

Standard Operating Manual

Allwin21 AW610 RTP

Contents

- 1 Picture and Location
- 2 Process Capabilities
 - 2.1 Cleanliness Standard
 - 2.2 Recipes
 - 2.3 Performance of Allwin21 AW610 RTP
- 3 Contact List and How to Become a Qualified User
 - 3.1 Emergency Responses and Communications
 - 3.2 Training to Become a Qualified User
- 4 Operating Procedures
 - 4.1 System Description
 - 4.2 Safety Warnings
 - 4.3 Operation Rules
 - 4.4 Initial System Checks
 - 4.5 Status Checks
 - 4.6 Steps to operate the equipment
 - 4.6.1 Load the samples into the chamber
 - 4.6.2 Select recipe
 - 4.6.3 Start the process
 - 4.6.4 Unload the samples
 - 4.6.5 Shut down the equipment after use

Allwin21 AW610 RTP

1. Picture and Location

Allwin21 AW610 RTP

This tool is located at NFF Enterprise Center Cleanroom Room 4162

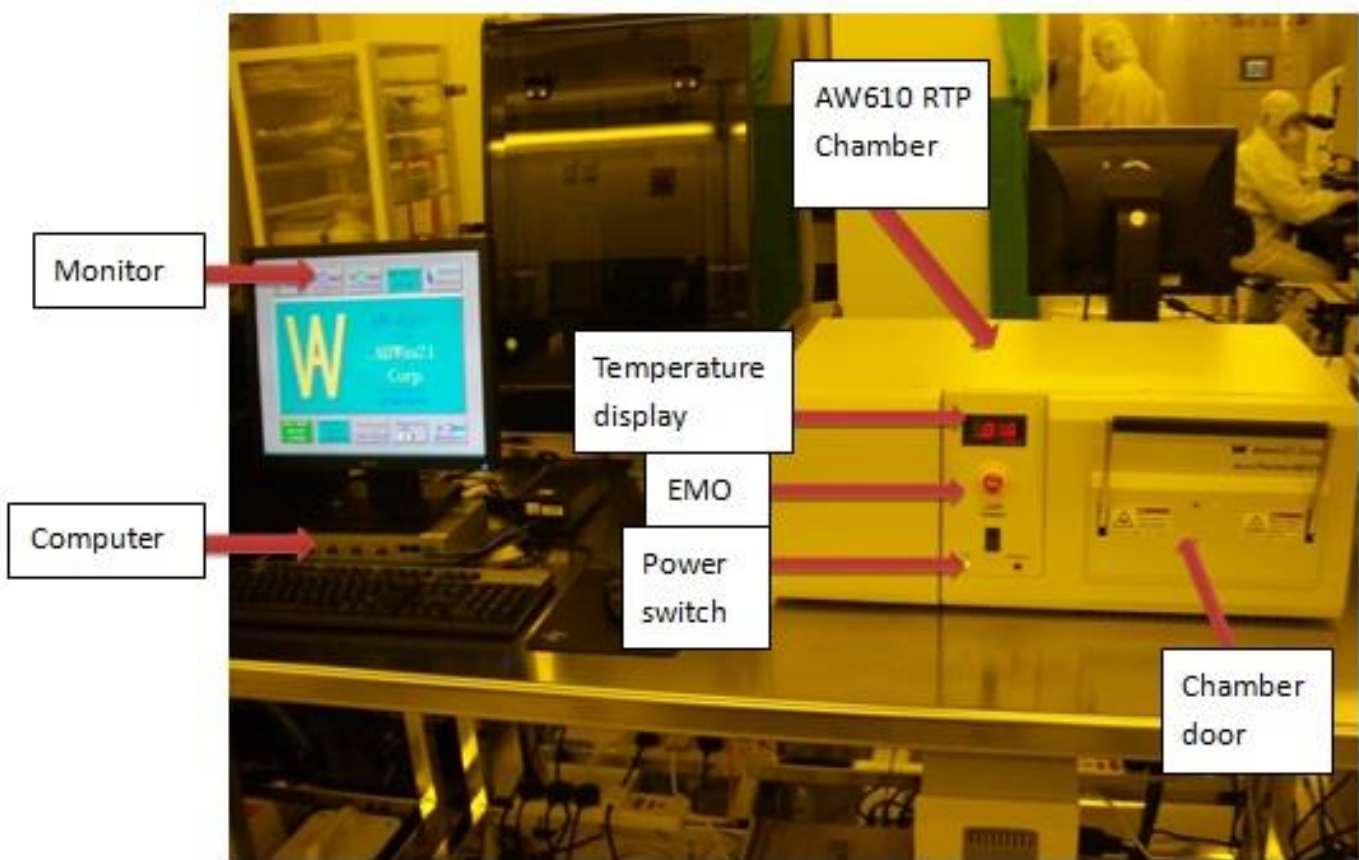


Fig.1 Allwin21 AW610 RTP

2. Process Capabilities

2.1 Cleanliness Standard

Allwin21 AW610 RTP is a “Non-Standard” equipment for high temperature annealing.

2.2 Recipes

No Standard recipes are provided for this equipment. The users can edit recipes based on what temperature the processes require. Please approach NFF staff for editing recipes and feasibility of the processes.

2.3 Performance of Allwin21 AW610 RTP

Maximum allowable temperature/process time for annealing: 850 °C/30sec

Substrate size: 2inch, 4inch in diameter, 1mm thick or specimens.

Process gases available: N₂ and O₂

Maximum allowable steady time (Suppose temperature ramp up/down rates are not less than 10 °C /sec)

10min (<=550 °C), 5min (>550 °C and <=600 °C), 2min (>600 °C and <=700 °C), 1.5min (>700 °C and <=750 °C), 1min (>750 °C and <=800 °C) and 0.5min (<=850 °C)

3. Contact List and How to Become a Qualified User

3.1 Emergency Responses and Communications

- Security Control Center: 2358-8999 (24hr) & 2358-6565 (24hr)
- Safety Officer: Mr. Wing Leong CHUNG 2358-7211 & 64406238
- Deputy Safety Officer: Mr. Man Wai LEE 2358-7900 & 9621-7708
- NFF EC Technician: Mr. Peter Yiu Cheong PUN 2358-7225 & 2358-7218
- NFF Phase 2 Technician: Mr. Wilson Pui Keung YIP 2358-7894

3.2 Training to Become a Qualified User

Please follow the procedure below to become a qualified user.

