STANDARD OPERATING PROCEDURE

CORAL Name: *tubeB4-Poly*

Model Number: MRL Low Pressure Chemical Vapor Deposition Polysilicon Reactor

Location: TRL

What it does: atmospheric diffusion tube

Introduction: MRL Industries' reactor in TRL is a low-pressure chemical vapor deposition system designed to deposit polycrystalline thin films on 6-inch silicon wafers. Polycrystalline silicon is deposited Using silane (SiH_4) at low pressure (200-300milliTorr) and in the temperature range of 560 – 630°C.

Operating at low pressure, the mean free path of the reactant gases increases. This assures a high uniformity of the deposited film thickness, but as a result decreases the deposition rate.
The process runs in the "Reaction Rate Limited Regime" (i.e. the transport rate of the reactant gases to the wafer surface is higher than the reaction rate). Silane is injected in the reactor at the load end zone and the vacuum port is located at the source end.
The Polysilicon film deposition runs at the following parameters:

- Temperature 620° C
- Pressure 250 milliTorr
- SiH_4 flow 100 sccm
- Deposition rate 100 A/min

The time to achieve a specific thickness could be extrapolated or interpolated as long as the process runs in the "reaction rate limited regime".

The Semy controller runs the furnace operation. The Semy software does not allow for variable time input, so a recipe has been created for each thickness level based on the above mentioned deposition rate.

The low-pressure level during operation is maintained by a MKS vacuum controller, which commands a throttle valve according to the set points established by the Semy controller.

Safety: Silane – SiH_4 is a very flammable gas in contact with Oxygen. It is a pyrophoric material. The Material Safety Data Sheet (MSDS for Silane can be found in the yellow MSDS binders in the copier room of building 39)

The reactor is equipped with safety interlocks at both the hardware and software level to minimize Silane related hazardous events.
Users of the equipment should be aware that the quartz ware associated with the system may be quite hot and should avoid direct contact with these parts. The use of thermal gloves to operate the quartz ware handlers and to open or close the reactor's vacuum tight door is required.

Procedure:

1. Check equipment reservation in Coral to insure that you reserved the correct machine in the correct facility for the correct date. Another user may have reservations; it is your responsibility to honor them if this is the case.
2. Use Coral to "engage" the machine. You must perform this step before proceeding or the machine will not allow you to proceed.
3. Bring the tube to atmospheric pressure to open the reactor door.

a. On the Semy controller select “MSC loader” under the Apple menu.
b. In the “select a” field pick “recipe” from the drop down menu.
c. Select the recipe “BACKFILL” Then click <open>.
d. Enter your operator id as “mtl” then click <start>
e. Once the download of the recipe is complete, select “Tube Status” option under the Apple menu.
f. Once the Status bar appears click on <mypro>.
g. Enter “mtl” as the operator id and click <ok>.
h. Once the mypro keypad appears click on <Start>.
i. The recipe will now start and you can monitor it through the Tube Status Bar currently open on your screen.

4. Load the wafers into the tube.
    a. Open the door fully Using the thermally insulated glove.
    b. Extract the boat from the tube Using the long and short quartz rods and boat carrier with stainless steel handle.
    c. Load your wafers on the boat, removing dummy wafers as required. The monitor wafers should have 1000A of thermal oxide already grown on them. This is to be able to measure the film thickness Using the Nanospec in TRL or the UV1280 in ICL.
    d. Load the boat back into the mouth of the tube Using the short quartz rod with the wafers’ front side facing the load zone. Wait one minute and then slowly push the boat to the middle of the tube Using the long quartz rod. The round mark on the long quartz rod should end at the front of the furnaces scavenger box. Take care not to rotate the boat during this procedure; rotating the boat could damage the profile thermocouple quartz sheath located on the bottom of the tube.
    e. Close the door Using the thermally insulated glove. Tighten the knurled nut that holds the door tight enough to hold the door shut, but not too tight that the door does not seal to the tube at all points. (You will put light pressure on the door later while it is pumping down to ensure a seal).
5. Start your process
    a. On the Semy controller select “MSC loader” under the Apple menu
    b. In the “select a” field pick “recipe” from the drop down menu.
    c. Select the correct process recipe you want to run. The recipes are labeled according to desired thickness. Then click <open>.
    d. Enter your operator id as “mtl” then click <start>
    e. Once the download of the recipe is complete, select “Tube Status” option under the Apple menu.
    f. Once the Status bar appears click on <mypro>.
    g. Enter “mtl” as the operator id and click <ok>.
    h. Once the mypro keypad appears click on <Start>.
    i. The recipe will now start and you can monitor it through the Tube Status Bar currently open on your screen. As the recipe starts, with thermally insulated gloves, apply light pressure to the reactor door until the readout on the MKS pressure controller registers the pressure is dropping.

6. Once your process has completed the tube will have returned to atmospheric pressure. Remove your wafers.
    a. Open the door fully Using the thermally insulated glove.
    b. Extract the boat from the tube Using the long and short quartz rods and boat carrier with stainless steel handle.
    c. Remove your wafers from the boat, reinserting the dummy wafers as required.
    d. Load the boat back into the mouth of the tube Using the short quartz rod with the wafers’ front side facing the load zone. Wait one minute and then slowly push the boat to the middle of the tube Using the long quartz rod. The round mark on the long quartz rod should end at the front of the furnaces scavenger box. Take care not to rotate the boat during this

procedure; rotating the boat could damage the profile thermocouple quartz sheath located on the bottom of the tube.

e. Close the door Using the thermally insulated glove. Tighten the knurled nut that holds the door tight enough to hold the door shut, but not too tight that the door does not seal to the tube at all points. (You will put light pressure on the door later while it is pumping down to ensure a seal).

7. Pump the tube back down to low pressure and return it to idle conditions.
    a. On the Semy controller select “MSC loader” under the Apple menu.

    b. In the “select a” field pick “recipe” from the drop down menu.

    c. Select the recipe “PUMPDOWN” Then click <open>.
    d. Enter your operator id as “mtl” then click <start>
    e. Once the download of the recipe is complete, select “Tube Status” option under the Apple menu.
    f. Once the Status bar appears click on <mypro>.
    g. Enter “mtl” as the operator id and click <ok>.
    h. Once the mypro keypad appears click on <Start>.
    i. The recipe will now start and you can monitor it through the Tube Status Bar currently open on your screen. As the recipe starts, with thermally insulated gloves, apply light pressure to the reactor door until the readout on the MKS pressure controller registers the pressure is dropping.
8. Use Coral to “disengage” the machine. Be sure to input any required data.

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