

<b>Tool Identifier</b>	ANNEAL (Phosphorus Diffusion)
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## ULTECH ANNEAL FURNACE

### Specifications

- **Substrate:** Si only.
- **Substrate size:** 4" only.
- **Types of depositions:** Phosphorus Diffusion from solid sources from Saint Gobain
- **Pressure range:** Atmosphere
- **Temperature range:** upto 1100°C
- **Gases presently connected to system:** N<sub>2</sub>, Ar,
- **Mass Flow Controller (MFC) Limit/Range :** N<sub>2</sub>: 10000 sccm Ar:10000sccm

### Training procedure:

1. Send a request for training to the system owner with copy to staff in charge, assistant lab manager, faculty in charge of the tool and your supervisor. State the purpose of training, types of samples proposed to be used and the project for which the work is being carried out. Get faculty approval.
2. The system owner in consultation with the user would then communicate a training schedule.
3. Get 1 training sessions with SO/AU
4. Demonstrate 1 independent run with SO/AU

### Violation Policy:

Operation of the tool in a way not conforming to the procedure outlined in this document would be considered a violation. Depending on the severity of the violation, appropriate disciplinary action would be taken against the offender. Should the user want to make changes to the operating procedure, she/he has to consult the system owner and obtain her/his consent for the change.

### THINGS TO FOLLOW:

- **NEVER** touch boats or wafers with your hands even if you are wearing gloves. Use **ONLY** the appropriate boat holder. Boat Holder must be clean also.
- Use **ONLY** clean tweezers or vacuum wand dedicated for that tube. Clean these implements often using isopropyl alcohol, DI water and clean wipes.
- **ALWAYS** clean wafers using either piranha or RCA type clean right before loading them into the tube. Wafers must be clean and dry. Use spin rinse dryer whenever possible. Never load a contaminated wafer or boat into the tube as this will contaminate the tube as well.

- Wafers and boats coming out of the tube are extremely hot. Do **NOT** set them on clean wipes, vinyl gloves or anything else which will melt. Set hot items on clean stainless steel bench or on dedicated quartz carrier.
- **ALWAYS** wear a face mask when loading and unloading your wafers into tube to minimize contamination from your breath.
- **ALWAYS** minimize the time that the boat and loader remains out of the furnace and makes sure the purge nitrogen is set to 5.0 liters or better to keep room air out of the tube.

## **Operating Procedure**

### **Things needed before entering the clean room**

1. Check the tool status. If the tool is down, you would not be able to do the processing.
2. Switch On the mains supply to the tube.
3. Ensure that the heater switches are in ON position.
4. Check for the GN2 pressure (from N2 plant). Minimum 5 bar pressure is required for smooth operation.
5. Check for the PN2 (5N purity) pressure (from cylinder). Minimum 4 bar pressure is required for smooth operation.

### **SWITCH ON Procedure after entering the clean room**

6. Check the Log book for any remarks from the previous run. Contact system owner if any remarks have been written.
7. Press the GREEN push button switch located right to the touch screen. (If any alarm comes, the alarm page automatically displayed without login).
8. Click on LOGIN and enter the password (“furnace1”) by using the on-screen key board.
9. Press ENTER.
10. Click on “Anneal” button on the top tool bar. The OVERVIEW page is displayed.
11. Do not change the settings in the CONFIGURATION page. Contact system owner if you would like to make changes.
12. Click the OPERATION button, Now set the front, center and rear temperature to 800C.
13. Let the three zone temperature be 800 C for a few hours till the furnace stabilizes to 800C. .

### **Editing the RECIPE**

14. Go to RECIPE page by pressing the “RECIPE” button located on the bottom tool bar.
15. Press OPEN located at the top right corner for 2 seconds. A beep will be heard and some of the cells in the recipe page will be highlighted in green background.
16. Click on the cell to change its value. A small pop up key pad is displayed.
17. Enter the required value (within operational limits) and Press ENTER. Press the cell once to change it into YES and vice-versa. **Recipe for activation and diffusion are given below.**

18. After editing all the cells press the SAVE button in the RECIPE page for 2 seconds.
19. Press OPEN once again to make the current recipe as active.