1. Read the operation manual of Allwin21 AW610 RTP which can be found in NFF web site.
2. Send an e-mail to Mr. Peter PUN requesting Allwin21 AW610 RTP operation training. Scheduling can take up to several weeks due to the many requests coming in for this tool.

4. Operating Procedures

4.1 System Description

Allwin21 AW610 RTP is a rapid thermal processing system, which uses high intensity visible radiation to heat single wafers for short process periods of time at precisely controlled temperatures.

The wafer to be processed is placed on a quartz tray that slides into a quartz isolation tube in the oven unit. Two banks of lamps, one above the quartz tube and one below it, provide the source of energy for heating the wafer. The lamps can be controlled automatically from the controller computer.

4.2 Safety Warnings

This equipment and users can cause injury if it is not being used under a cautious manner.

1. The chamber of the equipment is made of quartz which is hard but easily breaks. Be careful when loading or unloading the samples to avoid breaking the quartz chamber.
2. The tray to hold the wafer is also made of quartz which is hard but easily breaks. Be careful when loading or unloading the samples to avoid breaking the quartz chamber.
3. There is a thermal couple (TC) underneath the dummy wafer to read the temperature inside the chamber. Be careful and do not damage the TC.
4. The system can also be easily damaged if the recipe parameters are not correct.

NANOSYSTEM FABRICATION FACILITY (NFF), HKUST

Make sure that confirmation with NFF staff is needed for any changes of recipe parameters.

5. Hot quartz chamber and quartz wafer tray can cause burns. Make sure the temperature is low enough to open the door of chamber. Do not try to use hands to touch the chamber or the wafer.
6. There are different kinds of interlocks and sensors to prevent from damaging the equipment. If alarm message pops up during annealing, please inform NFF staff for checking. In urgent situation, press EMO button to power off the equipment immediately.
7. Byproducts which have hazardous characteristics maybe generated during annealing and stay in the chamber. Avoid skin , eye, and respiratory contact with process byproducts.

4.3 Operation Rules

1. If the equipment alarms during operation, do not try to fix the problem by yourself and should report to NFF staff immediately.
2. Do not operate the equipment unless you are properly trained and approved by NFF staff.
3. Do not leave an on-going experiment unattended.
4. **Do not run the process for more than 5 minutes when $T \geq 550^{\circ}\text{C}$, we accept run the process for 10 minutes when $T \leq 550^{\circ}\text{C}$.**
5. Enough time of cooling is needed before unloading the wafer or specimens from the chamber after process completed. Samples are allowed to be unloaded **ONLY** when the temperature is below 50°C .
6. Do not start the process while the door is still open.
7. Do not open the door while processing.
8. Except “main menu” and “Process for Engineering menu”, do not click into other menus such as “Maintenance menu”.
9. Do not stop the process by improper ways during normal operation. For example, turn off the power suddenly to stop the process during normal operation.
10. Do not change the machine settings without permission by NFF staff.
11. This equipment is only for purposes of annealing. For other request, please consult with NFF staff.
12. It is not allowed to anneal the wafer or specimens which consist of **Photo Resist**.

4.4 Initial System Checks

1. The valve of water **RETURN** is opened **FIRST** (Fig.2).
2. The valve of water **SUPPLY** is then opened after step 1 (Fig.2).

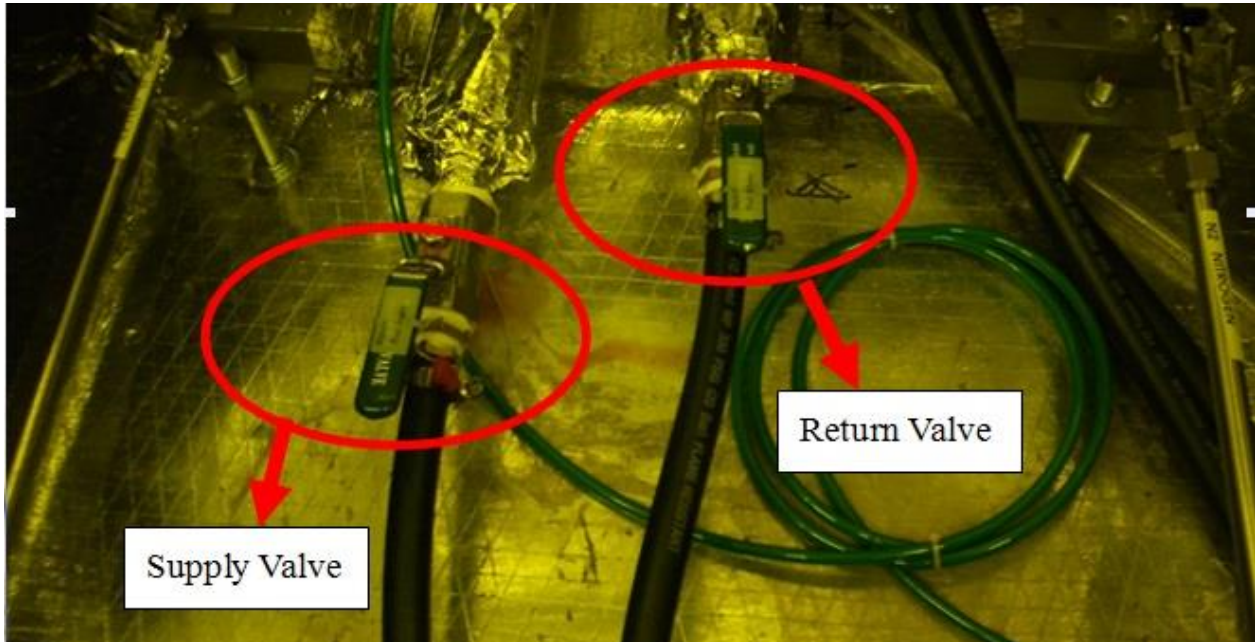


Fig.2 Location of cooling water valves underneath the floor

3. The N₂ valve or O₂ valve is opened (Depend on which gas the process is going to use). Make sure that there is positive pressure shown on the regulator (Fig.3).

