



IIT Bombay Nanofabrication Facility

Tool Name: Rapid Thermal Processing (RTP)

Standard Operating System (SOP)

Updated On: 25th Oct 2023

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Tool's Overview

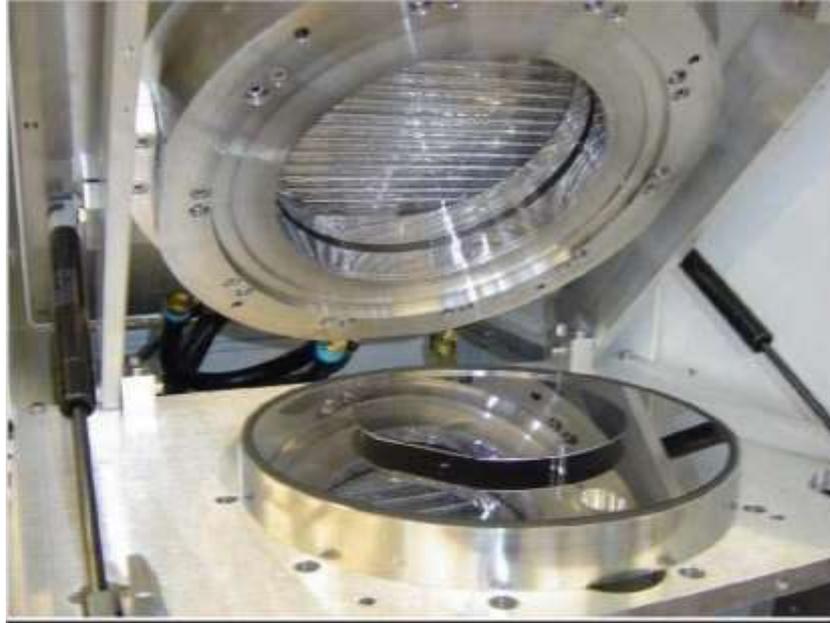


Fig. Rapid Thermal Processing (RTP)

Checklist (Before starting the tool)

Note: Slot cannot be booked for RTP if ICPCVD is already booked.

Materials not allowed:

1. Processing of Si wafers having back-side metal deposition.
2. Organic material is not allowed.
3. Wafer with traces of Photoresist
4. Other than Si, Ge, GaAs, GaN, Sapphire, if you have any confusion, please contact the system owners.

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

For Si

Thermocouple calibration table	Default_TC_Table
Pyrometer 1 calibration table (HT)	CAL_SI_PYRO1_24_08_2023
Pyrometer 2 calibration table	CAL_SI_PYRO2_24_08_23
PID control Parameter table	pyro1_Si_PID_24_08_2023

For Susceptor

Thermocouple calibration table	Default_TC_Table
Pyrometer 1 calibration table (HT)	CAL_SU_PYRO1_24_08_23
Pyrometer 2 calibration table	CAL_SU_PYRO2_24_08_23
PID control Parameter table	Pyro2_Su_PID_25_08_2023

- **Maximum allowed temperature** → **Pyro 1 = 1000°C (Max. time is 2 min.)**
→ **Pyro 2 = 900°C**
- **Maximum process time for single cycle** → **60s below 800°C process**
→ **30s above 800°C process**
- **Ramp Rate** → **Si → < 25C°/s**
→ **Succeptor → < 15C°/s**
- **For more than one cycle runs, Ramp down temperature should be half of the desired temperature.**
- **Do not open the chamber above 120°C after process.**
- **Power percentage should not be use** above **120%.**

Limitations

1. Maximum allowed temperature for Pyro 1 is up to 1000°C and for Pyro 2 up to 900°C.
2. Higher temperature process should not be run for long time. (eg: 60 seconds up to 799°C and 800-1000°C for 30sec).
3. PYRO1 temperature uses up to 799°C for 60sec and 800-1050°C for 30sec. for PYRO2 temperature uses up to 799°C for 60sec and 850°C-900°C for 30sec.
4. Do not use the power percentages above 120%.

