

# Bay1 Headway Research PWM32-PS Programmable Spin Coater Standard Operating Procedure

Version: 1.0

January 2014



UNIVERSITY OF TEXAS AT ARLINGTON



# Nanotechnology Research Center

## TABLE OF CONTENTS

<b>1. Introduction.....</b>	<b><a href="#">3</a></b>
1.1 Scope of Work.....	<a href="#">3</a>
1.2 Description.....	<a href="#">3</a>
1.3 Safety.....	<a href="#">4</a>
<b>2. Hardware.....</b>	<b><a href="#">7</a></b>
<b>3. Requirements.....</b>	<b><a href="#">8</a></b>
3.1 Training.....	<a href="#">8</a>
3.2 System Restrictions.....	<a href="#">7</a>
<b>4 Operating Procedures.....</b>	<b><a href="#">8</a></b>
4.1 System Pre-Checks.....	<a href="#">10</a>
4.2 Operating the Headway Research PWM32-PS spin coater.....	<a href="#">11</a>
<b>5 Technical Information.....</b>	<b><a href="#">17</a></b>
5.1 Lithography Troubleshooting .....	<a href="#">17</a>
5.2 Pre-Set PWM32-PS Spin Coater programs (Do not change)...	<a href="#">17</a>
5.3 Sequence Programming of the PWM32-PS Spin Coater Unit .....	<a href="#">20</a>

## 1.0 INTRODUCTION

### 1.1 Scope

These procedures apply to the Headway Research PWM32-PS Programmable Spin Coater located in Bay1 yellow room spin coater station.

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 Headway Research PWM32-PS programmable Spin Coater offers high acceleration, high torque, adjustable spinning speeds, electronic speed regulation, automatic cycle and breaking to rotate small sample pieces, glass slides, and up to 6" diameter wafers to uniformly coat photo resist, polyamide, HMDS, SOG and spin- on dopants across the surface of the sample.

The PWM32-PS spinner series offers microprocessor sequence control for up to 9 steps in one recipe, manual speed adjustment while a recipe is running, manual chuck vacuum override, LCD interface for user inputs and process display, abort circuit, start/abort switch and fail-safe vacuum interlocks.



The PWM32-PS Spin Coater 7.9" diameter bowl assembly is a two piece insert mounted in a rectangular box with a polyethylene splash deflector is capable of spin coating up to 6" diameter substrates. The bowl arrangement is designed for minimum space requirements.

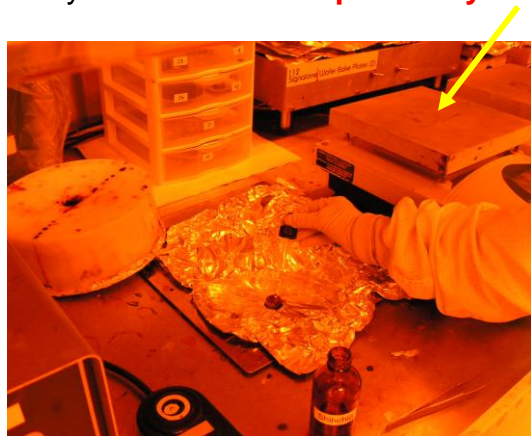
**The Bay1 Headway Research PWM32-PS Spin Coater is restricted to spin coating Semiconductor substrates, devices, glass slides for Photolithography resist coating, Polyamide, HMDS, SOG and spin on dopant processes only.**

**No solvents (acetone, methanol, IPA, etc.) should be spin coated on wafers. No solvents**

**should be sprayed anywhere on the spinner, wafer or on the spinner chucks.  
Any other use of the Spin Coater requires Staff approval.**

### 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 Do not spin coat materials if the **House Solvent Exhaust** is not working properly or the relative humidity and temperature are out of spec. If you encounter any of these malfunctions contact NanoFAB staff immediately.
- 1.3.3 The spin Coater bowl is in close proximity to the hot plate #1, be careful when drop casting your material so not to burn your arm. **The hot plate may be up to 300C°.**



- 1.3.4 No Solvents (acetone, methanol, IPA, etc.) should be spin coated on wafers. No solvents should be sprayed anywhere on the spinner, wafer or on the spinner chucks. Any other use of the Spin Coater requires Staff approval.**

**DO NOT place COMBUSTIBLE MATERIALS or COMBUSTIBLE CHEMICALS such as Acetone, Methanol and IPA within SIX (6) INCHES (15.24 CM) of the spin coater. NO FLAMMABLE LIQUIDS SHOULD BE IN THE NEAR OF THE SPIN COATER STATION.**