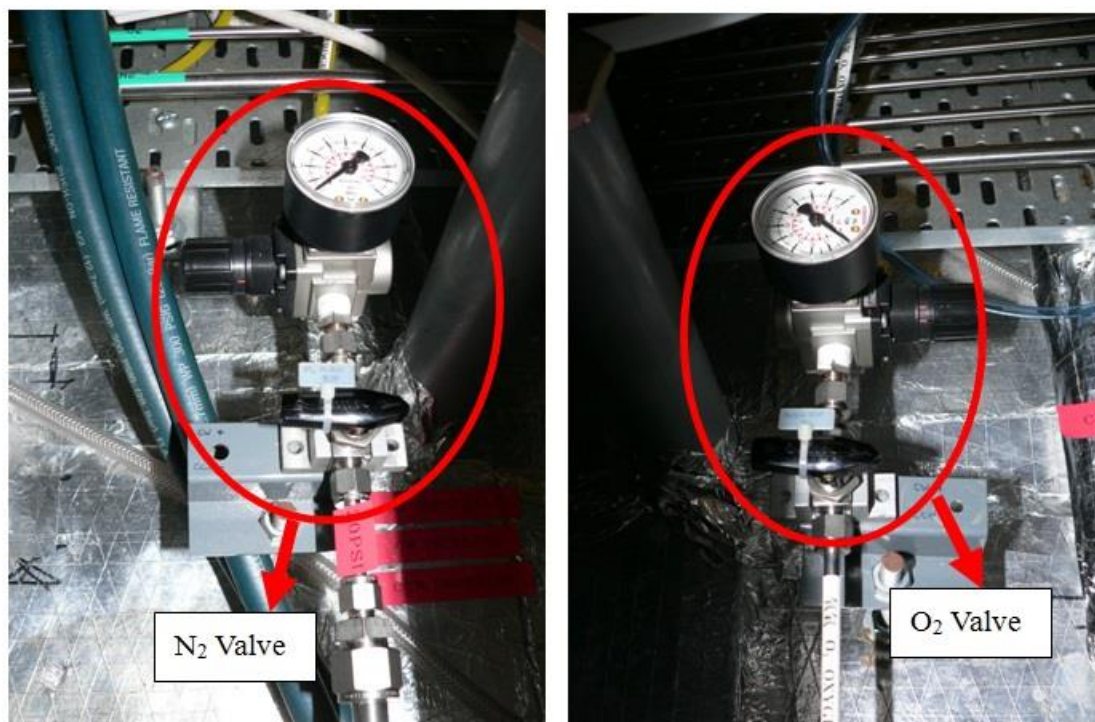


Fig.3 Location of N₂ and O₂ valves underneath the floor

4. The CDA valve is opened to have a pressure of 50 psi (Fig. 4).

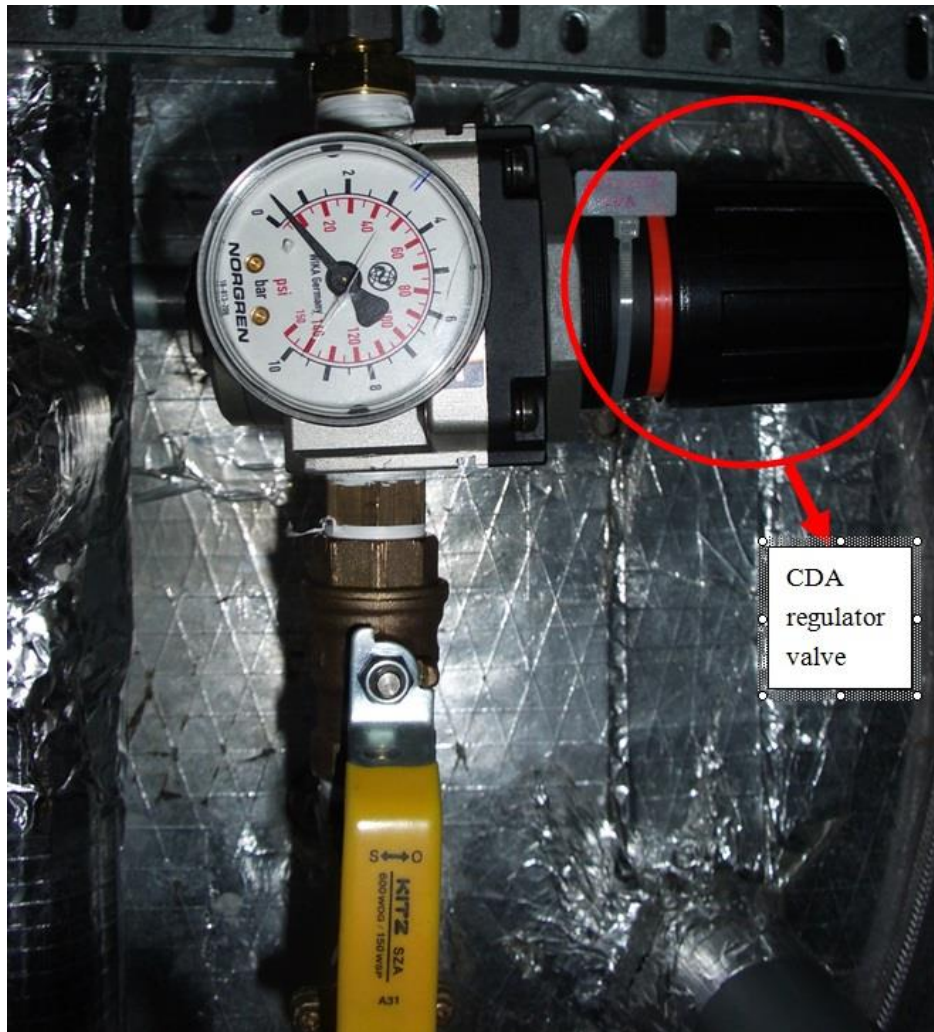


Fig.4 Location of N₂ and O₂ valves underneath the floor

5. The temperature of chiller is about 20°C (Fig. 5).

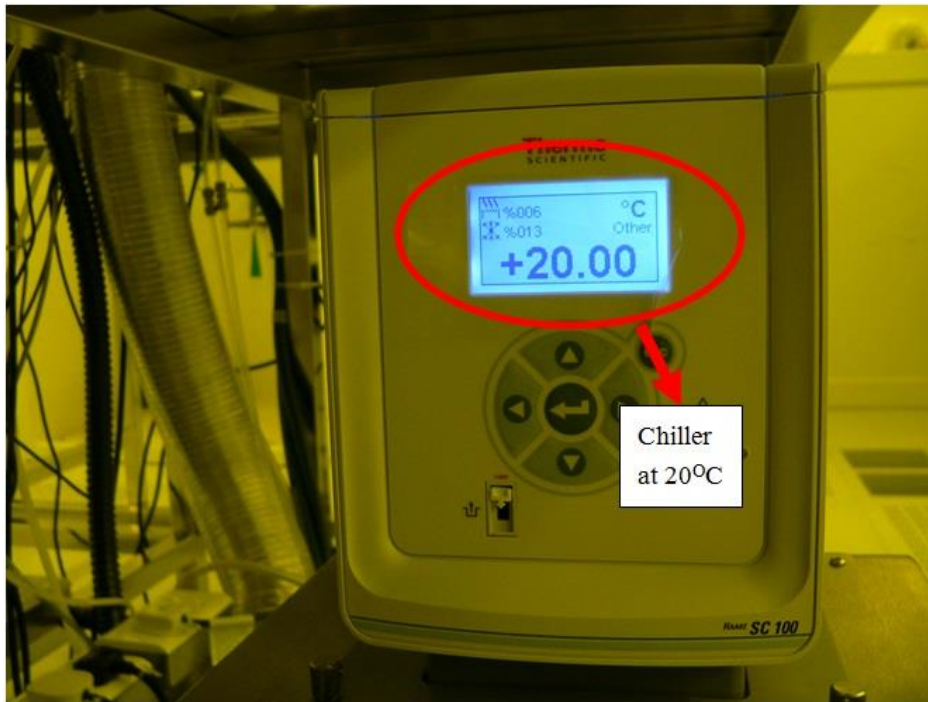


Fig.5 Chiller underneath AW610

6. The chamber door can be pulled or pushed smoothly (Fig.6).
7. Wafer holder (quartz tray) is clean and level (Fig.6).