Procedure for start-up:

Slot cannot be booked for RTP if ICPCVD is already booked.

Before entering the clean-room

1. Check whether the chiller is ON. Water pressure must be from 4Lpm-7Lpm.
2. Check PN₂, O₂, Ar gas cylinders are open.
3. For FGA (Forming Gas Annealing) and N₂O process, ask authorized facilities person to open if in case it is not open.

In the clean room

1. First switch on the main-circuit breaker.



2. Switch on Pump circuit breaker.



3. Switch on Pump starter (blower).



4. Switch on RTP general circuit-breaker at the back side of the RTP tool.



5. Switch on the RTP system by pressing the green button at the front.



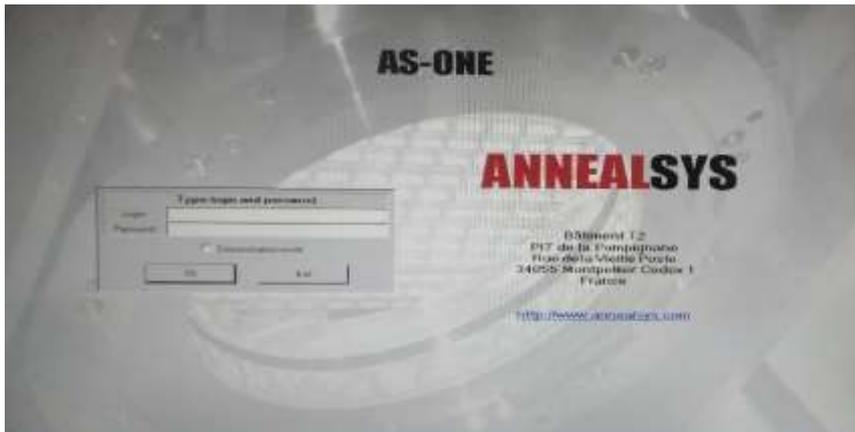
6. Computer mains.