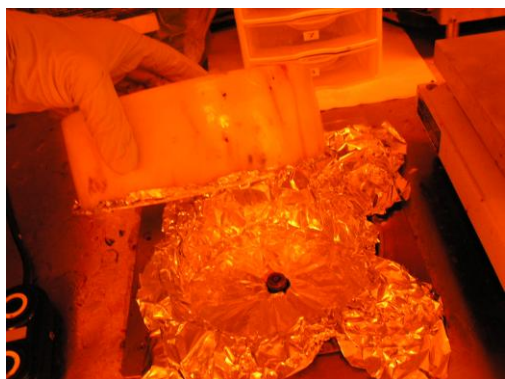
- 1.3.5 Read and understand the **Materials Safety Data Sheets (MSDS)** for all of the chemicals you will be using. Copies of the MSDS are located in BAY1 and TF Yellow Room and or you can find them online or from the vendor.  
<http://www.msdsxchange.com/english/index.cfm>

[illegible]

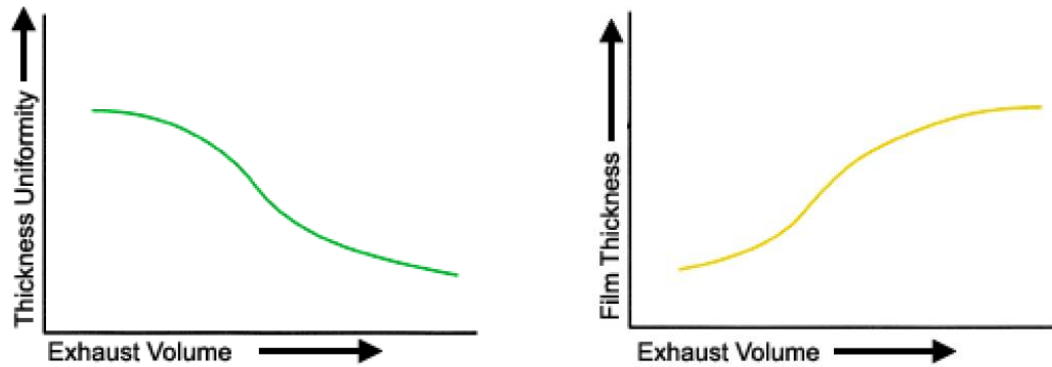
- 1.3.6 Always use appropriately sized vacuum hold down chucks for the size of your sample. All of the vacuum holes and grooves must be covered by the sample. Failure to do so may cause your sample to fly off and break and allow polymers to get inside of the chuck which results in a major cleaning.



- 1.3.7 Always use **polyethylene splash deflector** cover during the spin coating, slow the resist drying process and to minimize humidity variations producing a more uniform thickness across the wafer.








### 1.3.8 Read the posted Spin Coater and Hot Plate usage rules.

When finished coating your wafers collect all used photoresist containers, resist coated wipes, aluminum foil bowl liners and properly dispose of these items in the resist waste container (**lined green container**) located to the rear of the spinner station. To clean resist spills or droplets from the bench top use a damp (Acetone, IPA) clean room paper to wipe clean. Call Nanofab staff if you have questions or need assistance.

2/28/07

#### Bay 1 Spin Coater Usage Guidelines


- 1. Use clean vacuum chucks.
- 2. The sample must cover all vacuum grooves by using the appropriate size vacuum chuck.
- 3. If resist or other spun material gets under foil lining clean affected area with Acetone/Kimwipe wipe down.
- 4. Acetone should not be directly sprayed in the bowl. The bowl should be wiped with a moist wipe.
- 5. **Replace spin coater foil lining after every use.**
- 6. Dispose the photo resist contaminated wipes and foil in the dedicated waste can.
- 7. When finished coating and cleaning enter required information in the log book.



11/10/09

#### 3AY1 Cole Parmer Photolithography Hot Plate (HP) Usage Procedure:

1. Use extreme caution work surface may be very **HOT** (up to 300C).
2. Cover hot plate top surface with Aluminum foil for all runs.
3. If resist or other spun material gets under foil lining call staff to clean surface.
4. Cole Parmer HP1 and HP2 general use 30C to 300C is OK.
5. Cole Parmer HP3 is SB bake 90C +/- 5C ONLY.
6. Cole Parmer HP4 is PEB bake 110C +/- 5C ONLY.
7. If the hot plate is OFF press Heat OFF button. The LCD screen will display the actual plate temperature.
8. To set the plate temperature press plate temperature icon. The plate icon will flash.
9. Press the UP or DOWN arrow to the desired value. After 5 secs the plate will start to heat or cool.
10. The LCD display will toggle between TARGET (T) and ACTUAL (A). When both readings are the same heat your sample.
11. When you are finished with HP1 or HP2 change temperature back to 35C and turn hot plate OFF by pressing HEAT OFF button.
12. When you are finished with HP3 or HP4 change temperature




- 1.3.9 Read any posted **NanoFAB Engineering Change Notices (ECN)** for any hardware, process or safety changes before running the tool.