8. The thermal couple (TC) is under condition and touches the bottom of wafer (Fig.6).
9. The sealing surface and the sealing rubber of the door are under good conditions without damage (Fig.6).

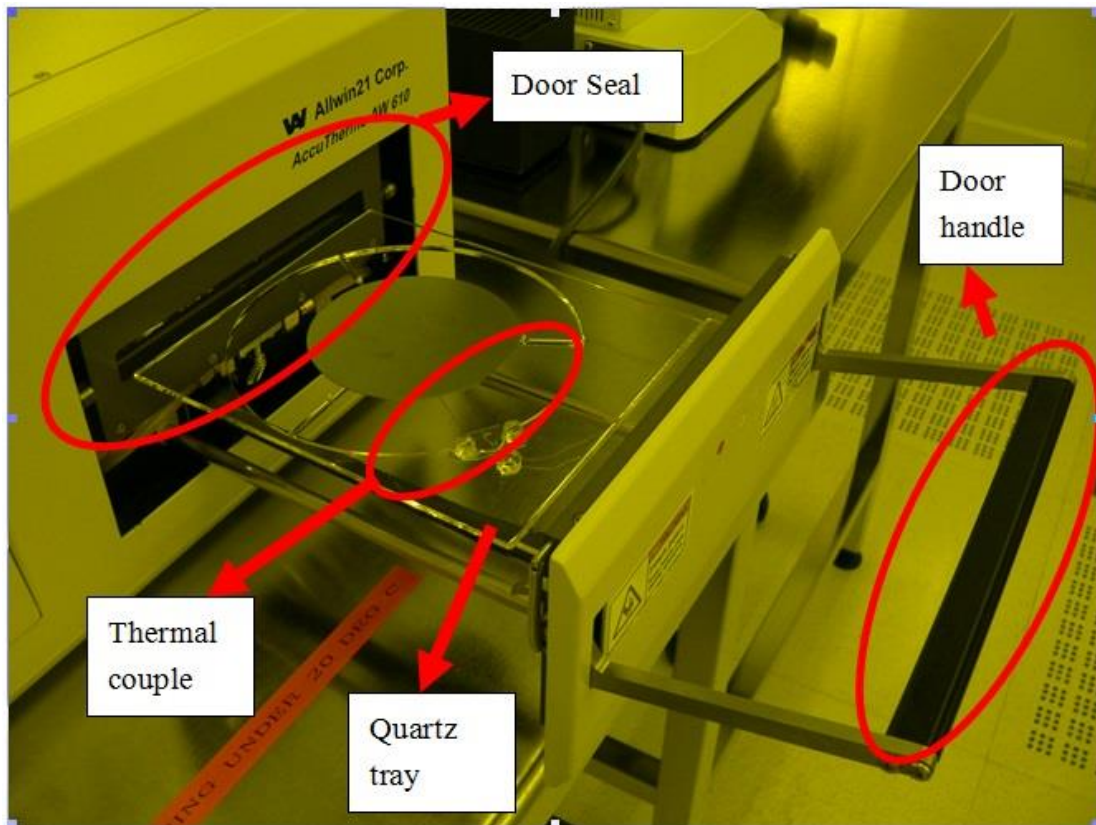


Fig.6 The loading part of AW610

10. Room temperature ($\sim 20\text{ }^{\circ}\text{C}$) is displayed on the panel after turning on the equipment.
11. The monitor is turned on and shows the main page of the software (Fig.7).