7. Open PN2, CDA and other process gas valves.

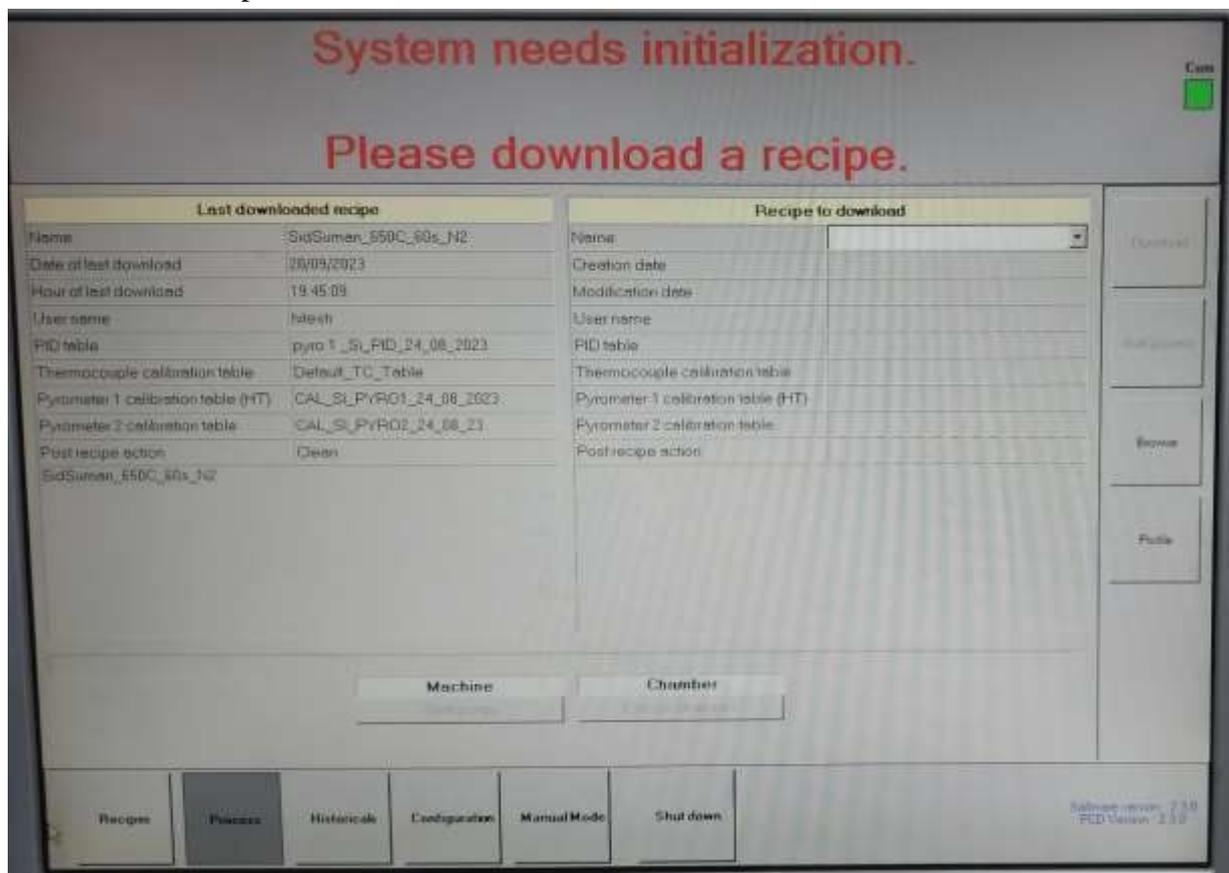


8. Log on to computer and open As One software.

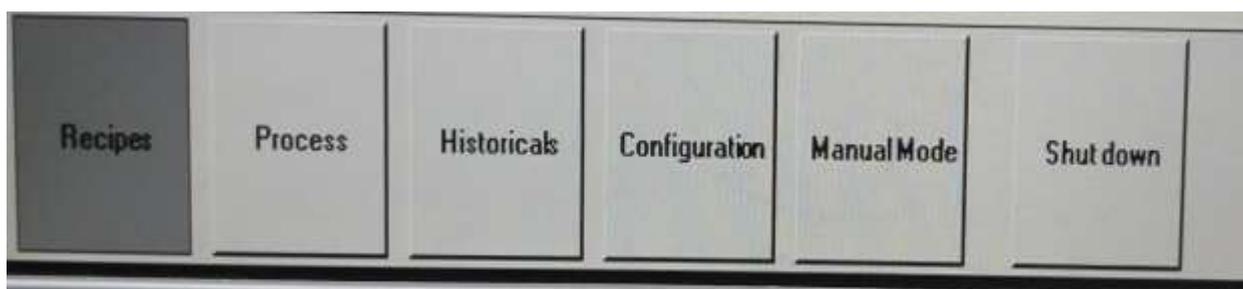
9. Now give the login-name and the password.



10. Download the recipe.



11. Go to Manual Mode.



12. purge the system before opening the chamber.



13. Clean chamber with IPA.



For Si wafers:

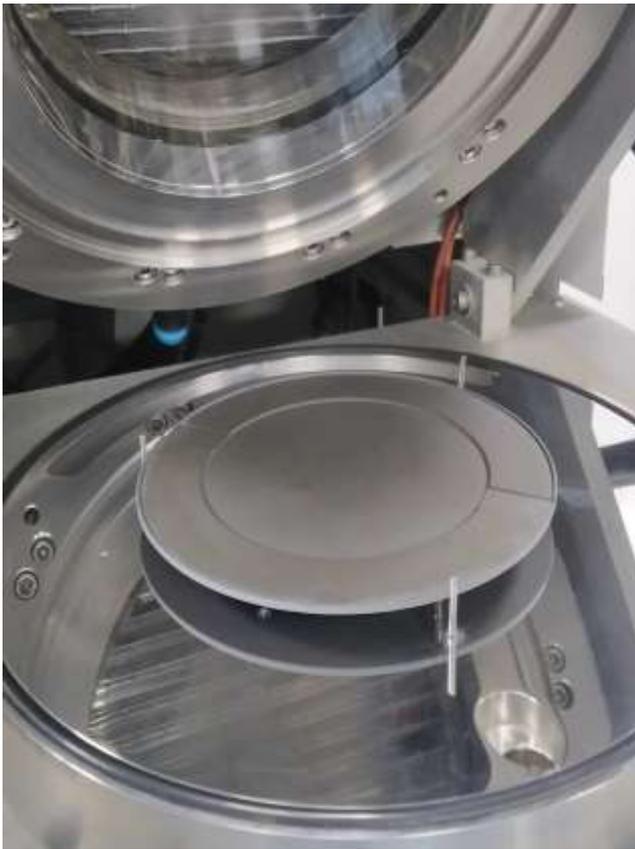
14. For Si wafers, put pins + 4" Si wafer and load Si samples and use dedicated tweezer for this.



