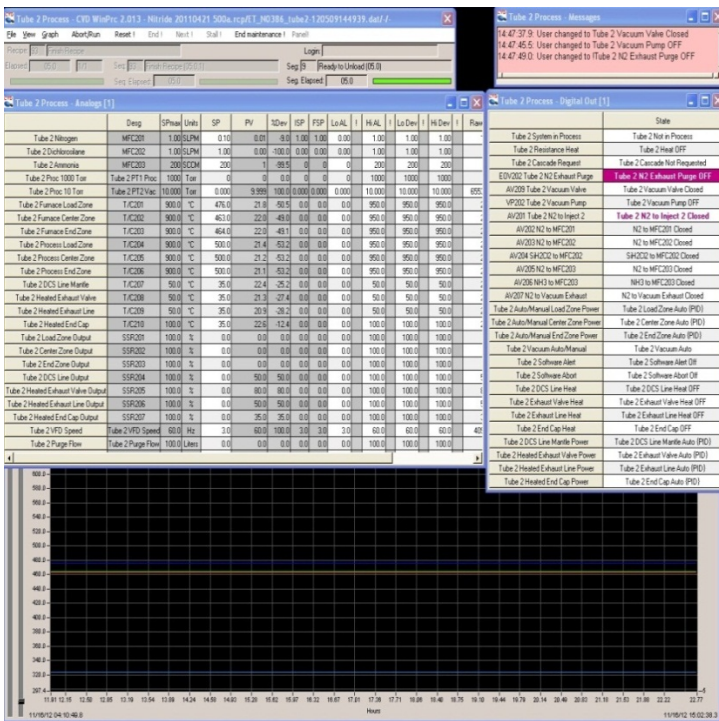


Figure #8: LPCVD tube controls screens on bottom monitor.

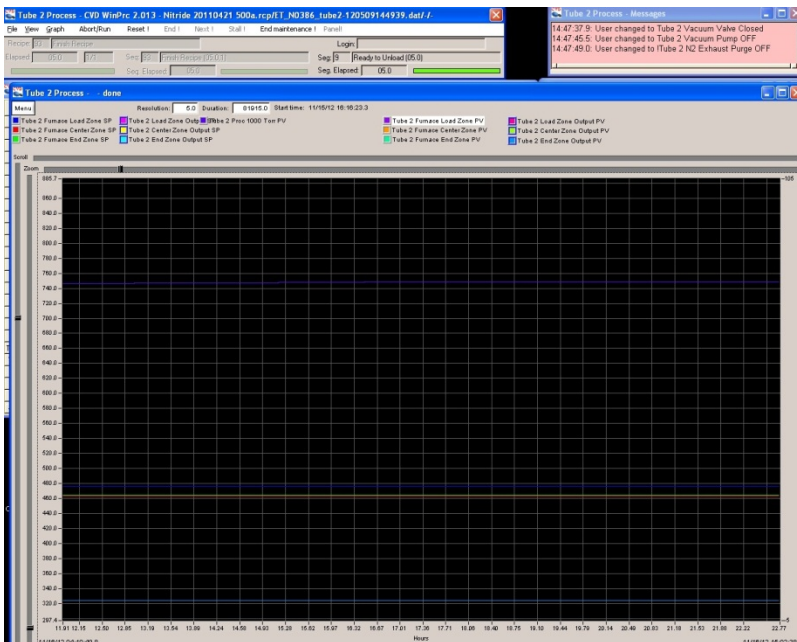


Figure #9: LPCVD process graph on the bottom window. (Note: Left/right click for Scroll/zoom)

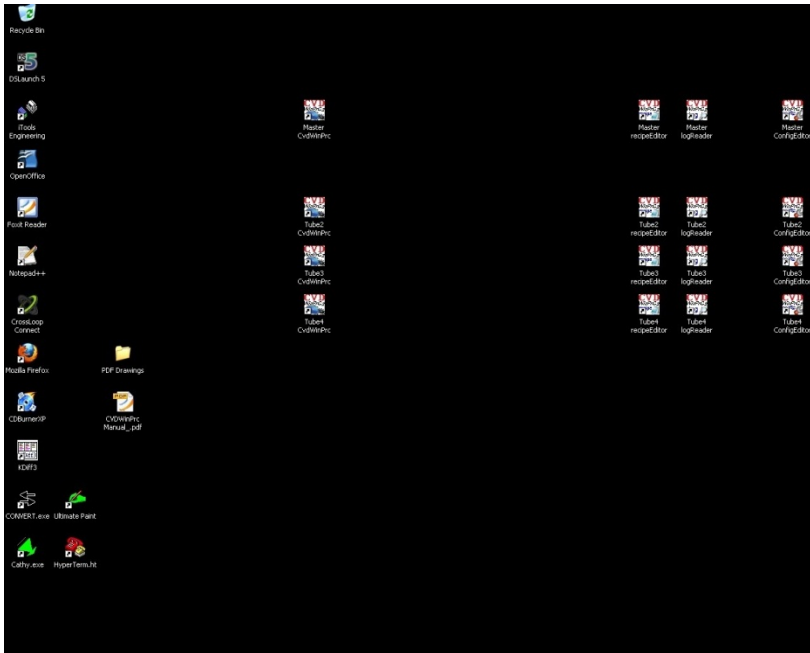


Figure #10: Control programs on bottom monitor.

**Basic Recipe Information: (Timing varies slightly between tubes)**

2 sec	Setup Initial
10 min	Timed Pump down
2 min	Checked Pump down
1 min	Leak check
5 sec	Backfill
5 min	Heat to temp (about 30 mins to 700C)
9 min	Cascade control
	Reference: <u>To this point takes about 54 minutes.</u>
10 min	Process <u>Step time varies on recipe and thickness.</u>
5 sec	Pump down and Cool (400C is 1.5-2 hours from 700C)
	Reference: <u>This step takes a minimum of about 2 hours.</u>
5 sec	Backfill to 720T
15 sec	15 sec overflow
2 sec	End Recipe

**Tube 2:**

STD Nitride 200A.rcp

11 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

STD Nitride 270A.rcp

20 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

STD Nitride 300A.rcp

16 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

STD Nitride 390A.rcp

30 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

STD Nitride 500A.rcp

27 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

STD Nitride 800A.rcp

44 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

STD Nitride 1000A.rcp

55 mins process/40sccm NH3/.1slpm Dichlor/.35T/780C

**Tube 3:**

STD Poly 800A.rcp

15mins 07 seconds/.1slpm SiH4/.3T/630C

STD Poly 1000A.rcp

18mins 54 seconds/.1slpm SiH4/.3T/630C

STD Poly 2000A.rcp

37mins 47 seconds/.1slpm SiH4/.3T/630C

STD Poly 3500A.rcp

66mins 07 seconds/.1slpm SiH4/.3T/630C

P Doped Poly 1600A.RCP

80mins -- Testing underway

**Tube 4:**

STD TEOS 800A.rcp

11mins 0seconds/50sccm Vaporizer N2/.3T/700C/.5gr per Min TEOS

STD TEOS 1500A.rcp

23mins 35seconds/50sccm Vaporizer N2/.3T/700C/.5gr per Min TEOS