### **Boat-Out and Loading the Source wafers**

20. After saving the recipe press OPERATION button located on the bottom tool bar.
21. Now press the BOAT-OUT button. It will take 12-14 minutes for complete boat out.
22. Load the Solid source wafers in the required slots. Handle the wafers with care and do not touch the wafer boat and process tube interior with gloves.
23. Now press the BOAT-IN button.

### **Running the Recipe**

24. Ensure that the recipe is saved after editing.
25. Press OVERVIEW button located at the bottom left corner.
26. Now press RUN on the top left located below the top tool bar and the RUN button starts blinking indicated that the process is started. Press skip button to start the recipe from process 1.
27. During process if any alarm comes refer Alarms page for corresponding action.

### **Boat-Out and Loading the wafers**

28. After the recipe is done, press the BOAT-OUT button.
29. Now load the cleaned wafers, in such a way that the polished side faces the solid source.
30. Now press the BOAT-IN button.

### **Running the recipe**

31. Ensure that the recipe for diffusion is saved.
32. Press OVERVIEW button located at the bottom left corner.
33. Now press RUN button and it starts blinking indicating the process has started. Press skip button to start the process from process 1.

### **Boat-Out and Unloading the wafers**

34. After the recipe is done, press the BOAT-OUT button.
35. Now unload the wafers and the source wafers.
36. Place the source wafers in the dessicator.
37. Press OPERATION and put the temperature as 0 in all the three zones and press the RUN button.

### **SHUTTING DOWN the system**

1. Do not switch off the mains power directly from outside in any case (Power failure is exceptional).
2. Wait for the temperature of the three zones to ramp down up to 300°C.
3. Press SHUT DOWN located on the top right corner. A small pop up window with RUN and CLOSE buttons is displayed.
4. Press RUN (in the pop up window). The Shut down in the pop up window starts blinking.

### **Check List before Leaving the System**

1. Make entry in the log book.
2. Let PN2 gas be flowing during ramp down.

### **Recipe for activation of source wafers:**

S.No	Step	Temperature	Time (minutes)	N2 gas flow (slm)
1	Push in	800	12	10
2	Stabilise	800	5	6
3	Soak	900	900	6
4	Stabilise	800	5	6
5	Pull out	800	12	10

### **Standard Recipe for diffusion:**

S.No	Step	Temperature	Time (minutes)	N2 gas flow (slm)
1	Push in	700	12	10
2	Stabilise	700	5	8
3	Soak	890	25	8
4	Stabilise	700	5	8
5	Pull out	700	12	10

### **Other relevant information**

As per the manufacturer's guidelines, the source has to kept inside the furnace tubes at a temperature of 400C when no diffusion process is carried out. However this is an expensive proposition. When the source wafers are taken from the dessicator for diffusion, they should be activated before diffusion process. The procedures for source activation and for changing of the source are given below.

**PH900:**

Activation time – 17 hours

Lifetime - 12 runs

**PH1025:**

Activation time – 4 hours

Lifetime – 15 runs

**Process for changing the Source:**

Keep the tube at the activation temperature of the previous source for approx. 15 hours, with a gas flow of 10000 sccm.

**Process if diffusion not done for several days:**

Keep the tube at the activation temperature of the source for approx. 8 hours with a gas flow of 10000 sccm.

## Alarms

1. Tube 1 No Air flow detected  
Indication: ORANGE indicator flashes.  
Reason: GN2 pressure from N2 plant is less than 4 bar.  
Action: Increase the GN2 pressure
2. Tube 1 No Gas flow is detected  
Indication: ORANGE indicator flashes.  
Reason: Either N2 or Arpressure is low.  
Action: Increase the pressure.
3. Tube 1 process has escaped the limit of heater temperature.  
Indicator: ORANGE indicator flashes.  
Reason: Operating the outside the allowed temperature range.  
Action: Set the temperature values within the allowed range.

These are the generally observed alarms during process run. If you observe any alarm other than those described above please contact the system owner.