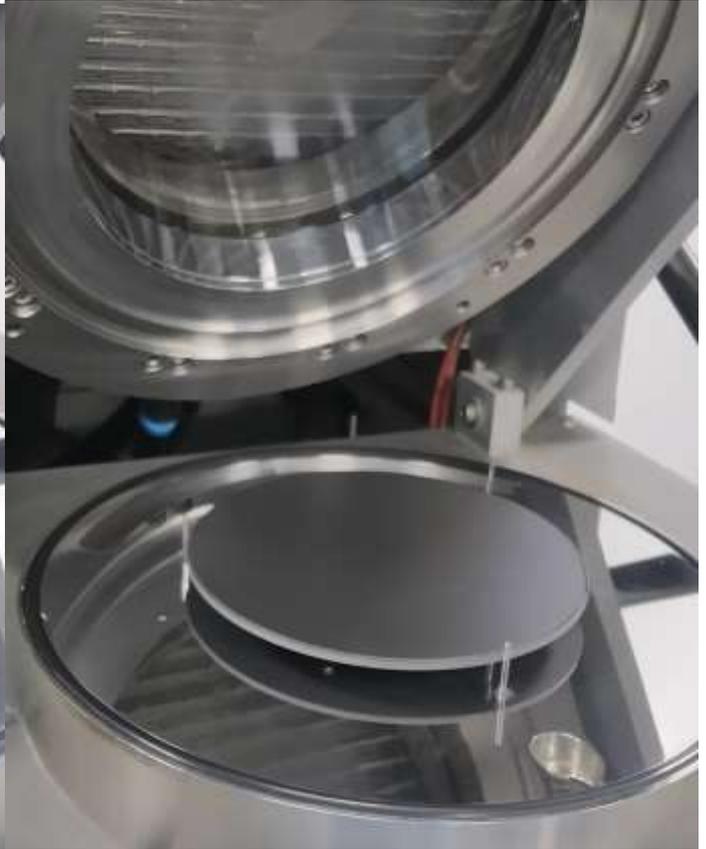
For GaN samples:

15. Now put quartz pin + susceptor (not for Si wafers) and load GaN samples. Cover the susceptor with lid and use dedicated tweezers for this.