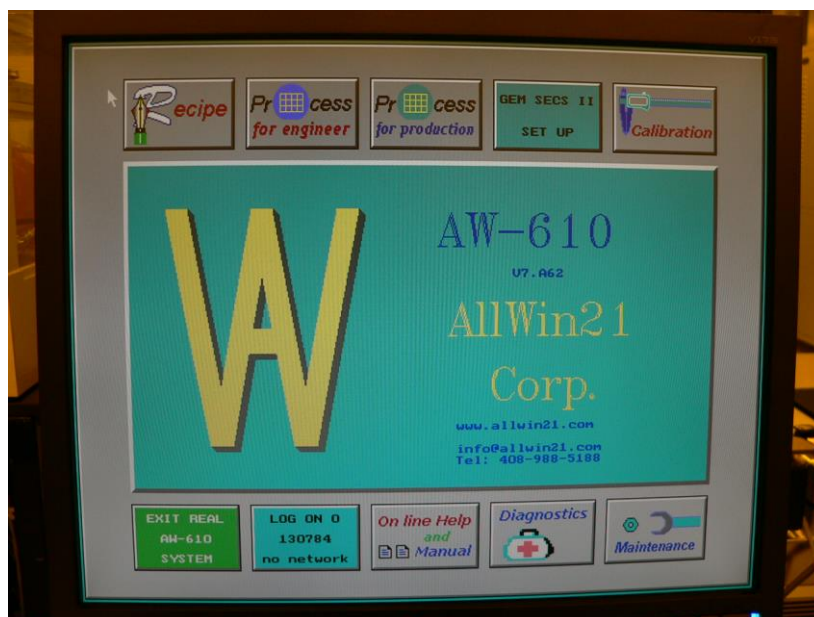


Fig.7 The main page of AW610 operation software

Remark: A completed check list of AW610 is provided. User must follow the procedures and fill in the list before operating the equipment.

4.5 Status Checks

Reservation is needed for this equipment. Please book and check in the equipment before operation.

4.6 Steps to Operate the Equipment

4.6.1 Load the samples into the chamber

1. Make sure the equipment is ready (Pass initial system checks).
2. Open the door by pulling the handle. Put the wafer or specimens on the quartz tray and then close the door slowly. Push up the handle to lock the door.

4.6.2 Select recipe

In AllWin21 operation interface, go to “Process for Engineer menu”.

1. Four columns can be found in this menu. Go to the last column “Recipe File”, select the correct recipe and click “Recipe Edit”. All recipes should be in *.RCP format (Fig.8).

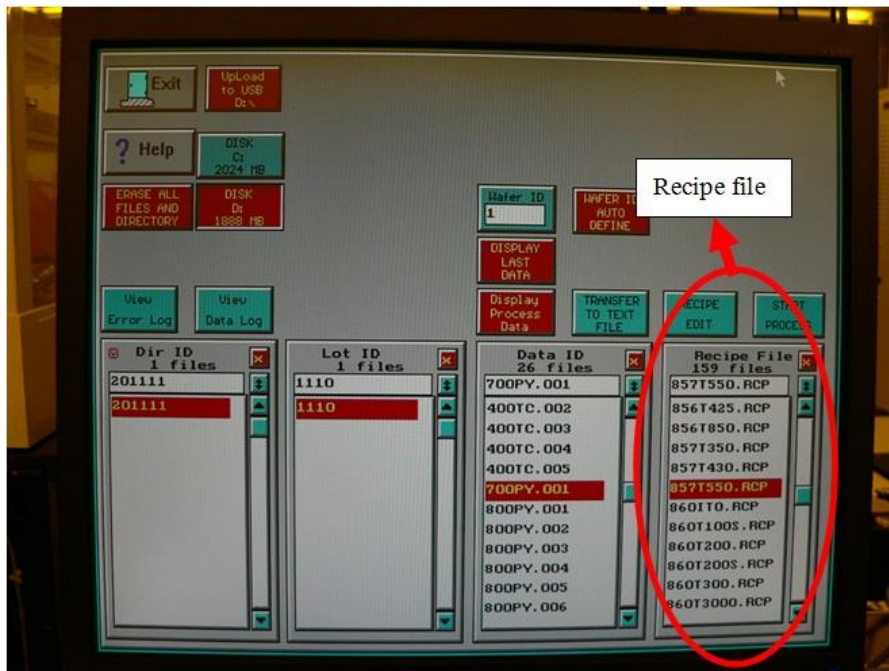


Fig.8 Recipe File in “Process for Engineer menu”

NANOSYSTEM FABRICATION FACILITY (NFF), HKUST

2. Check the recipe parameters in recipe editor (Fig.10) to make sure the parameters are correct. The table below shows the parameters of a recipe as an example.

| Step No. | Step Function | Time (sec) | Temperature (°C) | Steady Intn Factor | Gas5 N2 SLPM | Gas6 O2 SLPM | Steady Intn |
|----------|---------------|------------|------------------|--------------------|--------------|--------------|-------------|
| 1 | Delay | 180 | 0 | 1 | 10 | 0 | 0 |
| 2 | Ramp | 50 | 300 | 1.5 | 6 | 0 | 0 |
| 3 | Steady | 600 | 300 | 1.5 | 6 | 0 | 0 |
| 4 | Delay | 120 | 0 | 1 | 10 | 0 | 0 |
| 5 | Finish | 0 | 0 | 0 | 0 | 0 | 0 |

