BTU Wet Oxidation

SOP

I.   General Information and Usage

1.   The Bruce Furnace is a tube furnace capable of temperatures reaching (at least 1550°C). The Bruce is used for annealing, diffusion, and oxidation. It has four available tubes, each utilized exclusively for a different process. The Bruce can be programmed to allow for multi-step processes requiring various gasses at different flow rate ratios.

2.   Wet oxidation, using the BTU system, is done in Tube #2 of DUTT1 and DUTT2. These tubes have the capability of flowing N_2(0~10 LPM), O_2(0~10LPM), H_2(0~20LPM) and low flow N_2(0~1LPM). The low flow N_2 is used in cleaning the process tube and its use is described in the data sheet entitled "BTU TCA Clean"

3. H_2 and O_2 combine to form H_2O which then is used to oxidize Si. In order to avoid having un-reacted H_2 in the tube(which can be explosive) an oxygen rich condition is created. A safety feature of the BTU system is that H_2 can not flow unless there is oxygen flowing and the maximum H_2/O_2 ratio is 2:1. An adjustable potentiometer determines the $H_2:O_2$ ratio and has been set to give a ratio of ~1.7~1.0. Because of this feature, when O_2 and H_2 are flowing in the set point of the H_2 flow is determined by the O_2 flow and not by the set point you give the H_2. It is important though to know the proper flow for the H_2 and specify this value since warnings and alarms are based on the inputted set point.

4.   During a run the temperature is ramped from a low temperature (900^oC) to the diffusion temperature. For diffusions below 900^oC, a complete change in the recipe is required. Contact Edward XU (8-1656) for assistance before altering the recipe. The actual diffusion temperature during a wet oxidation should not be lower than 780^oC to ensure a complete reaction between O_2 and H_2 and this safety feature is included in the system software. The furnace alarm will sound when this condition occurs (binary alarm #5).

5.   It is recommended, for a good quality oxide, to do a dry oxide before and after doing a wet oxidation. There are two recipes stored on the DDC controller for tube 2. Recipe 1 is for dry oxidation and recipe 2 is for wet oxide. A description of each interval for recipe 2 is given below.

Interval 1: boat in

Interval 2: allow the temperature to stabilize

Interval 3: heat up of furnace to the desired diffusion temperature(8^oC/min)

Interval 4: allow the temperature to stabilize

Interval 5: diffusion using O_2 only(dry oxide)

Interval 6: diffusion using O2 and H2(wet oxide)

Interval 7: diffusiousing O2 only(dry oxide)

Interval 8: furnace cool down (8°C/min)

Interval 9: boat out

NOTE: The total gas flow in the tubes should always be 5 LPM. Drive-ins should be done using DUTT1.

II. **Equipment Specifications**
   1. Available gases: O_2 (wet and dry),
   2. H_2/N_2 (forming gas), H_2, N_2
   3. Ability to process up to (about 100) 4" wafers simultaneously
   4. Max Processing Temp: >1250° C
   5. Max # of process steps: 9

III. **Operating Instructions**
   1. CAUTION: Only use the tubes for their specific labeled uses. (Tube 2: Dry/Wet Oxidation. DUTT1_Tube 4: trans-LC HCl dry oxidation. DUTT2_Tube 4: forming gas anneal.
   2. Start Up (In the Support Area)
      1. Turn on any necessary gases. (Low-Pressure N2 at 40psi, Hydrogen and H2/N2 in the H2 gas cabinet behind the Bruce in Room 464, O2 tied against the wall for gas cylinders along the walkway) There are valves on the Bruce that must also be opened and checked for proper settings.
      2. Flip the main power breaker. An alarm will go off inside the furnace room. On the control panel hit the reset switch.
      3. Flip the power breaker (for heating) of the desired tube furnace.
      4. Cooling: switch on the heat exchanger fan and cooling water [When the process is run in the automatic mode, the machine will abort the run if the heat exchange water is not flowing.]
      5. Forming gas N2/H2(5%) anneal: N2/H2 pressure at ~20psi, N2 at ~30psi.
   3. Programming the Furnace (In the Furnace Room)
      1. Call recipe 2 from the DDC memory
      2. Change the recipe to meet your diffusion requirements. The only things that need to be changed are:
         1) diffusion temperature (intervals 3,4,5,6,7)
         2) ramp up/down times(interval 3,8)
         3) diffusion times(intervals 5,6,7)
      3. Ensure (double-check) that the valves for the N2, O2 and H2 input lines are open (all the ways to the corresponding gas cylinders). The black screw valve should be fully

counterclockwise and is located beside the furnace regulator on the source cabinet.

4. Using interval 0 set the temperature to the low temperature before diffusion (900^oC) and have N2 flowing (50%, 5LPM). Have the N2 flowing at least 10 minutes before continuing.
5. Take the boat out and put the carrier on the quartz rods. Put the boat back in.
6. Load the wafers onto the carrier.
7. Take the boat out again and load the carrier onto the paddle. For interval 9(boat out) to operate properly the boat in and boat out functions in interval 0 must be off. Press the start button (white) on the DDC controller to initiate the run.
8. Periodically monitor the progress of the machine by checking the "status". This is particularly important when the H2 is flowing.
9. When the run has finished the DDC beeper will go off and a highlighted "cycle complete" will appear on the CRT. Press "ACK" to stop the beeper. At this point the boat should be in the out position.
10. Place the wafer carrier on the quartz rods and put the boat back in.
11. When the carrier has cooled unload the wafers, take the boat out and load the empty carrier onto the paddle and put the boat back in.
12. Using interval 0 set the temperature to 0^oC (temperature group 1). Leave the furnace heat exchange water running until the temperature of the tubes is less than 400^oC. The fans should be left on until the temperature is less than 100^oC.
13. Finally, turn off the fan and cooling water

4. Shut Down (In the Support Area)
   1. Turn off gas valves
   2. Close valves to the gas cylinders

Last Update
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