

STANDARD OPERATING PROCEDURE  
FOR TUBE "A3-Sinter" furnace in TRL.

INTRODUCTION

Tube "A3-Sinter" is an Atmospheric furnace designed to sinter CMOS metals in the temperature range of 300-600C, using Forming Gas which is a mixture of Hydrogen and Nitrogen. The tube is a CMOS machine.

The system is operated in manual mode. Three Eurotherm temperature controllers provide a 20 inch long, flat profile in the Center Zone; they are arranged in a master/slave configuration and the temperature profile is set up in manual mode. The gases are introduced through a quartz injector, located at the Source end of the tube.

The gas control is provided by the Argus 581 Gas Control Module, which allows to set up and monitor the Mass Flow Controller flow for each gas, and also manages the safety hardware interlocks. The gas control could be manual or in a programmed sequence by using the Argus 771 Sequencer. The system has 3 MFCs with the following maximum flow ranges:

Nitrogen 10 SLPM  
Argon 10 SLPM  
Forming Gas 1 SLPM

The Forming Gas MFC has the a safety hardware interlock for Hydrogen hazard operation:

Nitrogen must flow for 15 minutes at more than 51%, before the N2/H2 gas flow starts. That to remove the Air/Oxygen traces from the tube before H2 comes in.

The wafer handling is manual: the quartz boat is introduced in the flat zone and extracted from the furnace with the help of quartz rods.

The system can be used for wet or dry thermal oxidation, anneal, film densification, wafer bonding, etc.

SAFETY.

The system has hardware safety interlocks, to prevent any Hydrogen related hazard.

High temperature: many furnace parts can be hot. Use the special heat resistant gloves to handle those parts

PROCEDURE.

- 1) "ENGAGE" the machine in CORAL for TRL tube "A3-Sinter" machine, before you start.  
Tube A3 was designated to run wafers that have been exposed to CMOS metals processing.  
Your wafers must be free of photoresist and other organic materials and cleaned according to PTC approved procedures.
- 2) Load the wafers into the tube:
  - place the wafers into the assigned quartz boat for tubeA1, with the flat up and front side to face the clean room side, when introduced into the furnace. Place the boat on the quartz half shell handler.
  - check if the tube temperature is bellow 600C and remove the furnace end cap using the heat resistant gloves; place it face down on the SS wafer transfer table.
  - transport the quartz boat with the boat handler to the tube opening, and push the boat with the short quartz rod into the tube.
  - using the long quartz rod push the boat to the Center Zone of the flat temperature profile; the quartz has a mark that should be aligned to the edge of the tube scavenger, when the boat is in the Center Zone.
  - replace the end cap: take care not to push it too hard, and align its exhaust to the scavenger opening.
  - set the Nitrogen flow to 50%:
    - \* select channel 1 using the Channel toggle switch on the Argus GCM, in MAN mode.
    - \* increase the MFC set point to 50% by moving upward the Set Point toggle switch.
    - \* push twice the Set Point button located bellow the display, to activate the set point, and the actual flow value will be displayed.
- 3) Set the process temperature profile:

- on the Central Zone Eurotherm controller, adjust the set point to the process temperature value by using the arrow keys. The set point is for the heater thermocouples located outside the quartz tube and should be lower than 1065C. Adjust the set point for the Load and Source zone controllers to a value between 10 and 20; these set points are relative to the Central zone controller set point .
- on the main Omega DSP display, select channel # 8 that correspond to the Central Zone profile Tc located inside the quartz tube, and wait for the temperature ramp up and stabilization.
- on the Omega display check the Load zone (channel 7) and Source zone (channel 9) temperature values and manually adjust the respective controllers set points to get a flat temperature profile; repeat these adjustments until all temperature values are within 2 degrees.

#### 4) Start the run

- Check if the system temperature profile is the one you need, and if it is stable.  
There is no programmable connection between the gas flow sequence and the tube temperature
- Check if more than 15 minute pass since the wafers have been introduced into the tube and the tube got closed with the quartz cap.
- Check/ Set the Forming Gas set point at channel #7 display to be 50%.
- on Argus 781 gas box push channel # 7 button: N2/H2 to start the forming gas flow, and then push channel # 1 button N2, to stop the pure N2 flow.
- if H2 alarm goes on, push RESET button, bring the gas system in idle mode and start the sequence again; ask the staff for help if H2 alarm comes on the second time.
- when the process ends (manual time count), turn off the Forming Gas flow, by pushing channel 7 button, start the N2 flow by pushing channel 1 button.

#### 6) To unload the wafers do the following:

When the program ends, the system will remain at the process temperature with Nitrogen flow at 51%, and a buzzer will be on signaling the end of the run.

You must ramp down the temperature bellow 600 C before unloading the wafers, and you must put the system controller in manual mode, and finally let the tube in idle state at 600C with 20 % N2 flow.

- on the Eurotherm Central zone controller push the down arrow key to bring the tube temperature set point to 600C; wait aprox 1 hour for the temperature to reach that level.
- check if the tube temperature is bellow 600C and remove the furnace end cap using the heat resistant gloves; place it face down on the SS wafer transfer table.
- using the long quartz rod bring the quartz boat to the tube edge, then using the short quartz rod pull the quartz boat onto the boat handler and move them to the transfer table.
- install back the end cap with its exhaust aligned to the scavenger opening, and take care not to push it too hard as it may get stacked and difficult to remove later.
- set the N2 flow to 20 %.

#### 7) End your session in CORAL, by "DISENGAGE" the machine after you input the measurement data in the comments section.

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