Table1. Recipe parameters

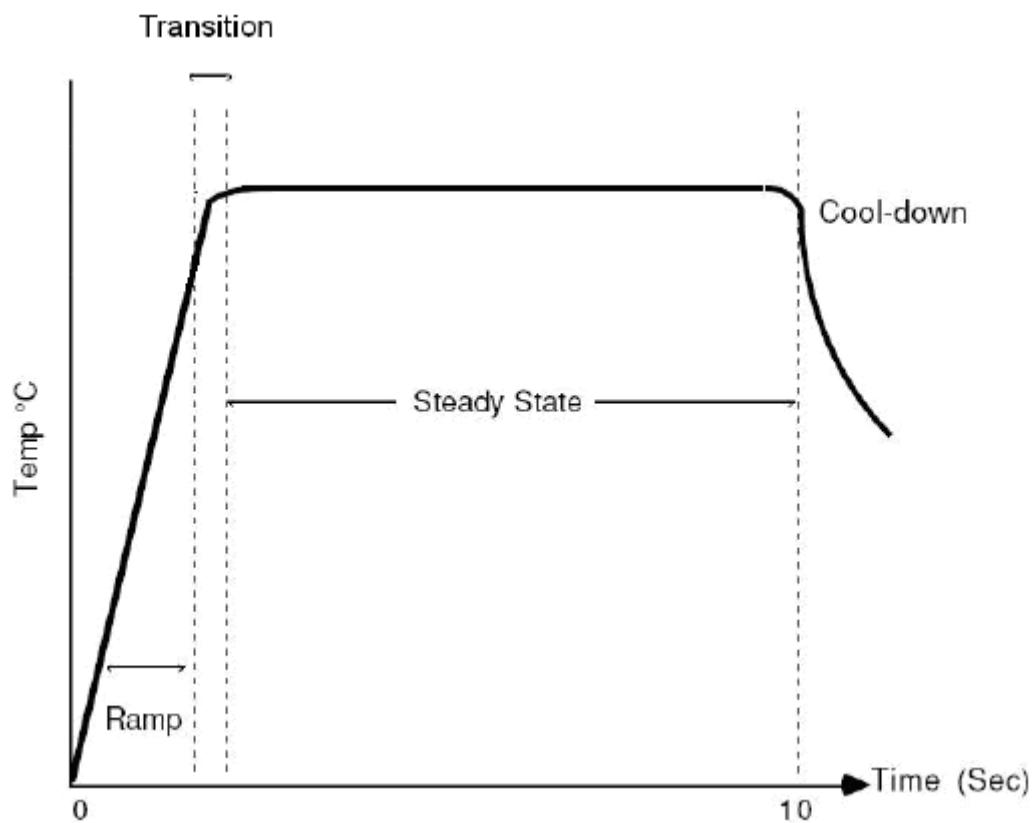


Fig.9 Temperature and time profile in a recipe cycle

NANOSYSTEM FABRICATION FACILITY (NFF), HKUST

The interface includes several control panels at the top:

- Exit** button
- RECIPE NAME**: ANL750
- EXT**: RCP
- HAFFER TYPE**: HAFFER RH-07
- Use SYSTEM**: Pyro Offset
- Pure Offset**: 1.00
- TC Offset**: 1.00
- Save** button
- BANK FACTOR**: RESET
- USE SYSTEM**: BANK FACTOR
- SENSOR TYPE**: PYROMETER
- Use SYSTEM**: Emissivity
- Emissivity**: 1.00
- SENSITIVITY**: 1.00
- TURN OFF GAS AFTER PROCESS (No)** button
- RECIPE HEAD** button
- BANK CONTROL** button
- Psu1 Limit**: 1.00
- Psu2 Limit**: 1.00
- DELAY**: 1.00
- Gain**: 1.00

The main table contains the following data:

| No. | Step Temp Func | Time (sec) | Temp/Intrn (%/%) | Steady Intrn Factor | Gas 1 N2/Ar SLPM | Gas 2 O2 SLPM | Gas 3 Ar2/H2 SLPM | Gas 4 HCL SLPM | Gas 5 N2 SLPM | Gas 6 Ar2 SLPM | Steady Intrn |
|-----|----------------|------------|------------------|---------------------|------------------|---------------|-------------------|----------------|---------------|----------------|--------------|
| 1 | Delay | 20.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 |
| 2 | Intrn | 10.0 | 15.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 |
| 3 | Ramp | 30.0 | 750.0 | 1.00 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 |
| 4 | Steady | 40.0 | 750.0 | 1.00 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 |
| 5 | Delay | 30.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 |
| 6 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

At the bottom, there are navigation buttons: ↑, ↓, Page Up, Page Down, Ctrl-Ins LINE INSERT, Ctrl-Del LINE DELETE, Ctrl+F7 LINE COPY, Ctrl+F8 LINE PASTE, RECIPE NEW (F7), RECIPE BRPM (F8), and RECIPE VALIDATE (F10).

Fig.10 Recipe editor

Definition:

Delay – Instruct the controller to turn the lamps off while setting and maintaining the setpoint of the other controlled parameters (i.e. Gases), until the specified time spent in the step has elapsed.

Ramp – Instruct the controller to increase the temperature at a constant rate until the specified temperature has been reached.

Steady – The controller increases and decreases the lamp intensity so the specified temperature can be maintained.

Finish – Finish ends the recipe. This is the last step in the recipe. Once the process controller sees a “FINISH”, it stops all processing.

Steady Intrn factor – It is a coefficient used only during RAMP and STEADY steps. It is used at the beginning of the steps to correct the initial lamp power intensity. This factor can be adjusted if the temperature is overshoot or undershoot during ramp or transition.

