



IIT Bombay Nanofabrication Facility

Tool Name: Rapid Thermal Processor (Annealsys AS-ONE)

Standard Operating System (SOP)

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Tool's Overview

Fig.: Rapid Thermal Processor (Annealsys AS-ONE)

Checklist (Before starting the tool)

Equipment Category: Semi Clean B

Gases available: Ar, O₂, N₂, FGA, N₂O

Mass Flow Controller (MFC) Limit/Range: 2000 sccm

Materials allowed: Only Si, Ge, and Diamond substrates are allowed.

CALIBRATION TABLES To be used (please do also note them on the latest log-book to verify):

1. Thermocouple calibration table:
2. For 4" Si wafer:
3. PID table for Si (PYRO1):

Note: Above will update according to the calibration. Please contact SO in case of any confusion.

Limitations:

1. Maximum allowed temperature for Pyro 1 is up to 1400°C. Bring own carrier wafer for the high-temperature (>1000 C) process.
2. Higher temperature process should not be run for a long time. (e.g., 60 s up to 900°C and 901 - 1400°C for 30 s). Maximum allowed time is **10 min**. For process requiring more than 10 min of time approval must be taken from SO, Process team and FIC.
3. The power percentage should be kept maximum to 12%.

4. The user must **wait for 15 min after each process run for chamber opening** (this allows the Pyro1 to cool down to nominal temperature).
5. There should be a **minimum 20 min gap between two process runs**.

Procedure for the start-up:

Before entering the clean-room

1. Ask the facility to Turn On Chiller and the required gases.

In the clean room

2. Mandatory: Open the gas line: CDA, PN2, PN2 (Purge)
3. Open the required gas lines for the process.
4. First, switch on the main circuit breaker
5. Second, switch on the system circuit breaker at the back side of the RTP tool.
6. Open the Laptop (It will automatically turn on)
7. Switch on the RTP system by pressing the green button at the front.
8. Open AsOne software.
9. Now, give the user's login name and password. Will be shared by SO.
10. Download the recipe and purge the system before opening the chamber. Next, check for the required gases pressure coming in the system or not.
 - a. If the gases pressure is not coming, please ask the facility team to change the gas cylinder.

For processes:

11. Put a quartz pin + carrier wafer and load your samples.
12. Close the chamber.
13. Turn on the primary pump by pressing **Primary** in the pumping section.
14. Wait for the dotted line to disappear as indicated in the Pumping section. Once the dotted line disappears, you can turn on the turbo pump.
15. To turn on the Turbo pump, press **Secondary** in the Pumping section, followed by pressing **Start** in the Turbo pump section (**this is to be done only at the time of tool start**). Wait for the Turbo RPM to increase to **1500**.
16. Wait for the chamber pressure shown by Full Range to come in order of 1E-4 mbar.
17. Stop **pumping** in the chamber by pressing **Stop** in the Pumping section.
18. You can start the process now. In the Process section, select the recipe and download it. Click on the **Start process** to run the recipe. (Do not run your process if RTP 1 is ON, the power line is shared).
19. If you suspect anything went wrong, you can press **STOP Process** on As-One software.
20. After the process is completed, enter the manual mode and turn on **Cooling**. Also, do a cyclic turn-on of N2 purge while cooling by turning on the **PEV valve**.
21. The Pyro has a lower temperature resolution of 239 °C. So, it's compulsory to **wait for 15 mins** after the process is complete before opening the chamber.
22. Now, open the chamber and unload the wafers.

If you have only one sample or all processes are finished:

- I. Unload the carrier wafer & quartz pin from the chamber
- II. Clean the chamber base and quartz window with a bit of IPA using lint free cloth. Do not clean the lamp as it might be hot.
- III. Make an entry in the logbook for your process.

If you have another process:

23. Load the new sample.
24. Turn on the Primary pump by pressing **Primary** in the Pumping section.
25. Once the dotted line disappears, press **Secondary** in the Pumping section to connect the turbo to the chamber.
26. Wait for the chamber process shown by Full Range to come in order of 1E-4 mbar.
27. Now, **stop pumping** in the chamber by pressing **Stop** in the Pumping section.
28. Follow **step 18** onward for further processing.

Shut down procedure

29. After unloading the carrier wafer & quartz pin from the chamber and cleaning it with IPA. Close the chamber.
30. Turn on the Primary pump by pressing **Primary** in the Pumping section.
31. Once the dotted line disappears, press **Secondary** in the Pumping section to connect the turbo to the chamber.
32. Wait for the chamber process shown by Full Range to come in order of 1E-4 mbar.
33. Now, **stop pumping** in the chamber by pressing **Stop** in the Pumping section.
34. To turn off the Turbo pump, press **Stop** in the Turbo pump section (**the turbo RPM will start decreasing**).
35. Log out the AsOne software. A message will pop up, "Turbo pump is running; it will be automatically stopped after an hour." **Press Ok.**
36. Shut down the AsOne software and computer.
37. Now switch off the RTP tool by pressing the red button on the front. Then red light on the Alarm would glow, indicating everything is correct.
38. Now switch off the circuit breaker at the back-side of the RTP tool.
39. Close all the process gas valves.
40. Switch off the main circuit breaker.
41. Inform facility team to turn off the chiller and other utilities.

Shut down procedure in case of Power failure:

1. If UPS is working, complete the running process recipe (if it is not too long) and follow the normal shut down procedure mentioned above.
2. If UPS is not working. First, switch off the circuit breaker at the back of the tool. Close all the gases.
3. Switch off the main circuit-breaker of the tool.
4. If your sample is inside the chamber, then take your sample out when the power comes.

Extra Precautions to be taken (Mandatory) during and after Process:

1. Clean the chamber (the steel base and the quartz window) right after your process is over with a bit of IPA after the chamber is cooled down to room temperature.
2. Do not flow gas (or reduce flow to very low) during ramping up as there could be temperature non-uniformity.
3. In case of warnings/ errors encountered during the process, refer to the list of the common errors the manuals kept near the system. It includes a list of quick checks that could result in a particular warning/error. Otherwise, contact SO or EMT.
4. Put the quartz pins inside the covers given every time after use.
5. To attain more purity ambient for the process, do cyclic pumping of the gas for at least 2-3 mins.
6. There should be a minimum 20min gap between two process runs.

Violations:

1. Ramp rate for Si processes could max be used as 60°C/s.
2. Maximum temperature of annealing for Si should not exceed 1400°C.
3. Not entering in the log book after a process run.
4. Using samples with metals and photoresist.
5. Not cleaning the chamber before and after processing with IPA.
6. Higher temperature process should not be run for a long time. (e.g., 60 s up to 900°C and 901 - 1400°C for 30 s). Maximum allowed time is 10 min.

Violation Policy:

1. System mishandling would lead to DAC and re-authorization by undergoing the training procedure again.
2. Standard sample mishandling and using non-allowed materials would lead to debarring from using the system. DAC, FIC and Process team will take the action.

Materials not allowed:

1. Processing of Si wafers having back-side metal deposition.
2. Metals and metal oxides are not allowed. Approval is required from FIC to process the wafers with metals and metal oxides.
3. Organic material is not allowed.
4. Wafer with traces of Photoresist.
5. Other than Si, Ge and Diamond samples, please contact the system owners if you have any confusion.
6. Samples with Au/Cu are not allowed. Samples processed in the GC tools are not allowed. In case of usage, Approval is required from process team and FIC.