Photolithography SOP

1. Scope

1.1 This SOP describes the basic process of photolithography. This includes preparing samples, using a spinner to deposit photoresist, baking samples, exposure to UV light and developing.

2. Table of Contents

1. Scope 1
2. Table of Contents 1
3. Reference Documents 2
3.1 Referenced within this Document 2
3.2 External Documents 2
4. Equipment and/or Materials 2
5. Safety 2
6. Setup Procedures 3
7. Photolithography Process 3

7.1 Sample Preparation 3
7.2 Applying Photoresist using solitec spinner 3
7.3 Wafer baking 5
7.4 UV Exposure using the Suss aligner 5
7.5 Develop 6
8. Clean Up 7
9. Revision History 7

Figure 1, Spinner Controls 3
Figure 2, Hotplate Controls 5
Figure 3, UV Intesity Meter 5

Table 1, Photoresist Amounts 4

3. Reference Documents

3.1 Referenced within this Document

3.1.1 Suss Aligner SOP.

3.2 External Documents

3.2.1 None.

4. Equipment and/or Materials

4.1 Photoresist-S1813, LOR 10B, or AZ9260

4.2 Solitec spinner

4.3 Wafer Baking hot plate

4.4 Suss Aligner

4.5 UV intensity meter

5. Safety

5.1 Follow all Nanofab safety procedures.

5.2 Wear white gloves over the blue gloves when working with photoresist at the spinner and at the wet bench.

5.3 Wear blue gloves when using the aligner and UV meter.

5.4 Replace cap on photoresist bottle as quickly as possible to avoid inhaling toxic fumes.

5.5 Dispose of all photoresist contaminated pipettes and materials in the vented trash can.

WARNING

PHOTORESIST IS A HAZARDOUS CHEMICAL

6. Setup Procedures

6.1 Check that all of the chemicals and materials you need are available before starting.

6.2 Set Hot Plates to desired temperatures.

7. Photolithography Process

7.1 Sample Preparation

7.1.1 Blank Si

7.1.1.1 Dip wafer in BOE for 30 seconds

7.1.1.2 DI rinse for 2 minutes

7.1.1.3 N2 dry

7.1.1.4 Bake on hot plate at 150 °C for 5 minutes

7.1.1.5 Allow wafer to cool for 2 minutes

7.1.2 Wafer with metal deposited on it

7.1.2.1 Bake on hot plate at 150°C for 5 minutes

7.1.2.2 Allow wafer to cool for 2 minutes

7.2 Applying Photoresist using solitec spinner

7.2.1 Open the lid by flipping the Process Head switch to up

7.2.2 Place prepared sample on the center of the chuck in the solitec spinner

7.2.2.1 Always use a chuck that is smaller than your sample.

7.2.3 Press the white vacuum button

7.2.3.1 If the Orange Vacuum indicator light does not turn off

7.2.3.1.1 Turn off the vacuum

7.2.3.1.2 Check the placement of the sample and the chuck.

7.2.3.1.3 Turn on the vacuum

7.2.3.1.4 If the orange vacuum light goes off continue to the next step

7.2.3.1.5 If the Orange Vacuum light does not turn off contact staff to fix the problem

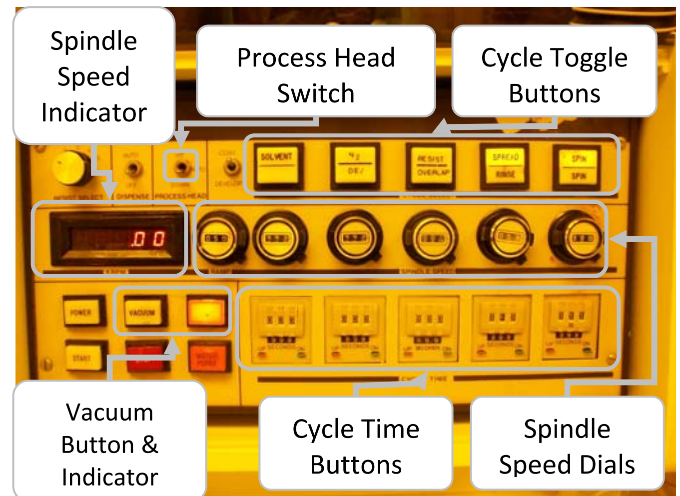

Figure 1, Spinner Controls

7.2.4 Press the start button

7.2.5 Check how centered the wafer is on the chuck

7.2.5.1 If the wafer is not centered

7.2.5.1.1 Turn off the vacuum

7.2.5.1.2 Re-center the wafer

7.2.5.1.3 Turn on the vacuum

7.2.5.1.4 Press the start button