## 2.0 HARDWARE

- 2.0 The PWM32-PS spinner series offers microprocessor sequence control with high acceleration, high torque, electronic speed regulation, automatic cycle control and automatic braking.
- 2.1 The spinner supports up to nine steps in one recipe and has memory capability for up to 10 user defined recipes.
- 2.2 Users can program into each step :
- RPM ( revolution per minute)
  - Ramp (acceleration or deceleration- RPM /minute)
  - Time ( seconds)
- 2.3 The spinner has wide programmable speed range - Standard speed is variable from approximately **50 to 10,000 rpm**.
- 2.4 The spinner has high programmable adjustable acceleration – The minimum acceleration is 100m/sec and the maximum is 1000 rpm/sec.
- 2.5 The PWM32-PS has Automatic Cycle Control - In the automatic mode, the start button initiates a complete spin cycle. Vacuum is automatically applied; spin started and timed, brakes applied at the present time, and the vacuum released. The timer resets for the next cycle.  
**The standard timer range is 1 to 999 seconds.**
- 2.6 The user can manually turn **ON** the vacuum to the chuck overriding the AUTO control.
- 2.7 The unit has Vacuum Interlock Protection - Adjustable vacuum interlock circuit protects the operator and the substrate. If the substrate is not properly seated or if the vacuum source is inadequate, the spinner will not operate. If the vacuum drops during a spin cycle, the machine will stop. A warning buzzer indicates vacuum difficulties when the start switch is pressed.

- 2.8 The spinner is equipped with abort circuit, Start /Abort switch and fail-safe vacuum interlocks.
- 2.9 The spinners PWM32-PS Spin Coater 7.9" diameter bowl assembly is capable of spinning up to 6" diameter substrates. The bowl arrangement is designed for minimum space requirements.
- 2.10 The spinner has a rectangular box with polished stainless steel; stainless steel bowl and fume exhaust port.

## 3.0 REQUIREMENTS

### 3.1 Training

All users must be trained and authorized on the PWM32-PS Spin Coater to use this tool. Training is supplied by a Nanofab staff member please contact the tool owner to schedule training.

### 3.2 System Restrictions

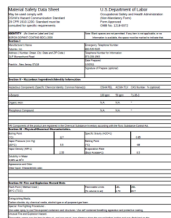
**3.2.1 The PWM32-PS Spin Coater in Bay1 Yellow is strictly restricted to coating semiconductor substrates, devices, glass slides for Photolithography resist coating, Polyamide, HMDS, SOG and spin on dopant processes only.**

**3.2.2 No solvents such as acetone, methanol and IPA are allowed be spin coated on wafers. No solvents are allowed to be sprayed anywhere on the spinner, wafer or on the spinner chucks. Any other use of the Spin Coater requires Staff approval.**

3.2.3 Do not spin coat materials if the **House Solvent Exhaust** is not working properly or the relative humidity and temperature are out of spec. If you encounter any of these malfunctions contact NanoFAB staff immediately.

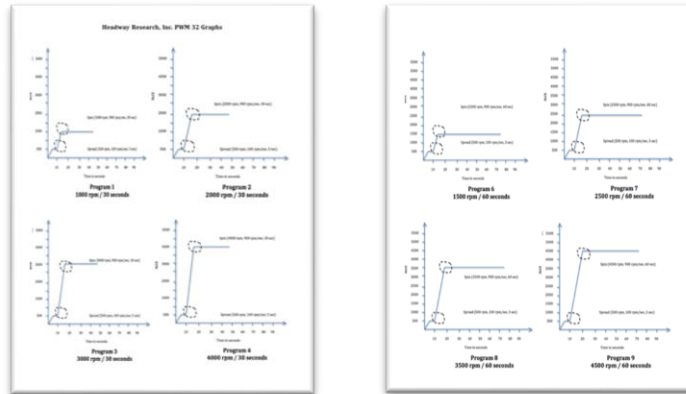
3.2.4 Read and understand the **Materials Safety Data Sheets (MSDS)** for all of the chemicals you will be spinning. Copies of the MSDS are located in BAY1 and TF Yellow Room or you can find them online or from the vendor.

<http://www.msdsxchange.com/english/index.cfm>



3.2.5 Users are **NOT** allowed to change recipes #0, 1, 2, 3, 4, 6, 7, 8, 9. These recipes are frequently used and can be found at the end of this SOP.





### 3.2.6 Users are Only allowed to change recipe #5



3.2.7 Always test the unit and recipe with a dummy wafer 1<sup>st</sup> before drop casting your material to be spun.

3.2.8 Any sample spinning above 6500 rpm requires staff approval.

3.2.9 The Main power switch must be turned **ON** at least 5 minutes prior to operation to allow the controllers sensitive components to reach thermal equilibrium.

3.2.10 Always use **polyethylene splash deflector** cover during the spin coating step to exhaust resist fumes.

3.2.11 Make sure you change the Aluminum foil bowl lining when you are done using the spinner and replace any labeled chucks back into the appropriate shelf. Resist bottles and containers need to be stored in the refrigerator or solvent cabinet. If you are letting the materials reach room temperature keep the container in the resist spin station next to the chuck shelves.



