

# University of Minnesota Nano Fabrication Center

## Standard Operating Procedure

**Equipment Name:** Rapid thermal Annealer

**Coral Name:** rta-1

**Model:** RTP-600S

**Location:** Bay 1

**Revision Number:** 2

**Revisionist:** K. Roberts

**Date:** 4/27/05

### 1 Description

The rapid thermal annealer consists of a small, quartz-lined chamber which is rapidly heated by high intensity, tungsten-halogen lamps. A single wafer loaded into the chamber can be heated to temperatures of 1250 C. Most commonly the RTA is used for surface repair following ion implantation and also for ohmic contacts.

### 2 Safety

- a Do not open chamber unless below 200 °C.
- b Be aware that thick quartz table will stay hot much longer than Si substrate.

### 3 Restrictions/Requirements

- c Must be a qualified user on rta-1.

### 4 Required Facilities

- a Compressed air, 60psi, 5 SCFM
- b Process chilled water, >2 GPM
- c HiN<sub>2</sub>, 0-30 SLPM
- d 5% H<sub>2</sub>/N<sub>2</sub>, 0-10 SLPM
- e Ar, 0-10 SLPM
- f 10% O<sub>2</sub>/N<sub>2</sub>, 0-10 SLPM
- g N<sub>2</sub>O, 0-10 SLPM
- h O<sub>2</sub>, 0-10 SLPM






### 5 Definitions

- a Thermocouple - A bi-metal junction which has been calibrated for temperature given the thermovoltic change in that junction. Wire leads from the junction should not be shorted against a metal (i.e chamber door) or semiconductor (wafer substrate), as this will cause an offset in the voltage reading, and may lead to significant errors in the temperature reading. The junction should press firmly against the material being measured so as not to under-estimate the temperature of the substrate, which leads to over-heating of the chamber.
- b Pyrometer - Solid state detector (photo-diode) which has been calibrated for temperature given the infra-red emission of silicon. Will only work accurately for silicon. Will not work for glass or sapphire substrates! Will have problems with highly reflective metals on the back of the wafer, especially aluminum.

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### 5 Definitions [cont.]

-  Real Temperature (within 40 °C of the Model Temperature). Temperature as measured by the TC or the pyrometer.
-  Real Temperature (not within 40 °C of the Model Temperature). Temperature as measured by the TC or the pyrometer.
-  Model Temperature. Feedback circuitry determined. It represents the temperature the system is trying to achieve.
-  Lamp intensity. Relative scale from 0 to 100% power.
-  Gas Flow. No vertically numbered scale on graph, but displacement on the vertical axis is proportional to the amount being flowed for the given MFC.

### 6 Operating Instructions

#### a LOGGING ON

- 1 Enable rta-1 on the NFC Coral system.
- 2 Fill out user info in the log book.
- 3 Press the "Power On" button. This will turn on the compressed air which cools the chasis and electronics, and will activate the lamp power relays.

#### b RUNNING A PROCESS

- 1 Open the chamber door by lifting up on the metal handle with your fingers, while using your thumbs to slowly but firmly pry the door seal from the chamber flange.
- 2 Based on the temperature requirements of your process, decide whether the TC (150 - 600 °C) or the Pyrometer (400 -1250 °C) will be used. Based on whether the TC is needed, either plug it in or take it out of the socket on the inside of the chamber door.

**NOTE: FOR CORRECT POLARITY OF THE TC SIGNAL, THE HEADS OF THE SCREWS SHOULD FACE DOWN. IF INSTALLED INCORRECTLY, THE TEMPERATURE WILL READ OUT AS A NEGATIVE TEMPERATURE, WHICH WILL CAUSE THE LAMPS TO BE DRIVEN TO 100% INTESITY. THIS CAN CAUSE SERIOUS DAMAGE TO THE SYSTEM.**

- 3 Place wafer (or samples on carrier wafer) on the three points of the quartz tray.

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### b RUNNING A PROCESS [cont.]

- 4 Close chamber door and press metal handle down. It is not necessary to press the metal handle all the way down, just enough to make the seal on the door press firmly against the metal flange.
- 5 Select F4 "Run Process" from the Main Menu.
- 6 Highlight the recipe you would like to run. Press "Enter" to run.

**NOTE:** There are usually 5 to 7 pages of recipes with 15 recipes/page. At around 100 recipes (when the 7th page is filling up) the computer will give a warning that the directory is full. Contact staff for help in moving some recipes from the directory.

- 7 Allow recipe to run. Process parameters will be graphed on screen. See definitions section for explanation of each line being graphed.
- 8 When run is complete, allow temperature to cool to  $\leq 200$  °C before opening chamber door to remove wafer.

### c TO PROGRAM A PROCESS

- 1 Select F3 "Recipe Menu" from the Main Menu.
- 2 Choose F6 "New Recipe" if you wish to write a recipe from scratch.

**NOTE:** The computer will give a message stating "NONE.rpd exists! Overwrite it?" Pressing the 'Y' key to answer 'Yes' is the most convenient answer. Pressing the 'N' key to answer 'No' will require you to also press the 'Enter' key to open the blank template file. Not much difference between 'Y' and 'N', in other words.

- 3 Fill out the fields at the top of the screen. Use the arrow keys to move about the screen.

**NOTE:** The file name should be restricted to 8 characters and should have the extension of '.rpd' typed into it or it will not be saved into the proper directory.

**NOTE:** Temp. Sensor Field: 'Space Bar' toggles between TC and Pyrometer.

**NOTE:** Control Mode Field: 'Space Bar' toggles between Close-loop and Open-loop. Always write your recipe in Close-loop mode, which means the temp. sensor will provide feedback to the lamp power output.

- 4 Write recipe. There are five commands to choose from: Idle, Hold, Ramp, Wait, and Stop. These are abbreviated 'I', 'H', 'R', 'W', and 'S' on the keyboard.

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c TO PROGRAM A PROCESS [cont.]

5 To save and validate the recipe, do the following from the **Command** field:

```
'F2'  
'F10'  
["Press any key to continue."] 'Enter'  
↑  
'F2'  
["Overwrite?"] 'Y'
```

d LOGGING OFF

- 1 Press the "Power Off" button.
- 2 Fill out any remaining process details in the log book.
- 3 Disable rta-1 on the NFC Coral system.

## 7 Problems/Troubleshooting

### Problem

Monitor is B&W instead of color...

### Solution

press the EMO button to shut off the computer, then press the EMO Reset button to restart the computer.