Furnace: A- Stack

Equipment Standard Operating Procedure
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1. Purpose
   1.1. A1 is used for sintering. A2 is used for boron deposition. A3 is not in use. A4 is used for boron drive in.

2. Reference Documents
   2.1. Thermco manual

3. Equipment
   3.1. N2 wand
   3.2. Quartz wafer holder

4. Materials
   4.1. H₂
   4.2. O₂
   4.3. N₂

5. Protective Equipment
   5.1. Eye Protection: safety glasses must be worn at all times.
   5.2. Hand Protection: latex-free gloves.
6. **Engineering and/or Administrative Controls**
   6.1. A-Stack is located in Silicon Bay.
   6.2. The tool owner is Tim Brock.
   6.3. The check-out persons are: Katharine Beach and Ning Gulari
   6.4. Only authorized user may operate this piece of equipment.
   6.5. This tool must be reserved in advance for use. Sign up sheets are located on the SSEL Scheduler.
      6.5.1. If you sign up for a time slot and cannot make it, then be considerate and remove your name from the scheduler.

7. **Procedure**
   7.1. Process Restrictions
      7.1.1. Whole 4-inch silicon wafers only.
      7.1.2. Always check to see how many dummy wafers are needed for a furnace before starting your Pre-Furnace clean.
      7.1.2.1. Do not mix dummies between the different tubes.
      7.1.2.2. Do not store A2 or A4 dummies in B1 storage tube.
      7.1.3. A1 is only used for sintering (annealing) metals. The drive-in gas is hydrogen. This is a post CMOS tube.
      7.1.4. A2 is used for boron diffusion. This is a CMOS compatible tube.
      7.1.5. A3 is not operational.
      7.1.6. A4 is used for boron drive in and is a thermal oxide furnace. This is a CMOS compatible tube.
      7.1.7. CMOS compatible means no metals, no glass substrates, no III-V substrates, and no wafers that were previously in the Semi-Group RIE, right chamber of Plasma Therm or “dirty ovens” are permitted in these tools.
      7.1.8. A2 to A4 Policies
         7.1.8.1. Wafers coming out of A1, B3 or C2 are not permitted in these tubes.
         7.1.8.2. There must be at least thirteen (13) wafers in A2 at all times.
         7.1.8.3. It is recommended that you have a full boat in A4 during a run.
   7.2. A1 Furnace Tube
      7.2.1. Load wafers facing door.
      7.2.2. Boat can hold 25 substrates.
      7.2.3. Some metals are allowed, but must be approved by tool owner.
      7.2.3.1. Allowed metals are aluminum, nickel, tantalum, chrome, iridium, molybdenum, tungsten and titanium.
      7.2.3.2. Gold, copper, lead, tin, and platinum are never allowed. Even if the metal are buried, do not place in this tube.
      7.2.3.3. Organics (example polyimide) are never allowed in the tubes.
      7.2.3.4. You cannot go into any other furnace tube except C2 after you have been in A1.
   7.2.4. Anneal
      7.2.4.1. Start program before wafer clean, so that tube could stabilize to proper temperature.
7.2.4.2. If you anneal at too high a temperature hillocking or spiking can occur.

