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1.0 INTRODUCTION

1.1 Scope
These procedures apply to the JetFirst 150 RTA system. All maintenance should follow the procedures set forth in the manufacturer’s maintenance and operations manuals. This document is for reference only. Users must be trained by Nanofab staff before operating this equipment.

1.2 Description
The JetFirst 150 RTA is a rapid thermal annealing system. The system is designed to run 4” wafers. Smaller samples can be processed in this system but they must be positioned on top of a bare, clean 4” silicon wafer for processing.

The JetFirst system can operate with the process chamber under reduced pressure or at atmospheric pressure. Process gases available on the system are N₂, Ar, & 5%H₂ - 95%N₂ forming gas. The system is capable of controlling the process temperature through the use of a pyrometer or via direct contact with a thermocouple.

1.3 Safety

1.3.1 This machine is connected to **HIGH VOLTAGE**. Be very careful and remain aware of electrical hazards. If you encounter any electrical malfunctions, contact NanoFAB staff immediately.

1.3.2 This machine can heat samples to > 1000°C. Be aware of the possibility of high temperatures when loading/unloading the oven and allow sufficient time for your sample to cool completely.

1.3.3 This machine has an EMO (Emergency Off) switch/button mounted on the top panel to the right. The EMO switch should be pressed only in an emergency. An emergency would be fire, smoke, electrocution hazards, or an impending injury to anyone using this particular piece of equipment. If the EMO is pressed notify NanoFab staff immediately.

2.0 HARDWARE

2.1 Process Gases – N₂, Ar, & H₂/N₂ forming gas

2.2 Quartz lamp heating system – annealing up to 1000°C

2.3 Vacuum pumping – to 1 Torr.
3.0 REQUIREMENTS

3.1 Training

All users must be trained on the JetFirst RTA 150 and authorized in the Nanofab reservation system to use this process system. Training is supplied by a Nanofab staff member please contact the tool owner to schedule training.

3.2 System Restrictions

3.2.1 Only 4” diameter silicon wafers may be annealed in this system. Samples may be positioned on top of a bare clean 4” silicon wafer.

3.2.2 Historical run logs must be saved to the user’s personal folder on the system computer after each process run.

3.2.3 Users are limited to 1000C maximum operating temperature.

3.2.4 Users must follow and not exceed the system limits in the “Temp vs Time” chart located on the wall behind the RTA system and in the spec.

3.2.5 NO processing above 500C with the Thermocouple present in the system.

3.2.6 Annealing temperatures up to 500C may be run using THERMOCOUPLE CONTROL and at ATMOSPHERIC PRESSURE with one of the process gases flowing.

3.2.7 Reduced pressure (vacuum) processing can only be run using the pyrometer as the temperature controller. This type of process is limited to the 400C – 1000C operating range of the pyrometer.
4.0 OPERATING PROCEDURES

4.1 System Checks and Start-up

4.1.1 Check the written System Logbook and verify no other users are currently running the system. If an incomplete log entry is present check to see if their sample is still present in the system. If so, you must contact the user to find out the status of the system.

4.1.2 If you plan to run a process that will exceed 500C in temperature you must verify that the Temperature Control TC (Fig. 4.1.2) is NOT installed. If the temperature control TC is installed then contact a Nanofab staff member to remove the TC before you begin processing at temperatures > 500C.

4.1.3 Check to ensure the system is “UP” and available in the Nanofab Reservation system and that no “Down to Eng” tag is posted on the system. If either of these issues is encountered contact a staff member.

4.1.4 If H2 – N2 forming gas will be used notify a NanoFab staff member to turn ON the delivery valves for this material.
4.1.5 If Argon gas will be used during processing go to the service chase behind the system and rotate the Argon cylinder valve CCW (Fig. 4.1.4a) to turn it ON. If the Argon bottle pressure, the gauge on the right, is below 200 psi notify NanoFab staff.

(Fig. 4.1.4a)

4.1.6 While you are in the service chase turn ON the mechanical pump. The pump’s ON/OFF switch (Fig. 4.1.5a) is located next to the power cord at the lower rear section of the pump.

(Fig. 4.1.5a)
4.1.7 Return to the cleanroom and move to the rear of the system. If Argon or H – N2 Forming gas will be used during processing then the gas selector valve will have to be switched. Rotate the black gas selector valve (Fig. 4.1.6a) to point at the desired process gas. The black valve handle is shaped like an arrow, point the arrow in the direction of the gas you will use. The gases are labeled on the incoming tubing lines.

(Fig. 4.1.6a)

4.1.8 The system is now ready to run your process.

4.2 Starting a Process

4.2.1 If the computer is powered OFF then turn ON the system computer by pressing the power button (Fig. 4.3.1a) on the front of the computer.