7.2.5.1.5 Check how well the wafer is centered (See 7.2.4)

7.2.5.1.6 Repeat until the wafer is centered

7.2.6 Set the Spread and Spin speeds and times (See Table 1)

7.2.6.1 On the display panel you will notice a row of large white buttons, a row of black dials below the buttons and a row of 3 digit numbers with "-" above the numbers and "+" below the numbers below the row of black knobs.

7.2.6.1.1 The Large white buttons control whether that cycle in the process will activate

7.2.6.1.1.1. If the light in the button is on, the step is on

7.2.6.1.2 The black dials control the rpm of the cycle. Turning the knob clockwise increases rpm, counterclockwise decreases rpm.

7.2.6.1.3 The 3 digit numbers control how long each cycle will remain active before moving to the next cycle.

7.2.6.1.3.1. To change the amount of time flip either the "+" or "-" up and press it in

7.2.6.2 There is a digital display to the left of the control buttons and dials which displays the current rpm of the chuck.

7.2.6.3 Set the spread speed to about 600 rpm and the spread time to 10 seconds. (See Table 2)

7.2.6.4 Set the Spin speed to the desired speed and the spin time to 45 seconds. (See Table 2)

7.2.6.5 To accurately set the rpm press start, wait until the cycle you want to adjust activates and adjust the rpm dial until you reach the desired rpm.

7.2.7 Use a pipet to place photoresist on the center of the wafer. For glass slides apply photoresist along the length of the slide. Use table 1 to determine the correct amount of photoresist to apply.

Table 1, Photoresist Amounts

Sample	S1813	LOR 10B	AZ9260		
4" Si	2 ml				
3" Si					
2" Si					
1X3" Glass					
1 cm Glass					

7.2.8 Close the lid on the spinner by switching the Process Head switch to the down position

7.2.9 Press the start button

7.2.10 Wait until the process completes

7.2.11 Open the lid by switching the Process Head switch to the up position

7.2.12 Turn off the vacuum

7.2.13 Remove your sample

7.2.14 Change foil when finished spinning all wafers

7.2.15 Close the lid

7.3 Wafer baking

Figure 2, Hotplate Controls

7.3.1 Place sample on hot plate and bake for desired time and temperature according to table 2

7.3.1.1 To adjust temperature press the “P” button, adjust the temperature using the arrow keys and then push “P” two more times.

Table 2, Pre-Bake Time and Temperature

Parameter	S1813					LOR 10B					AZ9260				
Spin Speed (rpm)	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000	1000	2000	3000	4000	5000
Thickness (µm)	3.06	2.28	1.91	1.74	1.64										
Bake Time (sec.)	60	60	60	60	60										
Bake Temperature (°C)	110					150					110				

7.4 UV Exposure using the Suss aligner

For detailed operating instructions refer to the Suss aligner SOP

7.4.1 Check the UV intensity

7.4.1.1 Get the UV intensity meter located in the right drawer under the Suss Aligner.

7.4.1.2 Turn on the UV intensity meter. Make sure the switch on the side is set to 365 nm and the switch on the right side is set to Norm.

