

SSI Solaris 75 Rapid Thermal Processor

Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)

Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)

(617)627-3246 (From off-campus or from a cell phone)

Tufts Emergency Medical Services are at x66911.

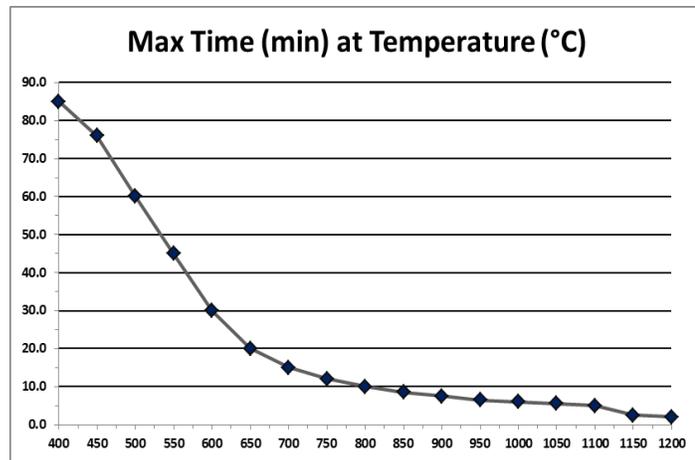
Revised: December 1, 2021

Warnings:

The instrument can achieve temperatures of 1200°C. Melting or vaporizing samples will cause permanent damage to the process chamber. Ensure that chamber temperatures are *at least* 50°C below your critical temperature. Note, during temperature ramp up, the unit can overshoot the target temperature by 100°C. Please plan with these factors in mind.

The system is typically used for short duration annealing, if you intend to process for extended times, the following charts show the time limits at various temperatures.

Temperature	Maximum Time(min)
1200	2.0
1150	2.5
1100	5.0
1050	5.5
1000	6.0
950	6.5
900	7.5
850	8.5
800	10
750	12
700	15
650	20
600	30
550	45
500	60
450	76
400	85



The gases used in the tool, N₂ and O₂, are not toxic. In order to minimize damage to the quartz process chamber each gas must be ultrahigh purity (UHP) grade 5.0 or better. Do not process with lower purity gases. The maximum process gas flow is 10slm combined.

Required Checkout:

You must be formally tested by the faculty supervisor or lab manager before you may use this tool unsupervised. When you are first learning procedures, work with experienced lab users (students, post docs, faculty or staff) to become familiar with the tool before requesting a formal checkout procedure.

1.0 Material Requirements:

- 1.1 Equipment:** substrate, wafer tweezers
- 1.2 Personal Protective Equipment:** nitrile gloves, safety glasses
- 1.3 Chemicals:** none
- 1.4 Gases:** Oxygen, Nitrogen
- 1.5 Reference Material:** SSI Rapid Thermal Processor software manual

2.0 Procedure:

2.1 Turn on the hardware:

- 2.1.1 Ensure the circuit breaker is in the ON position. If you find it in the OFF position, stop and contact management.
- 2.1.2 Turn the RTP on, there will be an audible click as circuit components engage.
- 2.1.3 Turn on the chiller. Do not turn the chiller on before the RTP, the chiller will shut down due to an overpressure condition. The display will default to fluid temperature.

To check the pressure depress the  key and the display will alternate between P1 and the pump discharge pressure

To check the flow rate press the same key again and the display will alternate between Flo and the flow rate value

Pressure should be 60-80psi, flow rate 2gp (7.5lpm) minimum. If outside these values please notify lab staff. After 60sec the display will revert to temperature

- 2.1.4 Turn on the gases at the cylinder tank valve. The regulator and inline valves are preset, they should not require any adjustment.

2.2 Start the software:

- 2.2.1 The PC should be left on, if you must reboot no passwords are required.
- 2.2.2 Double click the SSI icon to start the RTP software.
- 2.2.3 Select Start RTP Process.

2.3 Load Substrate:

- 2.3.1 Open the chamber by gently pushing the handle down to unlock and then pull out. Try to retract the chamber door in an even, careful fashion, it can get stuck.
- 2.3.2 Important! The quartz wafer tray, thermocouple (TC) and thermocouple wires are fragile! Be careful!
- 2.3.3 Load your wafer on the tray, make sure it makes good contact with the TC. The process chamber can just accommodate a 4" wafer, make sure everything is centered.
- 2.3.4 Slowly close the chamber door taking care you do not pinch the TC wires. Once the door is closed, lift the handle up to lock.