(Fig. 4.3.1a)
4.2.2  Power up the main RTA system by pressing the green “On” button on the upper right front panel of the RTA system (Fig. 4.3.2a). The ON button should illuminate once pressed.

(Fig. 4.3.2a)

4.2.3  Once the computer has finished booting up, double-click the “JETFIRST” icon (Fig. 4.3.3a) from the Windows XP desktop to start the RTA software.

(Fig. 4.3.3a)
4.2.4 To select an existing recipe to run, select the “Processing” button (Fig. 4.3.4a) from the jipelec main page.

**Note** If you need to create or edit a recipe before processing then proceed to Section 5.0 of this SOP. Once your process recipe is ready you may return to this step.

![Fig. 4.3.4a](image)

4.2.5 If prompted for an Engineering password (Fig. 4.3.5a) proceed by entering “nanofab” as the password.

![Fig. 4.3.5a](image)
4.2.6 Once the Processing option has been selected a recipe selection window will open. Highlight the recipe to download from the drop down menu (Fig. 4.3.6a).

4.2.7 Select the “Download” button and begin the recipe download, this will take approx 5 seconds at which time a “Download was successful” dialog box will open (Fig. 4.3.7a), now select “OK” to proceed.

4.2.8 Press the “Start Processing” button. A prompt will tell you to load your wafer into the oven. **Note** If you have not loaded your sample and you are unsure of how this is done proceed to Section 4.2 Loading a Sample if you need assistance.

4.2.9 Once your wafer or sample has been loaded properly select “Ok” to begin processing.
4.2.10 Your process will now begin and the Process screen will open. (Fig. 4.3.10a) This screen will remain open while your process is running and will show the system process parameters in real time.

(Fig. 4.3.10a)

4.2.11 Once your process has completed a dialog box titled “Process Saving” will open (Fig. 4.3.11a) Locate your personal file folder in the selection box in the upper left hand corner and double click on it to open it. Now you may enter any comments or change the file name and then select the “Save” button. ***Note*** – All runs MUST be saved, failure to do so will result in a loss of reservation privileges on this system.

(Fig. 4.3.11a)
4.3 Loading a Sample

4.3.1 The software will prompt you to load your sample when a process is started, however you may load a sample at any time.

4.3.2 Begin loading your sample by turning the front cover locking handle CCW 90 degrees (Fig. 4.2.2a) and lifting the main process chamber lid. Do not force the handle to rotate, if the system determines the chamber temp is too high it will lock the handle for safety reasons. Wait a few minutes and try to rotate the handle again.

(Fig. 4.2.2a)

4.3.3 If you are annealing a 4” wafer then position it centered directly on the quartz sample holder pins (Fig. 4.2.3a), with the polished side facing up. If you are annealing a smaller sample then you will have to sit it on top of a clean 4” silicon wafer, once again with the polished side facing up. The wafer and sample will then be carefully positioned on top of the quartz sample holder pins. If positioned properly the 4” wafer should be sitting level approximately ½” off the lower plate.

(Fig. 4.2.3a)
4.3.4  *(Note - If you are using pyrometer temp control in your recipe you may skip this step.)* If your process will be run at atmospheric pressure using thermocouple temperature control in the recipe then you must ensure that the tip of the TC is contacting the center of the bottom of your 4” wafer (Fig. 4.2.4a). **WARNING** It is important that you ensure the TIP of the Thermocouple wire CONTACTS the backside of the 4” wafer. Failure to do so may cause an over temperature condition in the chamber destroying your sample and damaging the Jetfirst system.

![Temp Control TC](image)

(Fig. 4.2.4a)

4.3.5  Once you have properly positioned the 4” wafer and thermocouple (if it is needed) you can close the process chamber lid and securely latch it by rotating the black handle 90 degrees CW.
4.4  **Unloading a Sample**

4.4.1  To begin unloading your sample, rotate the black handle on the process chamber cover 90 degrees CCW. If the handle is locked and will not rotate then the chamber is still above the safe temperature. Wait five minutes and then try to rotate the handle again.

4.4.2  Lift the chamber lid fully (Fig. 4.4.2a) until it stops, be careful to support the lid and make sure it does not fall back down under its own weight. Give your sample additional time to cool down if needed with the chamber lid open before attempting to unload.

(Fig. 4.4.2a)

4.4.3  Remove your sample from the chamber and then close and latch the chamber lid.

4.5  **System Shutdown**

4.5.1  Turn OFF the system computer by selecting the “Shutdown” option in Windows XP or by momentarily pressing the computers front panel POWER button (Fig. 4.5.1a).

(Fig. 4.5.1a)
4.5.2 Press the square red **OFF** button located on the upper right hand side (Fig. 4.5.2a) of the RTA system front panel. The illuminated green ON button should turn off at this time.

(Fig. 4.5.2a)

4.5.3 At the rear of the RTA system turn the Argon / H2·N2 Forming gas selector valve (Fig. 4.5.3a) to its closed position, it should be pointing straight down when closed.