7.2.4.3. Wafer clean for anneal

7.2.4.3.1. Empty solvent waste tank prior to starting this clean
7.2.4.3.2. Have a clean pair of over gloves at bench.
7.2.4.3.3. Clean an empty wafer carrier, by placing in the SRD (not the PFC), use program 1. Also clean the handle by rinsing in DI water for two (2) minutes.
7.2.4.3.4. Place wafers in wafer carrier closest to the H-bar.
7.2.4.3.5. You must also clean dummies.
7.2.4.3.6. Retrieve the Pre-Sinter beakers from the top shelf of the beaker rack, rinse thoroughly with DI water.
7.2.4.3.7. Place wafers in beaker using the horizontal handle. Only touch wafer carrier using the handles.
7.2.4.3.8. Fill beaker with enough acetone to immerse the wafers. Rinse with acetone for five (5) to ten (10) minutes, while agitating the carrier. Dump acetone into solvent waste tank.
7.2.4.3.9. Place wafers into the IPA beaker and fill with enough IPA to immerse the wafers. Do not let the acetone dry onto the wafers. Rinse in IPA for five (5) to ten (10) minutes. Dump IPA into solvent waste tank.
7.2.4.3.10. DI rinse wafers three (3) times, by filling beaker.
7.2.4.3.11. Empty DI water into waste, not solvent waste.
7.2.4.3.12. Rinse and dry in the SRD, Program 1.
7.2.4.3.13. Empty solvent tank and return beakers to proper storage.

7.3. A2 Furnace Tube

7.3.1. Each source must be rotated ¼ turn BEFORE each run. Rotate them so that the top comes towards you.
7.3.1.1. Indicate in logbook what sources could not be rotated.
7.3.2. There must be at least one (1) wafer on either side of the source at ALL times.
7.3.2.1. Failure to do so will damage the sources.
7.3.3. There should be at least thirteen (13) dummies in the tube.
7.3.4. The extra boat is used to store dummies. Do not store dummies in B1.
7.3.5. Never bring wafers from A1 and C2 and place in this tube.
7.3.6. You may only go from A2 into A4.
7.3.7. A2 is only used for Pre-dep of boron. Does not use for drive in, it will deplete the sources.
7.3.8. Only use the wafer wand marked for A2/A4. Do not use the wand labeled for A1.
7.3.9. Broken dummies should be placed in the glass waste container, do not leave at the system.
7.3.10. Broken sources should go into the container for boron sources, do not leave at the system.
7.3.11. There must be a dummy at the tube side of boron source and door side of boron source.
7.3.12. Total numbers of wafers that may be loaded into this tube are: 24 substrates if you want one side doped. 11 if you want both sides doped.

7.3.13. Flats of the wafers should face up.

7.3.14. General note, a forty-five (45) minute dope equals an eight (8) hour time slot. Schedule tool times accordingly.

7.3.15. A4 Furnace Tube

7.3.15.1. Oxide thickness characterization data located in front of the logbook.

7.3.15.1.1. Characterization data compiled with 25 double sided polish wafers facing the door.

7.3.15.2. Never bring wafers from A1 or B3 or C2 and place in this tube.

7.3.15.3. Do not mix dummies between A2 and A4.

7.3.15.4. Only use the wafer wand marked for A2/A4. Do not use the wand labeled for A1.

7.3.15.5. Broken dummies should be placed in the glass waste container, do not leave at the system.

7.3.15.6. Flats of the wafers should face up.

7.3.15.7. Load wafers facing the door.

7.3.15.8. Place monitor wafer in middle of boat.

7.3.15.9. Tube can only hold 25 wafers.

7.3.16. Process flow chart for A2 to A4

7.3.17. Sign into logbook.

7.3.18. Log onto Furnace computer

7.3.18.1. Press the rubout key to display main menu.

7.3.18.2. Enter the colon (:) and press return.

7.3.18.3. Enter the password. Password is all capital letters. Hit each key slowly and wait for cursor to move. Press return.

7.3.18.4. Press ctrl C to ensure password took.
7.3.19. Setup Variable Parameter Table
7.3.19.1. Press the rubout key to display main menu.
7.3.19.2. Type V (variable) and press return.
7.3.19.3. Press Ctrl R (read) to enter the name of the parameter table and hit return to read appropriate table.
7.3.19.3.1. Parameter table names are located in the logbook.
7.3.19.4. Modify the table.
7.3.19.4.1. PUL-600 is always set to 200
7.3.19.4.2. Settle is always set to SPIKSET.
7.3.19.5. Press Ctrl W (write) to enter the name of the parameter table and hit return to write (save) the table. Never use Ctrl W on a blank screen.
7.3.19.6. Press Ctrl R to read back the table and check each entry is correct.