NANOSYSTEM FABRICATION FACILITY (NFF), HKUST

3. If no recipe parameters are being changed, Click “Exit” and then click “START PROCESS” to start the process (Fig.11).

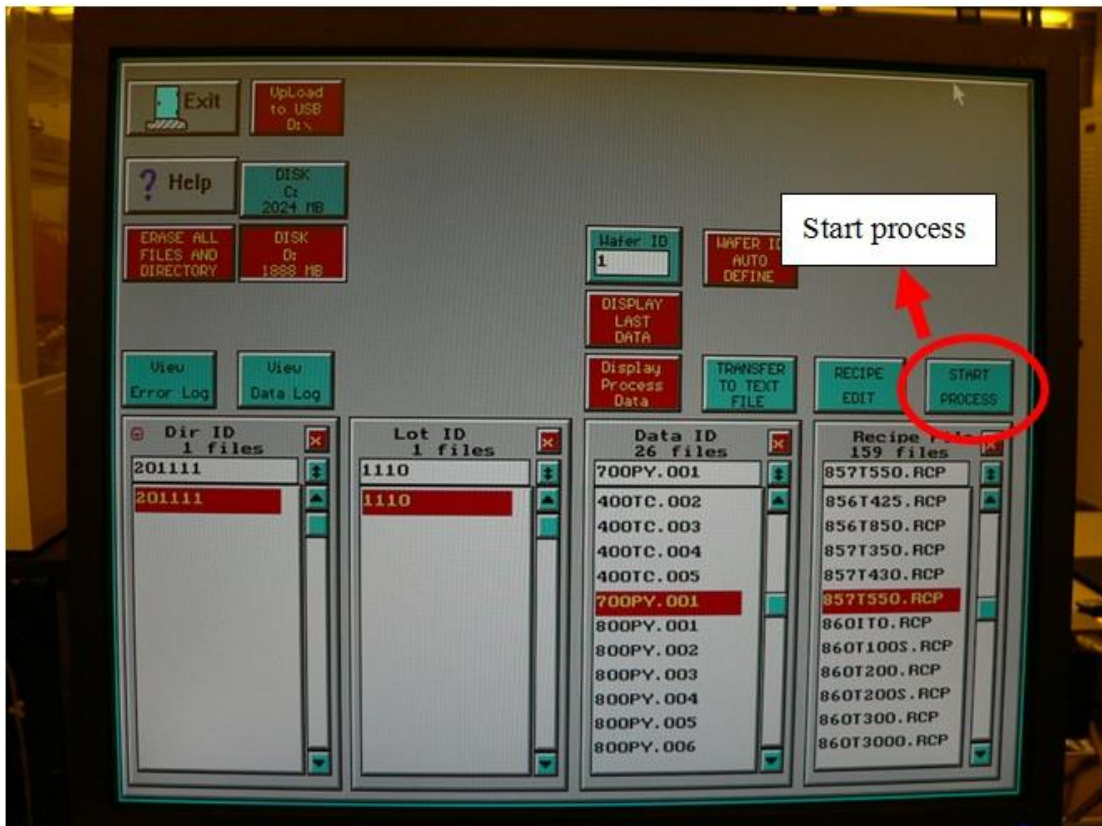


Fig.11 “START PROCESS” button

4. If recipe parameters have to be changed, choose the boxes, change the numbers and click “Enter”. To save the new settings, click “RECIPE VALIDATE” first. Click “Yes” on Popup message “Congratulation! Validation Success!” and then click “Save”. After that, click “Exit” to exit this page and click “START PROCESS” to start the process (Fig.12).

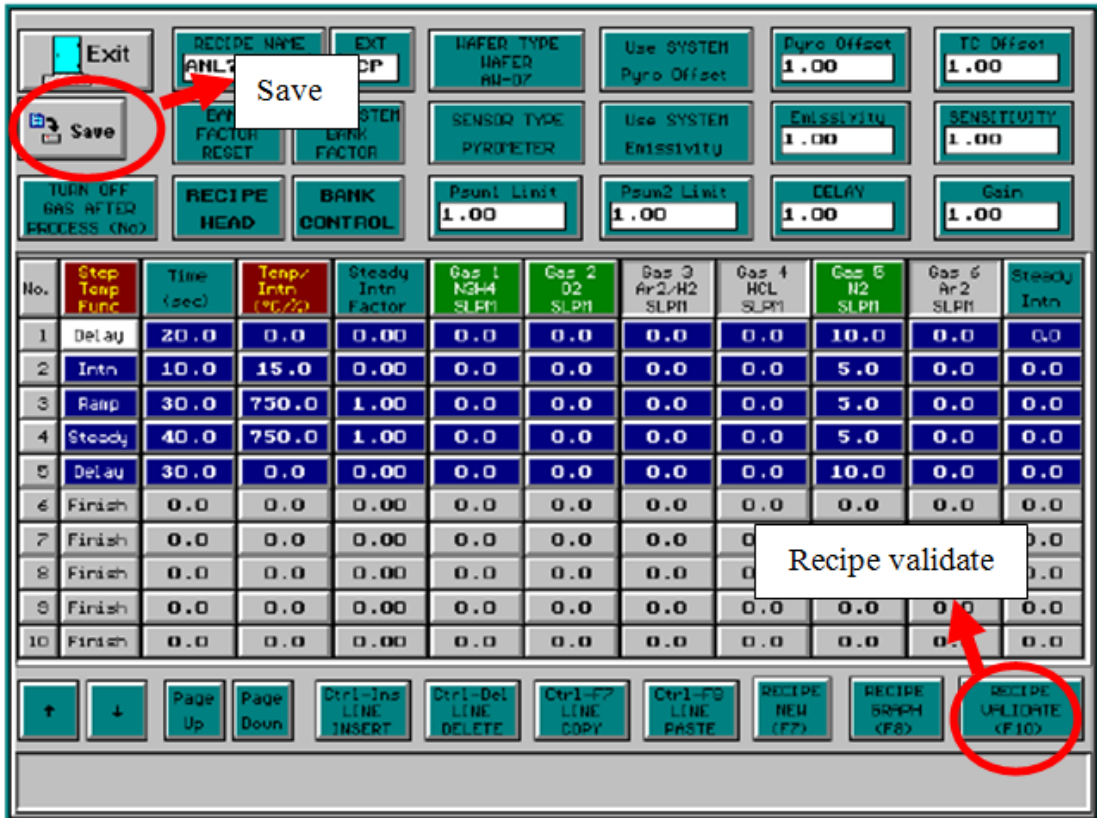


Fig.12 “RECEIPE VALIDATE” and “SAVE” buttons

Remark: For setting a new recipe, please contact NFF staff.