3.2.12 The PWM32-PS spin coater in Teaching Fab is **NOT** on the reservation system, however when you reserve the OAI MBA800, EVG620 or MJB3 Aligner you are able to use Bay1 spinner and the hot plates for processing during your reservation time period.

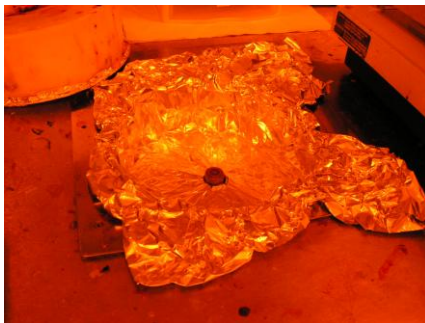


<http://nanofabreservation.uta.edu/>

## 4.0 OPERATING PROCEDURES

### 4.1. System Pre-Checks

- 4.1.1. Check to see if the spinner bowl has been re-lined with new Aluminum foil and is clean. The Aluminum foil should cover the whole bowl completely. The foil can be found on the BAY1 storage rack. If the bowl is dirty inform Nanofab staff.



- 4.1.2. Check to ensure appropriately sized vacuum hold down chucks for the size of your sample is on the chuck vacuum shaft or the chuck storage cabinet. If you cannot locate the correct chuck look in **TF Yellow room** spin station or call Nanofab staff.



**TF Yellow room** spin station

- 4.1.3. Check to ensure the **polyethylene splash cover** is on the spin station.



## 4.2. Operating the Headway Research PWM32-PS Spin Coater .

- 4.2.1. If you have not completed the **System Pre-Checks** in steps 4.1.1 – 4.1.3 then you must complete those before proceeding.
- 4.2.2. Remove the **polyethylene splash cover** and set it to the side to access the spinner bowl and chuck shaft.

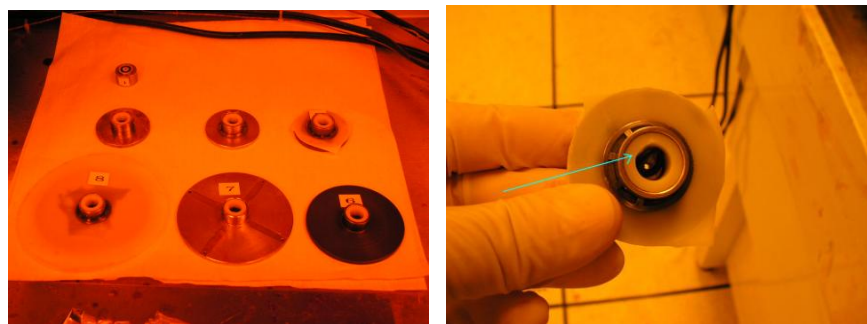


- 4.2.3. Turn **ON** the spinner controller by turning its power switch to the **ON** position.  
*(Main power switch must be turned **ON** at least 5 minutes prior to operation to allow the controllers sensitive components to reach thermal equilibrium.)*

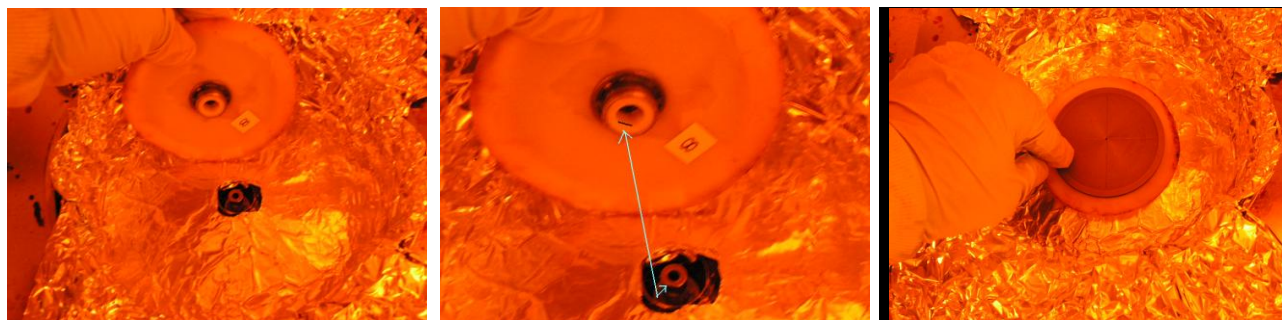


- 4.2.4. Install the right size chuck for your sample on the spinner shaft. All vacuum grooves need to be covered by your sample and check to ensure the vacuum chuck **black oring** is set in the chuck as shown.





