THERMAL OXIDATION SOP
Furnace 2
June 2013

Prepare the bubbler

a. If the water level in the quartz bubbler is below 1/3 of the capacity of the bubbler it will need to be refilled. Also, fill the thermo well for the thermometer with water to complete heat transfer.

!!!If you need to refill the bubbler, please contact a MNTC staff members to and if they can do it for you

OR

This can be done by removing the side fill cap, clamp and disconnecting the inlet line and outlet lines. Empty and refill the water bubbler to 1/2 full with fresh DI water from the goose neck spouts available at one of the wet benches!!!

b. Turn on the Thermolyne bubbler controller to the designated line for the bubbler temperature to achieve a temperature between 90°C and 100°C. Do not exceed 100°C.

c. Turn the heat tape controller to the designated line. This prevents steam from condensing before it reaches the tube furnace. Let the water temperature stabilize between 90°C and 100°C. Do not exceed 100°C before wet oxidation

Figure 1. (a) Thermolyne bubbler controller, (b) heat tape controller

Loading Wafers

a. Using the white thermal gloves on the metal rack remove the end cap from the tube furnace and place onto the ceramic plates.

b. Remove the oxidation rod from rod tube 2 on the lower section of the metal rack.
c. Using the u-shape boat holder remove the wafer boat and place it onto the ceramic plates. Replace rod back into the rod tube 2 making sure to place the hooked end into the tube first.

d. Retrieve the oxidation rod from rod tube 2.

e. Raise the boat holder to the mount of the tube furnace and push quartz boat into the mouth of the furnace.

f. Use the rod to push the boat into the center of the tube slowly at the rate of approximately 1" per 5 seconds (12" per minute). Exceeding this rate can cause the wafers to warp. Push the boat to the scribe line on the rod.

g. Replace rod into rod tube 2 making sure to place the hooked end into the tube first.

h. Place the end cap loosely onto the end of the tube furnace and do not push it on all of the way. These tubes and caps have a design error where the cap can become stuck due to heating and cooling of the both components.

**Program your thermal cycle with a ramp rate, dwell temperature, dwell time, and ramp down.**

1. Turn on the furnace controller by activating the circuit breaker on the left side of the control panel.
   - Let the controller run thru the self-test
   - The controller will display a flashing **AL1** and read the current temperature
   - Press the lower center and scroll to **AL1**
   - Press the 'SECRET' button located on the digits. A click should be heard. The controller will display **CLR**
   - The Excess Temperature features will be cleared allowing the furnace controller to operate properly

2. Open the door below the first row of buttons.

3. To make a ramp up and soak time program do the following.

4. Press and hold the far right scroll button. This will put you in the programming mode, allowing the program to be modified.

5. **PR1** is the ramp rate. Press the up arrow key to modify this number.

6. **PL1** is the operating temperature the furnace will reach. Use the up and down arrow keys to modify this value.

7. **Pd1** is the dwell time or soak time of the furnace. The value is in hours. Set the time using the up and down arrow keys.

8. Move onto the next program to program a ramp down.

9. **PR2** is the ramp rate. Press the up arrow key to modify this number.

10. **PL2** is the operating temperature the furnace will ramp down to. Use the up and down arrow keys to modify this value.

11. **Pd2** is the end time. Hold the down arrow key until the **END** is displayed. This will end the program.

12. Press the scroll key to display the amount of time left in the ramp program.
13. If the program is entered properly, wait for the program mode to exit.
14. Press the **RUN/HOLD** key to start the program running.
15. To modify a program while it is running, go into the program mode. Cycle to the value to be modified.
16. Press the **HOLD** key. A dot should be blinking next to the value.
17. The value is now safe to modify using the up and down arrow keys.
18. When done modifying the program, press the **HOLD** key again.
19. Allow the program to exit and return to the normal operating mode.

**Gas controls**

**Dry Oxidation**

a. Before starting the oxidation process, make sure that the valve is at Furnace 2 (Trash) position, Figure 2a.

b. At 1000°C open the oxygen green valve on the gas distribution rack (Figure 2a.). Oxygen should be flowing at a rate of 1L/min or a setting of 30 on the flow meter. !!! Please, do not adjust or change it!!!

c. Open or flip up the valve on the gas distribution panel and close or flip down the valve by the flow meter, see the diagram on Figure 2b.

d. Valve after the bubbler should be in Dry Oxidation position, Figure 2c

e. Perform dry oxidation for 0.1 hours, which will be followed by wet oxidation (next section).
**Wet Oxidation**

a. When Dry Oxidation is complete open or flip up the Dry Oxidation Valve after the bubbler, Figure 2c. Open or flip up the valve above the oxygen flow rate meter, close or flip down the valve on the side of oxygen flow rate meter, and rotate the valve after the bubbler to the Wet Oxidation position.

b. You should start to see oxygen bubbling through the bubbler and follow the wet oxidation for your desired duration.

c. Make sure that the Thermowell does not become dry during your program by refilling it frequently with DI water in the provided bottle.

**After Wet Oxidation & Turning off Oxygen**

a. After your wet oxidation is complete perform dry oxidation for 0.1 hours.

b. Turn off green valve on gas distribution rack, Figure 2a.

**Unloading wafers**

a. After the oxidation program is complete turn off the bubbler heat controller and heat tape.

b. Using the white thermal gloves on the metal rack remove the end cap from the oxidation tube furnace and place onto the ceramic plates.

c. Remove the oxidation rod from rod tube 2 on the lower section of the metal rack. Take care to not touch the rod past the line etched in the rod for this will help keep contamination from entering the tube furnace.

d. Pull out boat at 100-200°C slowly at the rate of 1” per 5 seconds. Allow the wafers to cool at the end of the oxidation tube furnace for five minutes before removing the quartz wafer boat from the furnace using the u-shaped wafer boat holder.

e. At the end of the 5 minutes cool-down period, remove the wafer boat using the u-shaped boat holder and push rod. Place the wafer boat only on the ceramic plates.

f. Replace rod back into the rod tube 2 making sure to place the hooked end into the tube first.