2.4 Select/Edit recipe:

- 2.4.1 From the Solaris RTP Main Menu select Recipe Edit (no password is required))
- 2.4.2 Select the saved recipe that most closely matches your desired parameters. Currently we have programmed a few recipes but must build up our database of saved recipes to cover more possible parameters. Each recipe is saved in the following format SIZE_SUBSTRATE_TIME_TEMP (for example 4in_Si_400C_30s, this recipe will anneal a 4 inch silicon wafer at 400C for 30 seconds).
- 2.4.3 Consulting the software manual, specifically section 6.6, adjust the recipe parameters to suit your needs;
 - 2.4.3.1 Each recipe should begin with a 10s purge of any gas lines that will be utilized
 - 2.4.3.2 Set a target temp and dwell time
 - 2.4.3.3 Set process gas flows (0 = no flow). There is 10slpm maximum flow, if you are using both N2 and O2, the 10slpm limit applies to the combined flow
 - 2.4.3.4 Do not adjust PID controller values or lamp settings
- 2.4.4 Using the SAVE AS command, save the recipe using the naming convention.
- 2.4.5 Exit to the Main Menu

2.5 Run your process

- 2.5.1 From the Solaris RTP Main Menu select Run Processes.
- 2.5.2 Press START, the process should begin with a gas line purge.
- 2.5.3 Monitor the temperature and other parameters, if there is overheating condition or some other issue arises, click stop or press any key to abort the process.
- 2.5.4 Important considerations
 - 2.5.4.1 If the tool is “cold” (unused for 30 minutes or more) a warm up run is advisable – run your process on a dummy wafer to warm the tool. You will get more consistent results on a warm tool vs a cold tool
 - 2.5.4.2 If you are making large changes to the original recipe (changing substrate type or size, large changes in dwell temperature) you should make 1-2 runs with learning mode engaged and an appropriate dummy wafer. This will allow the tool to optimize its internal parameters. Consult the software manual for more information
- 2.5.5 Once your run is complete, you may save the run data. Please save to an easily accessible folder with your name. Let’s not clog up the RTP folders with everyone’s process data.
- 2.5.6 Continue to monitor the temperature. After it has cooled sufficiently (below 200°C) open the chamber and carefully remove your substrate using a wafer tweezer. If you are performing another run load the next sample.
- 2.5.7 Close and lock the chamber door taking care with the TC and wires.
- 2.5.8 **IMPORTANT NOTE:** If you run into any issues running the recipe it is advisable to run the communication diagnostic – see section 7.1 in the manual.

2.6 Shut Down

- 2.6.1 Exit the RTP software to the desktop, it is not necessary to shutdown the PC
- 2.6.2 Chiller off, it will take a few seconds to power down. Important to shut down the chiller before the RTP, otherwise the chiller will trip off due to an overpressure condition.
- 2.6.3 RTP off using the switch on the front panel, there will be an audible click from within the instrument. It is not necessary to set the circuit breaker to off.
- 2.6.4 Process gases off – close the cylinders at their respective tank valves. Do not adjust the regulator or inline valves, that way they will be properly set for the next run

3.0 Emergency Shutdown:

- 3.1 Processes can be interrupted by clicking the “STOP” icon. This will turn off the heating lamps.
- 3.2 Processes can be interrupted by pressing any key on the keyboard. Similar to clicking the STOP icon, this will turn off the heating lamps
- 3.3 If for some reason “STOP” is not working and something very bad is happening, push the large red emergency off button on the front of the tool. This should cut all power to the instrument.
- 3.4 If you had to engage any of these emergency procedures please let management know as soon as possible. Its important that we take the unit off line before another user attempts to use the tool

If at any time you feel a situation is dangerous, do not hesitate to call the safety office (x73246, Peter Nowak) the faculty supervisor/lab manager (x72210, Robert White), or Tufts Emergency Services (Police/Fire/Ambulance at x66911).

Report all accidents (injuries, major spills, fires) to the safety office at x73246 (Peter Nowak) and Prof. White at x72210. For emergencies, call Tufts Emergency Services at x66911.