



PhosPlus - Phosphorus Diffusion Furnace

Safety

- The furnace gets extremely hot and remains hot to the touch hours after it has been turned off. Use extreme caution and use appropriate PPE.
- Do not place hands or other body parts inside furnace.

Allowed Materials and Processes

The Phosphorus Furnace can be used to create highly doped N-type substrates.

You can use silicon or glass wafers. The PHOSPLUS TP-250 sources are in the drawer underneath the Modulab Oxidation furnace.

Restricted Materials and Processes

Please do not place other sources besides the Phosphorus sources in the Phosphorus Furnace. Ensure that substrates and sources are placed correctly in quartz source tray and not doubled-up or shifted.

Important Equipment Notes

- Be extremely careful when handling quartz source tray and quartz rod
- Wafers may be loaded and unloaded at higher temperature (greater than 400 C) but must be done slowly to not thermal shock the wafers or the sources.
- Once unloaded, the wafers should be placed on one of the metal tables to completely cool (usually around a minute) before stored in the plastic case.
 - Clean a spot on one of the metal tables with a clean wipe and isopropyl alcohol before cooling wafers on it.
- Oxygen may also be used during some diffusion runs. If oxygen is needed, turn on the oxygen tank in the back of the cleanroom and turn on the oxygen valve connected on the right of the furnace. The oxygen gas flow should be set to 9 and left on for the desired time and temperature during the specific Phosphorus diffusion. This step will not always be needed for all diffusion processes.
- Heating up and cooling down times:
 - To heat up to 825 C, the furnace takes about 30 min

Operating Procedures

1. Check reservations and make one
2. Check tool status and configuration
 - a. Visit: <http://www.mmf.montana.edu/equipment-status.html>
3. Check lab status
 - a. Check that the N2 bottle pressure is above 400 PSI.
 - b. Check that N2 is on for lab.
 - c. If your process needs oxygen or argon, check the O2 or Ar bottle pressures as well.
4. Log into SUMS
5. Equipment checks
6. Plug in furnace and turn on.



- a. To turn on the furnace, hold the circular power button while switching the main power switch to the on position.
 - b. Continue holding the reset button until the temperature readings appear on the display.
7. Record experiment parameters in the logbook located in the bin on the wall next to the furnaces.
8. Clean quartz rod and metal tray with isopropyl alcohol and clean wipe.
 - a. Use the rod and metal tray that are marked with the red tape
9. Unload quartz source tray from furnace.
 - a. Place metal tray at the entrance of the furnace, making sure the furnace tube and the metal tray are lined up and flat.
 - b. Slowly push quartz rod into furnace, making sure to keep the end of the rod as low as possible.
 - c. Hook the end of the rod through the loop on the quartz source tray.
 - d. Slowly pull rod and quartz source tray towards entrance of furnace.
 - e. When you reach the end of the furnace tube and the start of the metal tray, slightly lift the metal tray on the side closest to you.
 - f. Continue to pull the quartz source tray until most of the quartz source tray is on the metal tray.
 - g. Lower the metal tray back down to its original resting position.
 - h. Pull the quartz source tray all the way out of the furnace tube and fully onto the metal tray.
10. Load desired number of Phosphorus disc sources into source tray.
 - a. The Phosphorus discs are white with slits in the perimeter to allow for thermal expansion.
 - b. There are four Phosphorus disc sources.
 - i. If all four sources are not in the tray already, additional sources are located underneath the Modulab Oxidation Furnace in a drawer on the right-hand side.
 - ii. If four sources are not needed, carefully wrap the spare sources in aluminum foil and write "Phosphorus" on the aluminum foil. Place them underneath the Modulab Oxidation Furnace in a drawer on the right-hand side.
11. Load wafers (two a source) into source tray with the desired side facing the Phosphorus disc.
12. Reload quartz source tray into the middle of the furnace.
 - a. Place loaded quartz source tray on metal tray.
 - b. Hook the end of quartz rod into loop of quartz source tray.
 - c. Gently push metal tray into the middle of the furnace.
 - i. You can check if the metal tray is in the middle of the furnace by marking the spot on the quartz rod that is at the entrance of the furnace. Remove the rod from the furnace and line up the marked spot with the entrance of the furnace on the outside. Where the end of the rod is located is where the start of the quartz source tray is.
13. Shift the source tray partly up one of the side walls of the furnace.
 - a. This will prevent the tray from sticking to the furnace due to the residue produced during diffusion process.
14. Set desired temperature on the master control of the furnace



- a. The other zones will be automatically set to match the master control.
15. When the temperature of the furnace exceeds 400 C, turn the Nitrogen gas on and set the flow to 7.
 - a. This is the valve connected to the right-hand side of the furnace.
16. Run the diffusion process for the desired time at the desired temperature.
17. When the furnace run is complete, set master temperature control of the furnace to 0 C.
18. Allow the temperature of the furnace to decrease below 400 C.
19. Turn off the Nitrogen gas flow valve.
20. Clean the metal tray and quartz rod with isopropyl alcohol.
 - a. Use the rod and metal tray that are marked with red tape.
21. Unload quartz source tray from the furnace.
 - a. Place metal tray at the entrance of the furnace, making sure the furnace tube and the metal tray are lined up and flat.
 - b. Slowly push quartz rod into furnace, making sure to keep the end of the rod as low as possible.
 - c. Hook the end of the rod through the loop on the quartz source tray.
 - d. Slowly pull rod and quartz source tray towards entrance of furnace.
 - e. When you reach the end of the furnace tube and the start of the metal tray, slightly lift the metal tray on the side closest to you.
 - f. Continue to pull the quartz source tray until most of the quartz source tray is on the metal tray.
 - g. Lower the metal tray back down to its original resting position.
 - h. Pull the quartz source tray all the way out of the furnace tube and fully onto the metal tray.
22. Remove wafers from quartz source tray.
23. Reload source tray into the furnace once wafers are removed.
24. Turn off furnace.
25. If no one else is in the lab, turn off house nitrogen.

Troubleshooting

- Furnace is plugged in but will not turn on.
 - Check that someone is logged into SUMS.
 - If no one is logged into SUMS contact MMF Staff.