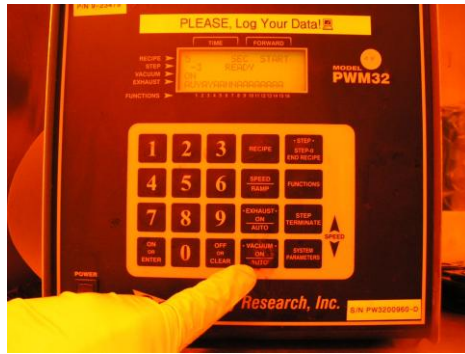
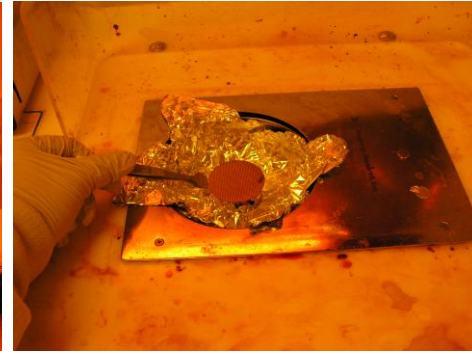
- 4.2.5. Make sure you align the flat on the shaft with the flat on the chuck insert **before** pushing it down several **mm**. If you don't follow this you will damage the chucks Teflon insert.



- 4.2.6. Using substrate tweezers place your wafer or sample on the center of the chuck  
(*Test system and recipe with a dummy or your wafer 1<sup>st</sup> before drop casting resist*).



- 4.2.7. Press the **VACUUM ON** button and check if your sample is held on the chuck by gently pushing/ tapping the edge of your wafer your tweezers.

Vacuum button **ON** switch

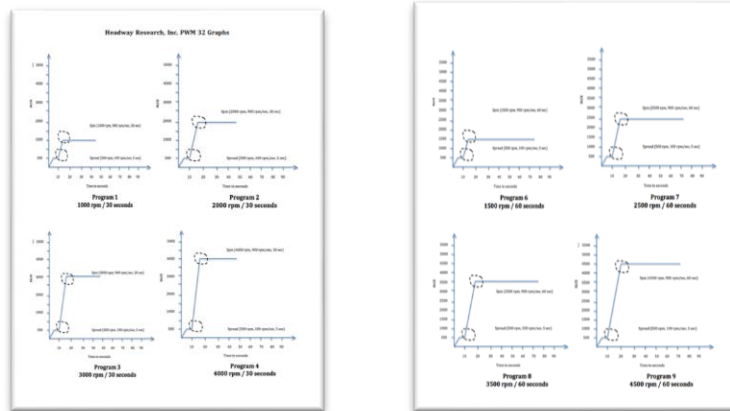
tap the edge of your wafer your tweezers.

- 4.2.8. Select the appropriate recipe on the controller by pressing the **RECIPE** button followed by a number key. The selected recipe is displayed in the upper left hand corner of the LCD screen.



- 4.2.9. There are total of ten recipes with numbers 0 through 9. Number 0 is reserved for staff (to troubleshoot) and **recipe number 5 is for USER's to customize**. Frequently used recipes are numbers 1-4 and 6-9 and must **NOT** be changed. Recipe number 1-4 and 6-9 can be found in section:
- 5.2 Pre-Set PWM32-PS Spin Coater programs (Do not change)**



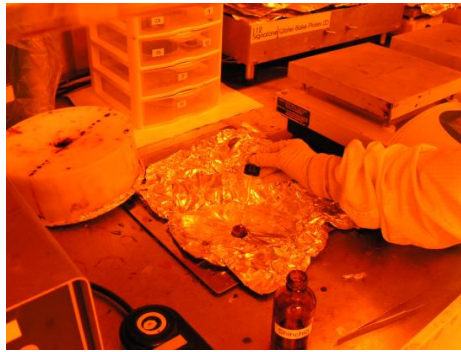


- 4.2.10. If the recipe you want is available then select that recipe per step **4.2.8** and proceed to step **4.2.12**
- 4.2.11. If the recipe you need is not among these (1-4, 6-9) you must create the recipe using recipe # 5 only. To create a customized recipe go to section and follow the steps.
- 5.3 Sequence Programming of the PWM32-PS Spin Coater unit (#5 ONLY)**
- 4.2.12. Run dummy test run to test the system and recipe.  
(for any machine malfunctions or vacuum errors call staff) .
- 4.2.13. Press the start button switch as shown (start button has a letter “s” on the switch).

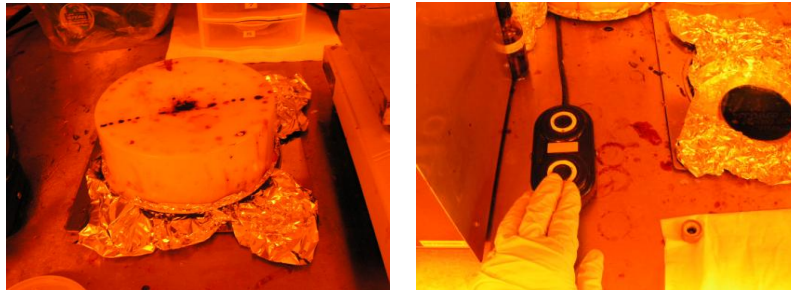


**Start button has a letter “s” on the switch**

- 4.2.14. If you need to abort the spin sequence press the abort button switch labeled “a” followed by the “s” button to reset the abort command.
- 4.2.15. For any machine malfunctions or vacuum errors call staff.
- 4.2.16. If the spin recipe completes without errors then drop cast your photoresist or other material that you want to spin-coat on your wafer using an eyedropper or pipette covering 80% to 100% of the sample. This amount of dispensed material generally gives a better coating.



