



Lindberg/Blue – Boron Diffusion Furnace

Safety

- The furnace gets extremely hot and remains hot to the touch hours after it has been turned off. Use caution and wear necessary heat protection.
- Do not place your hands or other body parts inside furnace.
- Use caution when unplugging and plugging the furnaces into the large outlet.

Allowed Materials and Processes

- The Boron Furnace can be used to create doped P-type regions on silicon wafers.
- You can use silicon wafers only for temperatures above 500 C. The BORONPLUS GS-139 sources are in the drawer underneath the Modulab Oxidation furnace.
- This tube can also be used for select annealing processes with explicit permission from the lab manager.

Restricted Materials and Processes

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

Operating Procedures

1. Check reservations and make one.
2. 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.
3. Equipment checks
 - a. When no gas is flowing, the N2 regulator pressure on the wall should read ~25 PSI.
 - b. When no gas is flowing, the O2 regulator pressure should read ~16 PSI.
4. Plug in furnace and turn it on by flipping the white power switch up. The three zone controllers should turn on and read the actual (upper) and set (lower) temperatures, and the red light next to the switch should illuminate followed by a click.
5. Slowly and carefully, without squishing the gas lines on the back or bumping the quartz lid on the front, rotate the furnace out to get clear access to the front cover.
6. Record experimental parameters in the logbook located in the bin on the wall next to the furnaces.
7. Clean quartz rod and metal tray with isopropyl alcohol and cleanroom wipes. Use the rod and metal tray that are marked with the blue tape



8. Unload quartz source tray from furnace.
 - a. Remove the quartz lid with the hot pad grabber and set it on a cleaned surface.
 - b. Place the metal tray labeled “BORON DIFFUSION FURNACE” at the entrance of the furnace, making sure the furnace tube and the metal tray are lined up and flat.
 - c. Slowly push quartz rod into furnace, making sure to keep the end of the rod as low as possible.
 - d. With the hook facing downward, hook the end of the rod through the loop on the quartz source tray.
 - e. Slowly pull rod and quartz source tray towards entrance of furnace.
 - f. When you reach the end of the furnace tube and the start of the metal tray, lift the metal tray so the quartz boat slides without banging or dropping.
 - g. Continue to pull the quartz boat tray until most of the quartz source tray is on the metal tray.
 - h. Lower the metal tray back down to its original resting position.
 - i. Pull the quartz boat all the way out of the furnace tube and fully onto the metal tray.
9. Load desired number of Boron disc sources into source boat.
 - a. The Boron discs are white and completely solid.
 - b. There are four Boron 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 “Boron” on the aluminum foil. Place them underneath the Modulab Oxidation Furnace in a drawer on the right-hand side.
10. Load wafers (two a source) into source tray with the desired side facing the Boron disc.
11. 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. 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.
12. Set desired temperature on each zone controller by pressing the up and down arrows. Press the buttons once to get the LEDs to turn on. If you set the wrong temperature, wait until the lights turn off before attempting to set a new temperature.
13. When the temperature of the furnace exceeds 400 C, turn the Nitrogen gas using the valve on the right hand side of the furnace and set the flow to 7. (Note: it is ok to turn on the N₂ right away if you are ramping from room temperature to the desired temperature if it is above 400 C.)
14. Run the diffusion process for the desired time at the desired temperature.
15. When the furnace run is complete, set the temperature of all three zones of the furnace to 0C.
16. Allow the temperature of the furnace to decrease below 400 C this will take approximately 2.5 hours.
17. Turn off the Nitrogen gas flow valve.
18. Clean the metal tray and quartz rod with isopropyl alcohol.
 - a. Use the rod and metal tray that are marked with blue tape.



19. 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. Pull the tray out to the end of the insulation, and start pulling out at 1 inch per minute.
 - f. 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.
 - g. Continue to pull the quartz source tray until most of the quartz source tray is on the metal tray.
 - h. Lower the metal tray back down to its original resting position.
 - i. Pull the quartz source tray all the way out of the furnace tube and fully onto the metal tray.
20. Remove wafers from quartz source tray.
21. Reload source tray into the furnace once wafers are removed.
22. Turn off furnace.
23. If no one else is in the lab, turn off house nitrogen.

Additional Notes

- If the Boron sources have been left on the table for an extended period of time (over two weeks without being used), it will be necessary to dehydrate these sources before using them for a diffusion process. To dehydrate these sources, load all four into the quartz source tray and heat them in the Boron furnace for 45 minutes at 400 °C.
- Wafers may be loaded and unloaded at higher temperature (greater than 400 °C) but must be done slowly so as 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 being 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

Version History

- 2020.1 - Original document written by Geneva Feist and Andrew Lingley.
- 2022.1 - Updated procedures.
- 2025.1 – Updated for accessibility by Owen Bunn