Solaris 150 Rapid Thermal Processor Standard Operating Procedure
Draft v.0.2

QUICK GUIDE

PROCEDURE OVERVIEW
1. Start up and Login
2. Loading a Sample
3. Running the RTP Process
4. Data Access
5. Finishing up

CRITICAL PRECAUTIONS AND COMMON MISTAKES
(1) Turn on the computer first.
(2) Turn off the RTP before loading a wafer.
(3) Check cooling water flow before loading a sample.
(4) Check cooling air flow before loading a sample.
(5) This RTP is not equipped with a Pyrometer for the measurement of temperature. All temperature measurements are made with a silicon-encased thermocouple that makes contact with the bottom surface of the sample.
(6) No toxic gases are run through this tool.
(7) Don’t be afraid to hit the Emergency Off (EMO) button.
(8) The Solaris is password protected. There is one password for Users and a Administrator password of the Clean Room Staff. The User password allows recipes to be loaded and run. The Recipe Editor, Administrator, and Engineering pages are only accessible through the Administrator password.

Before you start

Tool condition for the next user
- Chamber should have cooled to <70C
- RTP should be OFF, but attached PC should be ON
MATERIALS RESTRICTIONS

Guiding principle: materials that can melt or decompose begin evaporating, and can begin coating the walls of the chamber, compromising radiant heating of substrate

Under normal operating conditions:
- No organics (resist), No low-melting-point metals (Pb, Ga, Zn, Sn, Cu, Se, Te)

SUSPENDABLE OFFENSES
- Leaving the tool on after finishing use
  o This wastes 3L/min of N2, which we pay for!! Due to the infrequent use of the tool, this quickly adds up to many hundreds or thousands of dollars.
  o It also consumes additional PCW and CDA capacity, putting unnecessary strains on building infrastructure
- Modifying recipes, or using additional materials without informing the MNFL staff

HANDLING REMINDERS

For the “Clean Si” RTP:
- Must be using pure Si or SiO2, and use an approved Si cleaning procedure. At present, an RCA clean is the only approved procedure. Additional procedures can be evaluated upon request

For the III-V RTP
- Small pieces (1x1cm) should be bordered by Si “shim” pieces, to prevent it from being blown around the chamber during operation
- Make sure to approve any modifications to tool recipes with the MNFL staff!!
  o Outgassing from III-V materials can become considerable at higher temperatures, generating materials that can deposit on the chamber walls and influence processing for subsequent users
  o The tool has time/temperature restrictions on processing, exceeding these can damage the tool
## TOOL OVERVIEW

### FULL PROCEDURE

**A) Start up and Login**

1. **Check Process Chilled Water (PCW) Feed Isolation Ball Valve** open.
2. **Check PCW Return Isolation Valve** open.
3. **Check House Nitrogen pressure** at 20 psi.
4. **Check Compressed Dry Air (CDA)** at >60 psi.
5. **Press Solaris RTP Power On/Off** to turn on the RTP and confirm the green power light is on.  
   The PCW water flowmeter should move from 1 gpm to 2 gpm. The CDA should start flowing resulting in a whooshing sound.
   The Solaris Operating Software Version 3.4 should automatically load, leaving the following screen on the monitor.
7. **Select Start RTP Process**, calling up the following Main Menu. Users may access Run Processes, Review Process Data, and User Login.  
   As needed, **Staff will access Recipe Management, System Diagnostics, Run Open Loop Processes, System Calibration, and Administration.**
8. **Press User Login** and log in with the password given you.

![Solaris RTP Main Menu](image)
B) Loading a Sample

1. **Open the Sample Door to load a sample on the quartz wafer tray** with a four or inch wafer.
   
a. If your sample is smaller than 4 inches, use the Dummy 100mm Silicon Wafer, which is stored in a Wafer Tray at the tool.

b. Do not move tools, parts, dummy wafers, or other items tween the Si RTP and the III-V RTP.

c. Use a polypropylene or Teflon wafer for sample loading and unloading in the Si RTP. A polypropylene tweezer has been set aside in a marked tweezer box for the Si RTP.

d. Use a metal tweezer for sample loading and unloading in the III-V RTP. A metal tweezer has been set aside in a marked tweezer box for the III-V RTP.

e. **Carefully place the sample on the quartz tray.**

Please note that the sample is held by three prongs pointing up. These prongs are fragile, as their cross section has been minimized to minimize thermal conduction away from the sample.

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C) Running the RTP Process

1. **Press Run Process** to bring up the following Solaris RTP Process Page.

![Solaris RTP Process Page]

2. Select your desired recipe file.


4. Set Overtemp set point to 1000°C. **No not increase the Overtemp setpoint above 1000°C without consulting the Staff first.**

5. Leave Power Limit at 100%.

6. Leave the Purge MFC Set Point at 3 SLPM.

7. Leave the Learn Mode Off unless you wish to use it and have been instructed in it.

8. For TC Select, choose TrayTC.
9. **Press Start.** The User Login screen will come up with blocks for Sample Name, User name, and Notes. Enter your desired labels and press Start Process. The Sample Name will be used as the run data file name.

10. When the lamps power turns on, the current temperature should rise above room temperature. 

    **Note:** the graphing of the process data uses a single vertical scale, so that Control Temperature and actual Temperature are directly plotted, while Total Gas Flow in sccm is multiplied by 10 and Power Level in % is divided by 10.