- 4.2.17. Place the **polyethylene splash cover** over the spinner bowl and press the start button switch (start button has a letter “s” on the switch) to start the spin-coat on your device wafer.



*Start button has a letter “s” on the switch*

- 4.2.18. After the spin coating is complete remove the **polyethylene splash cover** and place to the side to access your wafer. Press the **VACUUM ON** button on the controller to release wafer vacuum and remove your wafer with your wafer tweezers.



*Vacuum button **ON** switch*

- 4.2.19. If you are done spin coating all your wafers carefully remove the dirty bowl foil liner and place in the resist contaminated container. Re-line the bowl with new Al foil and carefully reinstall the wafer chuck and dummy wafer.



**Note :** Make sure you align the flat on the shaft with the flat on the chuck insert before pushing it down several mm. If you don't do this you will damage the chucks Teflon insert.

4.2.20. Replace the **polyethylene splash cover**.



4.2.21. Turn the controller OFF by switching the power switch to the **OFF** position.



4.2.22. Return your photoresist, polyimide, SOD,SOG bottles back into the appropriate storage areas ( do not leave them out )



4.2.23. Enter the required information in the logbook.

[illegible]

## 5 Technical Information

## 5.1 Lithography Troubleshooting

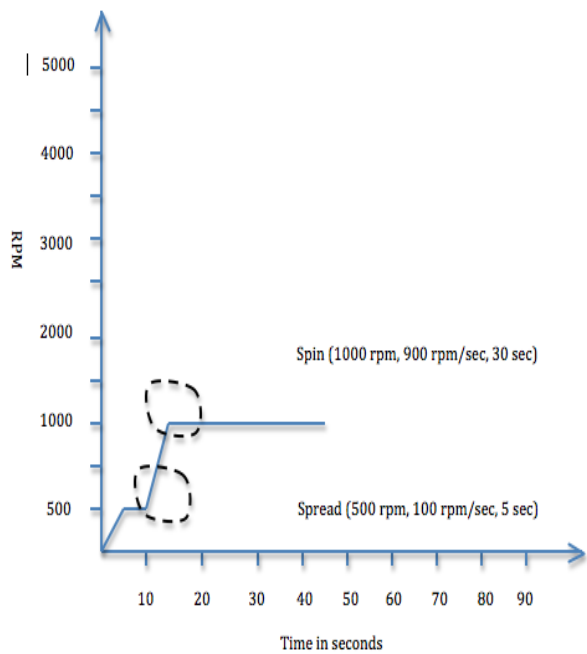
5.1.1 [http://www.microchemicals.eu/technical\\_information/lithography\\_trouble\\_shooting.pdf](http://www.microchemicals.eu/technical_information/lithography_trouble_shooting.pdf)

5.1.2 If you are using **glass slides** or very thick substrates (they transfer heat slower than the standard 300µm to 500µm thick Si wafers) first choose the soft bake and post exposure bake temperatures you require.

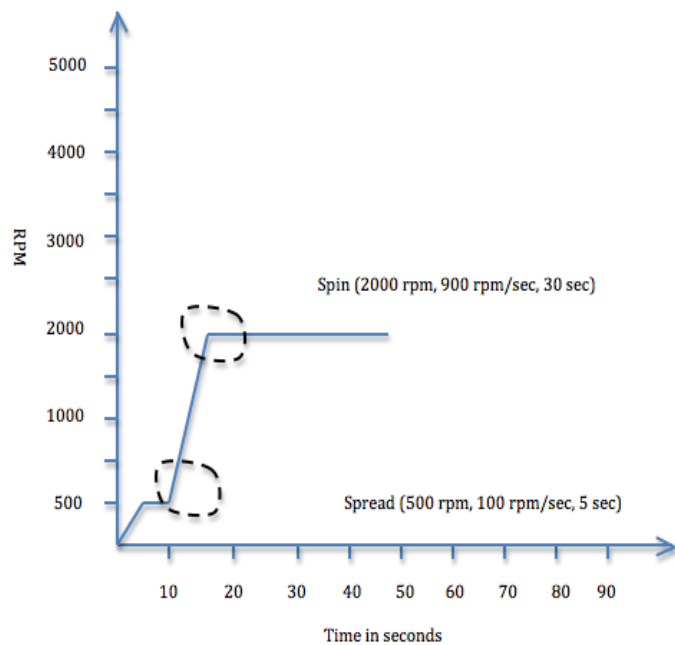
### 5.1.3 Then run a test :

Put the slide on the hot plate at the temperature selected, use the portable TC probe and record the time it takes for the top of the glass slide to reach the soft or post exposure bake temperature then add this time to the soft bake temperature you are using for the process. For glass slides or very thick substrates material do this for both types of positive or negative photoresist .