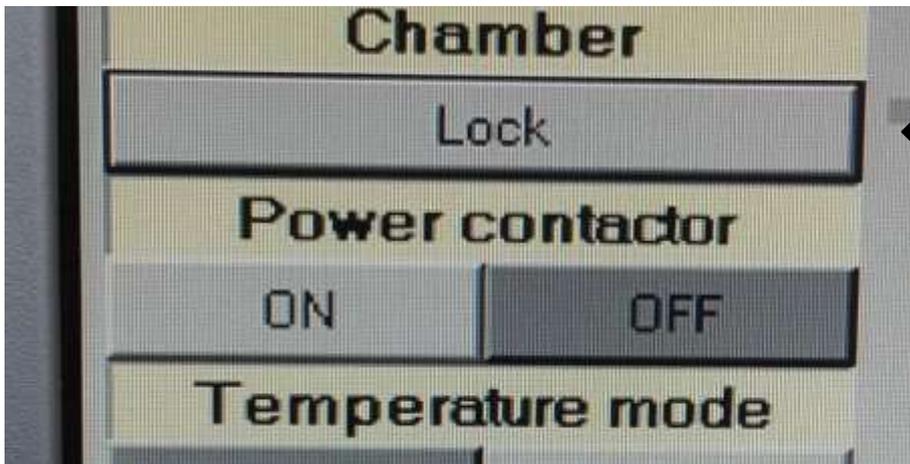
a) Susceptor



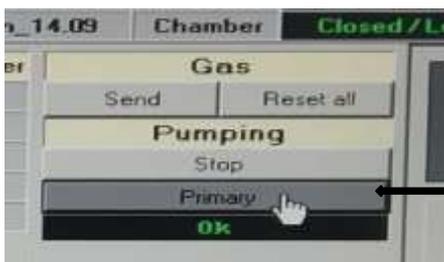
b) after loading sample Cover the susceptor with lid.

16. Close the chamber.

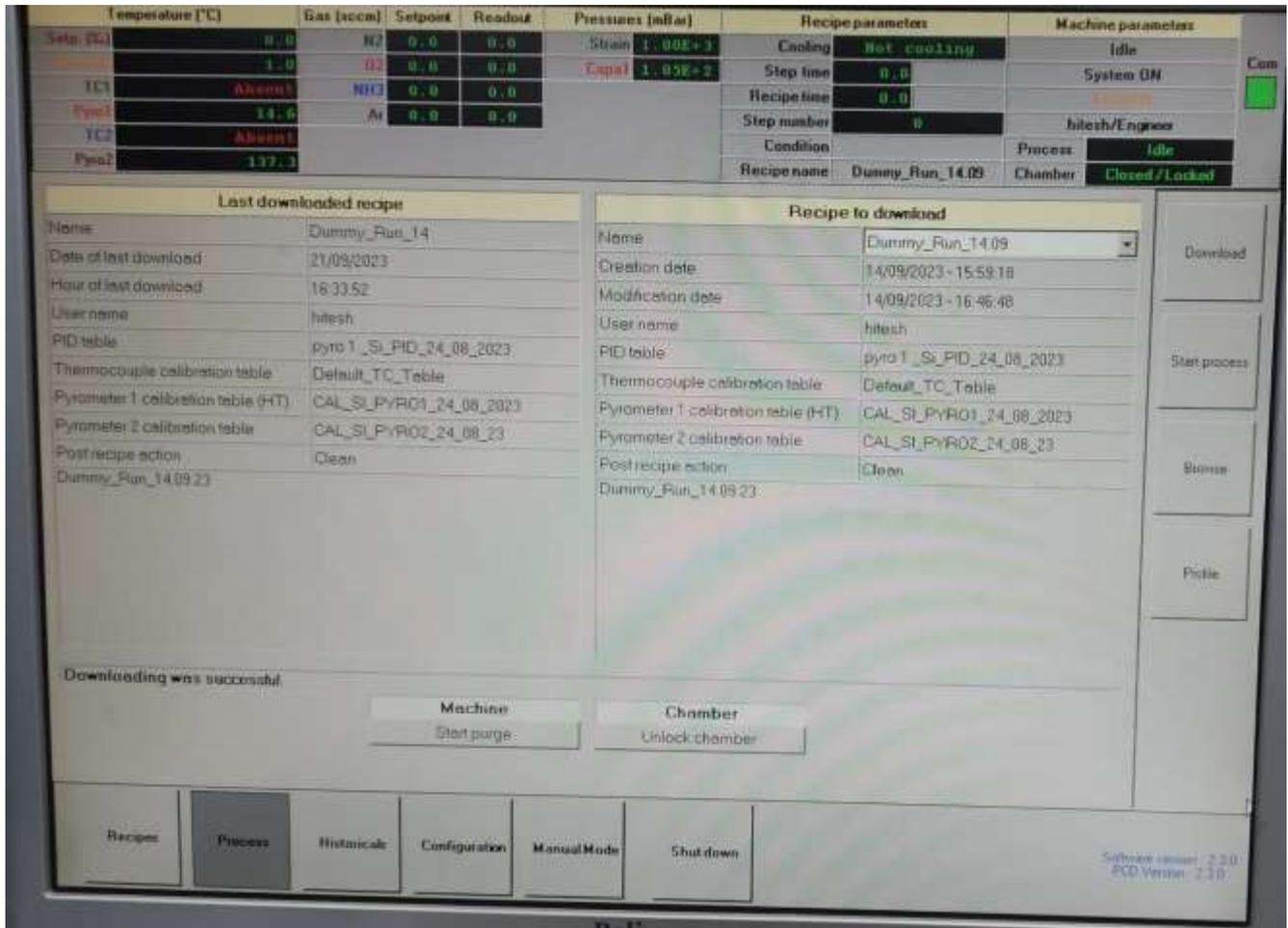
17. Lock the chamber.