4.6.3 Start the process

1. Once click “START PROCESS”, the process monitor screen comes out (Fig.13). In figure 13, the x-axis indicates the process time (in second) and the y-axis indicates the measured process temperature. There are four curves to display the monitored process:

Green: The recipe temperature as defined by the Recipe

Black: The model temperature curve

Blue: The real (measured) temperature during the wafer process

Red: The lamp intensity (in power %) during wafer process

Light blue: The temperature feedback from TC



Fig.13 Process monitor screen

2. Monitor the parameters during wafer process. **Don't go away while machine is running and keep monitoring the process until completed.** If parameters are out of range, alarm message may come out and you should report to NFF staff.
3. The process may be interrupted and stopped by pressing “STOP NOT SAVE” button. This will turn off the lamps.
4. At the end of the process, “PROCESS OVER” will be printed over the process monitor screen and be blinking in different color. (Fig.14) Click “STOP NOT SAVE” button to exit the process monitor screen.

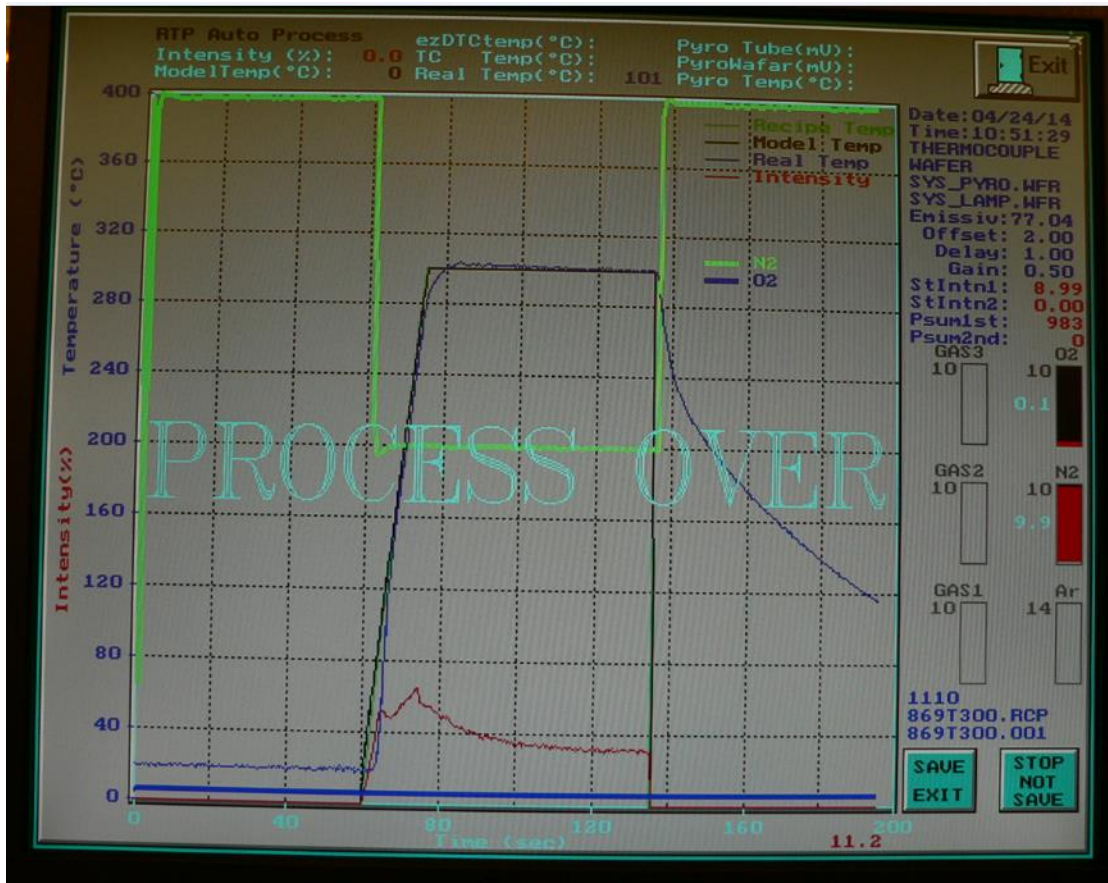


Fig14. Process over on the process monitor screen

4.6.4 Unload the samples

1. Make sure the cooling time is enough so that the temperature shown on the panel is about room temperature ($\sim 20^{\circ}\text{C}$).
2. Pull the handle and the door, unload the samples carefully and check the condition of the equipment (eg. Any flakes are found on the quartz tray. If yes, cleaning is needed.)
3. Close the door slowly and push up the handle to lock it.

4.6.5 Shut down the equipment after use

1. Make sure that the equipment is not running any processes and it is in “idle” status. Temperature should be about room temperature ($\sim 20^{\circ}\text{C}$).
2. Switch off the power switch of the equipment.
3. Switch off the monitor.
4. Close O_2 and N_2 valves underneath the floor.
5. Close the valve of CDA regulator.

NANOSYSTEM FABRICATION FACILITY (NFF), HKUST

6. Close the valve of water supply **FIRST**.
7. Then close the valve of water return after step 6.
8. Check out the equipment through NFF web site.
9. Pass the completed check list to NFF staff.

Remarks:

- If continuous annealing process is needed, at least 5 to 10 minutes of cooling time is required in between two annealing processes.
- Maximum temperature for the wafer process is 850°C for 30 seconds.
- Please reserve sufficient time to run the wafer process and arrange the last 15 minutes for cooling.
- No **PHOTORESIST** is allowed in wafer annealing process.