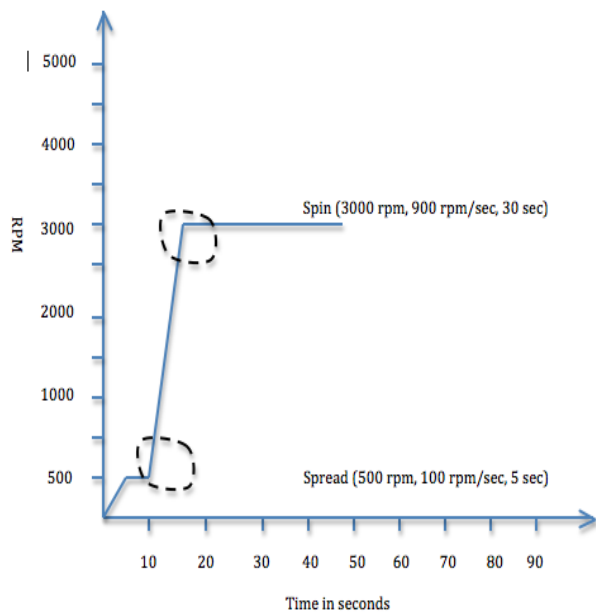
## 5.2 Pre-Set PWM32-PS Spin Coater programs (Do not change)



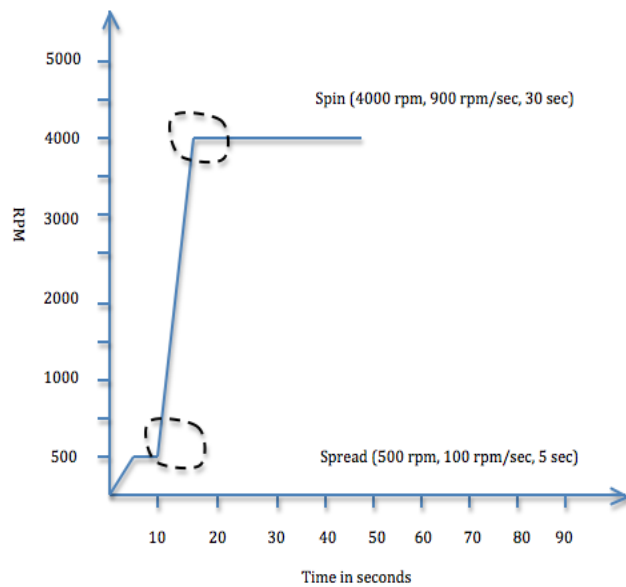
**Program 1**  
**1000 rpm / 30 seconds**