7.3.20. Compile a Recipe
7.3.20.1. The tube must be in standby.
7.3.20.2. Press Ctrl C (compile) to get to the compiler screen.
7.3.20.3. Enter the name of the recipe at the recipe#1 prompt and press return.
7.3.20.4. The cursor will prompt for recipe#2, press return to skip this entry.
7.3.20.5. The cursor will prompt for the variable parameter table, enter the table name and press return.
7.3.20.6. The cursor will prompt for the tube id, enter tube number and press return.
7.3.20.7. Do not touch keyboard until the mux has finished compiling and transmitting or the computer will lock up.

7.3.21. Operate/Load Furnace Normal Recipes
7.3.21.1. A1
7.3.21.1.1. Push start and temperature stabilizes.
7.3.21.1.2. Push start again and tube opens.
7.3.21.1.2.1. Immediately load or unload wafers.
7.3.21.1.3. Push start again and tube closes.
7.3.21.1.4. Use the correct wand.
7.3.21.2. A2-A4
7.3.21.2.1. Push start on the tube panel to pull boat out.
7.3.21.2.2. Load the Pre-Furnace cleaned wafers after the boat is all the way out.
7.3.21.2.3. It takes about ten (10) minutes for boat to move out of tube, but this is tube dependent.
7.3.21.2.4. Use the correct wand to load wafers.
7.3.21.2.5. Have all slots filled.
7.3.21.2.6. Push start on the tube panel and the boat will start to move back into the tube.
7.3.21.2.7. Stay at furnace until tube is closed.
7.3.21.2.8. In-Bt recipe the boat will not come out at the beginning.

7.3.22. Monitor Furnace during a Run
7.3.22.1. Push Ctrl T (tube status screen); enter the tube number and press return.
7.3.22.2. This screen alternates between the gas and temperature screen.
7.3.22.3. Press G to monitor gas screen only.
7.3.22.4. Press M to monitor the main (temperature) screen only.
7.3.22.5. Press A to alternate between the two (2) screens.
7.3.23. Unload A2 and A4 Furnace
7.3.23.1. Tube panel will be in hold condition.
7.3.23.2. Press start on the tube panel to pull boat out.
7.3.23.3. Unload wafers after the boat is all the way out.
   7.3.23.3.1. If going directly into another furnace, load wafers in a PFC box.
   7.3.23.3.2. If finished processing, place wafers in the quartz boat located at the furnace. Then use tweezers to place into your storage or processing boat.
7.3.23.4. Push start on tube panel to load the boat into the tube. Stay at furnace until tube closes.
7.3.23.5. Sign out of logbook.
7.3.23.6. Measure film thickness (5-points) and record in logbook.
7.3.24. Unload A1 Furnace
7.3.24.1. Tube opens automatically at the end of the recipe.
7.3.24.2. You must be at tube when recipes end.
7.3.24.3. Push start to close tube.
7.3.25. Alarms on Furnace
7.3.25.1. Identify which tube is alarming.
7.3.25.2. Look at the upper right hand corner of the tube panel; you should see several two (2)-digit numbers flashing.
7.3.25.3. Record numbers, this may take a few minutes as codes do not flash in numeric order.
7.3.25.4. There will be three (3) lights labeled T, G, and B one or more will be lit. Record which ones are lit.
7.3.25.5. Depress button labeled mute to silence the alarm.
7.3.25.6. Notify tool owner.

8. Waste Products
8.1. Broken dummies or wafers should be placed in the glass waste container, do not leave at the system.
8.2. Broken sources should go into the container for boron sources, do not leave at the system.

- Report all accidents (injuries, spills, fires) to the MNF On Call or other MNF staff. For emergencies during non-business hours, call the MNF Emergency Response Team at (734) 764-4127 or Department of Public Safety at (734) 763-1131.