11. **Monitor the process until it sends.**

    a. Press the Stop Process button if it is necessary to end the program early. When the run is complete the following window will appear.
    
    b. Press the Store Data button to save the run information.
    
    c. The sample run data will be saved in a text file with the following characteristics: sample name as the file name, user name, recipe, calibration file, time & date, maximum temperature, and the process run data in tabular format.
    
    d. The data will be stored in the Solaris Process Data folder.
    
    e. Pressing Next Wafer will erase the information about the just completed process run without saving it.
D) Data Access

1. To access the saved data, go up the **Solaris RTP Main Menu** and choose Review Process Data.

2. The file selection window will open up. **Choose the Solaris Process Data folder**, which is a dedicated subfolder in the Solaris program folder. All users’ data will be stored in the same folder.

3. Your data will be identified by the run name you gave, along with the time and date of the run.

   a. Select and load your data file. The data is stored in text form.
   b. For off line review, you may email your files to yourself using the Outlook Web Applet.
   c. If you need to change the file type from unlabeled to .txt, you may do so manually.
   d. Every 10th data value will be saved.
   e. If you need more detailed data, contact the Staff to change the sampling rate from 1 in 10 to 1 in 8, 1 in 4, or 1 in 2.
### E) Finishing up

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>After the process ends, <strong>allow 5 minutes for the sample to cool prior to opening the RTP Door.</strong></td>
</tr>
<tr>
<td>2.</td>
<td>Open the RTP Door and remove the sample using the appropriate tweezer. Close the door and wait a further 5 minutes before turning the RTP off.</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Leave the cooling water valve, N2, and Compressed Dry Air (CDA) valves open.</strong></td>
</tr>
</tbody>
</table>
APPENDIX A: RECEIPES

The RTP Recipe Editing Page is shown below.

Current File – The name of the recipe being created or edited. (Note: do not enter the .txt as part of the filename)

<table>
<thead>
<tr>
<th><strong>Save and Save As Recipe:</strong></th>
<th>The name of the recipe being created or edited.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delete Last Line:</strong></td>
<td>Deletes the last step in the recipe.</td>
</tr>
<tr>
<td><strong>Delete All Lines:</strong></td>
<td>Clears all lines in the recipe box.</td>
</tr>
<tr>
<td><strong>Step:</strong></td>
<td>Identifies the current recipe step.</td>
</tr>
<tr>
<td><strong>Operation Type:</strong></td>
<td>Purge, Ramp up, Hold, Ramp down, and Finish.</td>
</tr>
<tr>
<td><strong>Control Device:</strong></td>
<td>Tray TC. Only the Staff uses the K-Type Calibration Wafer.</td>
</tr>
<tr>
<td><strong>Control Temperature:</strong></td>
<td>Identifies the steady state or setpoint temperature.</td>
</tr>
<tr>
<td><strong>Ramp Rate box and Step Time:</strong></td>
<td>Identifies the time at steady state if the Hold operation is selected for the step, or the purge time if the Purge operation is selected for the step. If the step operation is a Ramp Up or Ramp Down, this box sets the ramp rate in degrees/sec.</td>
</tr>
<tr>
<td><strong>Local Lamp Power:</strong></td>
<td>Lamp power may be set for the Upper Front Lamp Power (UFLP), Upper Rear Lamp Power (URLP), and the Lower Lamp Power (LLP).</td>
</tr>
<tr>
<td><strong>REM/Intensity:</strong></td>
<td>This is a Dual Use box. For Ramp steps, the value is Ramp Exit Modifier, which identified the point in the Ramp Up in which closed loop temperature control makes a transition from ramp up to steady state. For steady state Intensity steps, the value is the lamp intensity at which the temperature is optimized for a particular process.</td>
</tr>
<tr>
<td><strong>PID Parameters:</strong></td>
<td>PID parameters are active in Steady State Hold steps. For most steps, the PID values will be zero.</td>
</tr>
</tbody>
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APPENDIX B: LEARN MODE

Learn Mode may be used to optimize an already written recipe. Learn Mode changes the PID values within a Hold Step to minimize overshoot. **Note: Learn Mode does not work if the Hold Step has an undershoot condition.**

If the tool has not been run in the past 30 minutes, do a warm up wafer to put the tool into a stable state. Select Learn Mode On in the Solaris RTP Process Page, and run the recipe. Shown below is a 400°C recipe being run in Learn Mode. **Also note that Learn Mode works less well at lower temperatures.**
## APPENDIX C: PASSWORDS

<table>
<thead>
<tr>
<th>Tool</th>
<th>Level</th>
<th>Password</th>
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<tbody>
<tr>
<td>Silicon RTP (Tool 6)</td>
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<tr>
<td></td>
<td>User</td>
<td>A</td>
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<td>D</td>
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<td>E</td>
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<tr>
<td></td>
<td>Administrator</td>
<td>F</td>
</tr>
<tr>
<td>III-V RTP (Tool 7)</td>
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<tr>
<td></td>
<td>User</td>
<td>A</td>
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<td>Author</td>
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<td>v.0.1</td>
<td>November 29, 2016</td>
<td>Conrad L. Silvestre</td>
</tr>
<tr>
<td>v0.2</td>
<td>May 1, 2020</td>
<td>Eric Mills</td>
</tr>
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