**Program 2**  
**2000 rpm / 30 seconds**

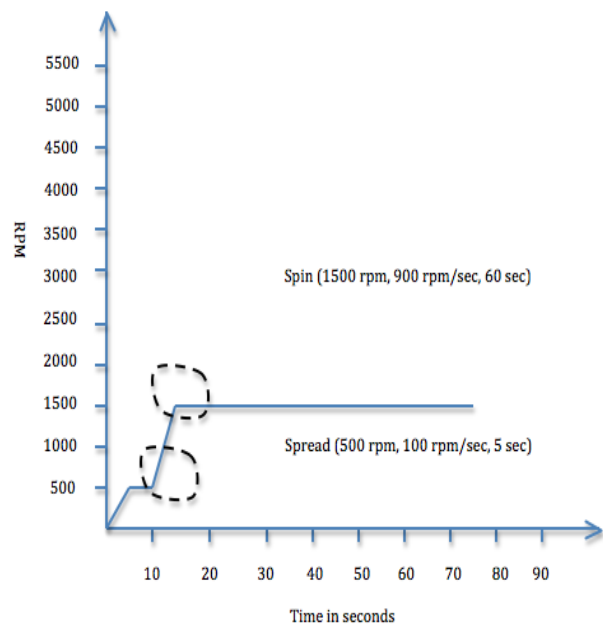


**Program 3**  
**3000 rpm / 30 seconds**

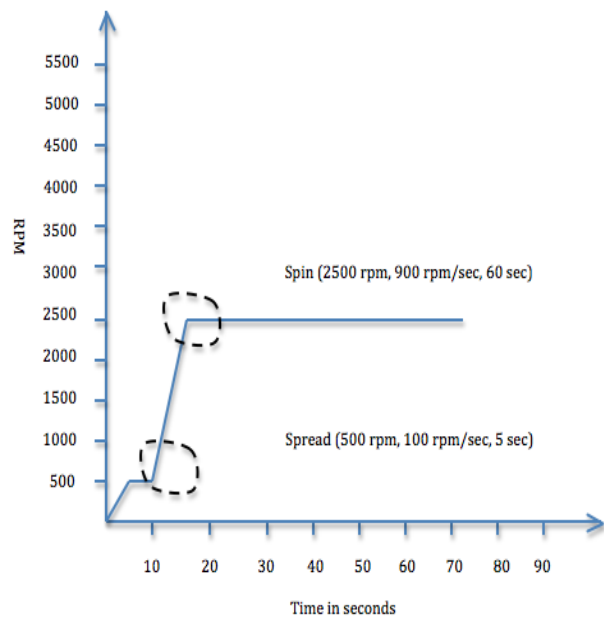


**Program 4**  
**4000 rpm / 30 seconds**

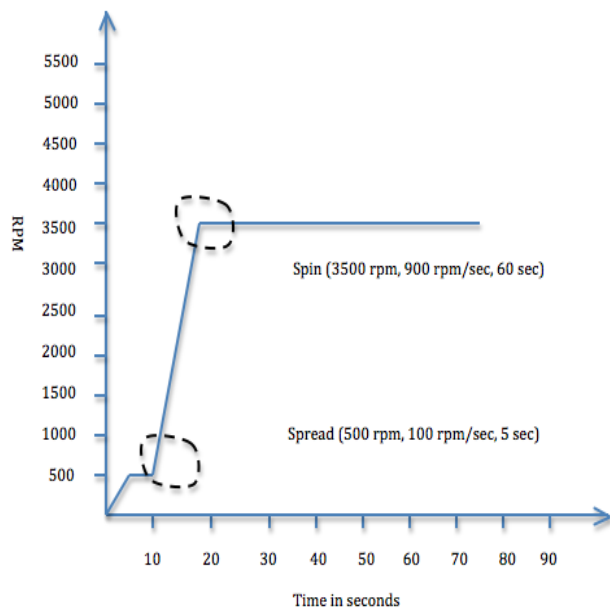




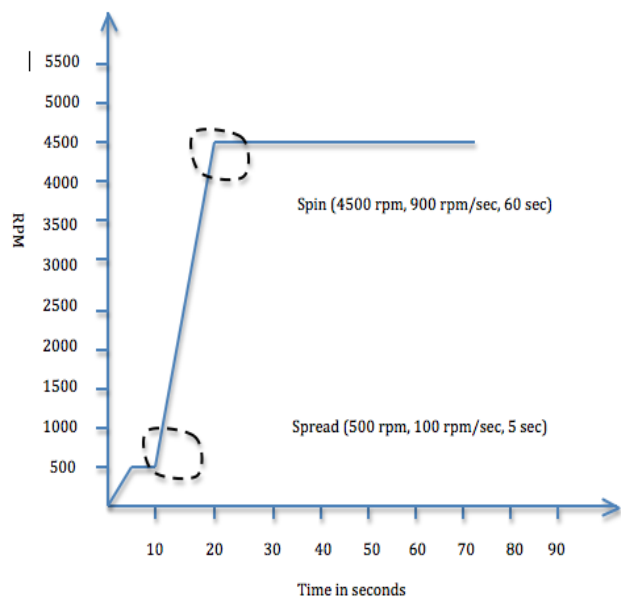
**Program 6**  
**1500 rpm / 60 seconds**



**Program 7**  
**2500 rpm / 60 seconds**



**Program 8**  
**3500 rpm / 60 seconds**



**Program 9**  
**4500 rpm / 60 seconds**

### 5.3 Sequence Programming of the PWM32-PS Spin Coater unit (#5 ONLY)

- 5.3.1 To make a custom recipe press **RECIPE** then **CLEAR** and then the number **5**.  
(This will delete the recipe at position 5 and then you can enter your recipe)



- 5.3.2 If you do not want to delete recipe 5 but just want to modify then press **RECIPE** and then the number **5**



5.3.3 Press **STEP** and the number **1**. Now you can edit step 1



5.3.4 Press **SPEED/RAMP** and enter the desired speed for step1 ( rpm ) using the number keypads and then press **ENTER**. The maximum speed is 6500 rpm.



5.3.5 Press **SPEED/RAMP** again and enter the desired ramping acceleration (rpm / second) for step1 using the number keypads and then press **ENTER**. The minimum acceleration is 100 rpm /sec and the maximum is 1000 rpm/sec.

**Note :** Ramp will either be acceleration or deceleration depending if the current speed is higher or lower than the previous step speed

- 5.3.6 Press **STEP TERMINATE** and enter the spin time (seconds) for step1 using the numeric keypad and then press **ENTER**. This is the time the spinner will stay at the speed (rpm) entered for this step.



- 5.3.7 Press **STEP** and then the number **2** to modify or create step 2. Follow the same procedure as for step 1 (5.3.4 to 5.3.6). Each recipe can have a maximum of 10 steps.

**Note :** A single step in a recipe cannot be deleted, however **STEP TERMINATE** can be set to **0** to skip it.

- 5.3.8 After you are finished entering all steps press **STEP** and then **0** to save the recipe.



- 5.3.9 Proceed to section 4.2.12 and run a test wafer to check the system and recipe