18. Click on "Primary" to bring it in Vacuum (1.22×10^{-4} mbar)



19. Now download the recipe and run the process. (Do not run your process if ICPCVD process is going on, as the N2 and power line is shared and they may have problems if RTP runs in parallel with their tool). Refer image for example.



20. After the process is complete click “cooling” till temperature reaches 120 deg C.



21. Purge the chamber to atmosphere (1.00 E³ mbar).
22. Now open the chamber and unload the wafers.
23. Also unload the susceptor & quartz pin from the chamber.
24. Unload 4" Si wafer in case of Si wafers.
25. Clean the chamber base and quartz window with IPA after it has reached sufficiently low temp near to room temperature.
26. Make an entry in the log-book for your process.

FGA processing step:

1. Evacuate both FGA and Ar gas lines.
2. Turn on valve for FGA.
3. The gas inlet for FGA and Ar is common so ensure that Ar gas valve is OFF.
4. Follow above operating steps for further processing.

Shut down procedure

1. Pump down chamber.
2. Make sure cooling is off in the software.
3. All MFCs are set to 0scm.
4. Stop pumping.
5. After completion of process, shut down AsOne software.
6. Shut-down computer.
7. Now switch off the RTP tool by pressing red button on the front. Then red light on Alarm would glow indicating everything is right.
8. Now switch off the circuit breaker at the back-side of the tool.
9. Switch off Pump starter (blower).
10. Switch off Pump circuit breaker.
11. Switch off the main-circuit breaker.
12. Switch off process gases valve.
13. Switch off CDA.
8. Turn off the computer mains.
9. If you were doing process in FGA ask authorized facilities people to close the cylinder valve, do not get it closed if it is currently in use on other systems.

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

1. Cleaning of the chamber (only the steel base) right after your process is over with 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 even at 200sccm of flow inside the chamber.
3. Do not use metal tweezers on susceptors as they might aggravate the failure of susceptor by creation of pinholes. This could result in graphite dust contamination in the sample/chamber.
4. In case of warnings/ errors encountered during process, immediately inform to SO. Click the error photos and report to SO, EMT by email about the process run, errors.
5. No self-troubleshooting to be done.
6. Put the quartz pins inside the covers given every time after use.

Training Procedure:

For student/staff from Electrical Department:

1. User must register on Slot booking module and (s)he has to send Training Request under Equipment usage form on slot booking module. Request must also be approved by guide.
2. Minimum watching three runs performed by an authorized user
3. If the trainee is confident, then (s)he has to do two runs in the presence of an authorized user
4. One independent run including making a new process recipe from beginning in the presence of respective SO.

Violations

1. Ramp rate for Si processes should be max 25°C/sec while for susceptors should be less than 15°C/sec for better longevity of the system.
2. Maximum temperature of annealing for Si should not exceed 1000°C and for susceptors it should be below 900°C.
3. Not entering in the log book after a process run.
4. Not cleaning the chamber before and after processing with IPA.
5. Higher temperature process should not be run for long time. It should follow 60sec upto 799C and above 800 C for 30sec).
6. PYRO1 temperature uses up to 799C for 60sec and 800-1000 for 30sec. and PYRO2 temperature uses up to 799C for 60sec and 800-900 for 30sec.
7. Mishandling tool.