(Fig. 4.5.3a)
4.5.4 Go to the service chase behind the system and close the main Argon cylinder valve by turning it fully CW until it stops (Fig. 4.5.4a). If the bottle supply pressure gauge on the right hand side is reading less than 200psi notify NanoFab staff at this time.

(Fig. 4.5.4a)

4.5.5 In the service chase turn OFF the mechanical pump (Fig. 4.5.5a).

(Fig. 4.5.5a)

4.5.6 If H2 – N2 forming gas was used during processing notify Nanofab staff to turn off the forming gas supply valves.

4.5.7 The system is now secure.
5.0 Recipes

5.1 Recipe Rules

5.1.1 Basic recipe rules.

- Never exceed 1000 deg C for any period of time.
- You must follow the “Temp Vs Time” chart (Fig. 5.1).
- If you create a recipe you must use your name in the recipe title.
- You must use PYROMETER temp control when processing under vacuum conditions.
- The pyrometer can only control temperatures from 400C – 1000C.
- Thermocouple temp control can ONLY be used with the chamber at atmospheric pressure. In other words, **REDUCED PRESSURE PROCESSING IS NOT ALLOWED WHILE UNDER THERMOCOUPLE CONTROL.**
- When controlling the temperature using POWER mode do not exceed 30% power request or overheating and system damage can occur.
5.2  Creating a New Recipe

5.2.1  **Note**  It is much easier to edit an existing recipe to meet your requirements than to create a new one every time. Proceed to Section 5.3 to edit an existing recipe and save it with your own filename.

5.2.2  To begin creating a new recipe, select the “Recipes” button (Fig. 5.1.2a) from the main jipelec software interface menu.

5.2.3  If prompted for an Engineering password (Fig. 5.1.3a) proceed by entering “nanofab” as the password.
5.2.4 A box titled “Recipes” (Fig. 5.1.4a) will open. Now select the “New” button in the lower left hand corner.

(Fig. 5.1.4a)

5.2.5 The first screen that opens will be the “Recipe Heading” screen. On this page you are required to fill in the 3 boxes labeled Filename, Pyrometer Calibration table and Thermocouple calibration table. All other information on this page is optional. The Pyrometer calibration table for every recipe should be “HT150” and the Thermocouple calibration table should be “StandardTC”. The filename should have the users name as a portion of the title, this will be the actual recipe name.
5.2.6 Once you are finished filling in the information on the Recipe Heading screen select the “Edit” button. The screen that opens will be Step #1 of your new recipe. Fill in the pertinent information in this step then select the button titled “Next Step”. Below is the basic format of a complete recipe and Step 1 (Fig. 5.1.6a) of a recipe.

**Basic recipe step format.**

- **Step 1 – Evacuate the chamber**
- **Step 2 – Purge the chamber back to atmosphere**
- **Step 3 – Ramp to process temp**
- **Step 4 – Ramp to process temp 2 for multi-temp processes.**
- **Step 5 – Ramp to low temp and cool for unloading.**

(Fig. 5.1.6a)

5.2.7 You can move forward or backward at any time during editing by pressing the buttons titled Next Step or Previous Step.

5.2.8 Once you have completed your recipe steps select the “Save” button.

5.2.9 It is recommended that you go back through your recipe steps and thoroughly inspect them for any errors before running the new recipe, be sure to click “Save” again after any changes.

5.2.10 To run your new recipe proceed to Section 4.3.
5.3 Editing an Existing Recipe

5.3.1 To begin editing an existing recipe, select the “Recipes” button (Fig. 5.2.1a) from the main Jipelec software interface menu.

(Fig. 5.2.1a)

5.3.2 If prompted for an Engineering password (Fig. 5.2.2a) proceed by entering “nanofab” as the password.

(Fig. 5.2.2a)

5.3.3 A box titled “Recipes” will open. Now scroll to the desired recipe in the upper right hand menu and highlight that recipe then select the “Open” button.

5.3.4 The next window that opens will be the “Recipe Heading” screen. If you wish to edit this recipe and save it with a new recipe name then enter the new name in the box titled “Recipe name” and then press the “EDIT” button. If you plan on keeping the existing recipe name do not change anything just press the “EDIT” button.
5.3.5 Once you press the “EDIT” button the next window which opens will be the first step in your edited recipe. You may begin making changes to the individual steps now. Press the “Next Step” or “Previous Step” buttons to navigate through the recipe.

5.3.6 When you have finished making changes to the recipe select the “Save” button. A prompt will notify you that saving was successful, select “Ok”.

5.3.7 Now select the “Exit” button, a prompt will open telling you to save your recipe changes before exiting. As long as you have saved your changes select “Yes” to exit the recipe edit screen.

5.4 Nanofab Standard Recipes

5.4.1