7.4.1.3 Place the circular sensor, with the white circles up, on the wafer holder plate

7.4.1.4 Expose the sensor to the UV light using a lamp test

7.4.1.5 Record the Intensity

7.4.1.6 Deactivate the UV lamp

7.4.1.7 Turn off the UV meter

7.4.1.8 Put the UV meter back in the drawer under the Suss Aligner.

7.4.2 Load the mask into the aligner

7.4.3 Load your sample

7.4.4 Using the intensity you recorded, refer to Table 3 to find the exposure time needed

Figure 3, UV Intesity Meter

Table 3, UV Exposure Times (seconds)				
Intensity(mw/cm^2)	S1813	LOR 10B	AZ9260	
5.5	12.7	14.5	72	12 reps of 6 seconds on 30 seconds off
6	11.7	13.3	66	11 reps of 6 seconds on 30 seconds off
6.5	10.8	12.3	60	10 reps of 6 seconds on 30 seconds off
7	10	11.4	55	11 reps of 5 seconds on 30 seconds off
7.5	9.3	10.6	54	9 reps of 6 seconds on 30 seconds off
8	8.8	10	50	10 reps of 5 seconds on 30 seconds off
8.5	8.2	9.4	48	8 reps of 6 seconds on 30 seconds off
9	7.8	8.9	45	9 reps of 5 seconds on 30 seconds off
9.5	7.4	8.4	42	7 reps of 6 seconds on 30 seconds off
10	7	8	40	8 reps of 5 seconds on 30 seconds off
Recommended exposure dose	70	80	400	

7.4.5 Set the exposure time

7.4.6 Align as necessary

7.4.7 Start the UV exposure by pressing the start button

7.4.8 After the UV exposure is finished pull the wafer holder tray out

7.4.9 Remove your sample

7.4.10 Remove your mask

7.5 Develop

7.5.1 Pour some developer into a clean container. Enough to submerge your sample.

7.5.2 Set up a D.I. rinse container

7.5.2.1 Place a chemically resistant container under the sink faucet in the wet bench

7.5.2.2 Fill the container with water

7.5.2.3 Turn the faucet to a low pressure

7.5.3 Place your sample in the developer and gently agitate the container

7.5.4 While agitating the container watch for when the photoresist “clears”

7.5.4.1 The photoresist is considered “cleared” as soon as the red clouds stop coming up from the sample (See Table 4 for approximate develop times and Developer type and concentration)

Table 4, Developer type and concentration and suggested develop time									
	S1813			LOR 10B			AZ9260		
Spin Speed (krpm)	Time (sec)	Developer	Concentration	Time (sec)	Developer	Concentration	Time (min)	Developer	Concentration
1	60	AZ 300 MIF	100%		352	100%		AZ 400K	3:1,water:Dev
2	55	AZ 300 MIF	100%	120	352	100%		AZ 400K	3:1,water:Dev
3	50	AZ 300 MIF	100%		352	100%	5-10	AZ 400K	3:1,water:Dev
4	45	AZ 300 MIF	100%		352	100%		AZ 400K	3:1,water:Dev
5	40	AZ 300 MIF	100%		352	100%		AZ 400K	3:1,water:Dev

7.5.5 Rinse your sample

7.5.5.1 Remove your sample from the developer

7.5.5.2 Place your sample in the D.I. rinse container under running water

7.5.5.3 Rinse for 1 minute

7.5.5.4 Turn off the sink and remove your sample from the rinse container

7.5.6 Dry your sample

7.5.6.1 Hold your sample with tweezers with one edge of the sample and blow dry with an N_2 gun.

7.5.7 Inspect under a microscope.

8. Clean Up

8.1.1 Dispose of developer.

8.1.1.1 Turn on the wet bench sink and gently pour developer in the sink.

8.1.1.2 Rinse out container with D.I. water 3 times.

8.1.2 Replace foil in the spinner.

8.1.3 Clean up all spilled photoresist.

8.1.4 Dispose of all materials containing photoresist in the vented photoresist bin.

WARNING

Failure to clean up results in a $100 fine or three hours of lab service

9. Revision History

Rev	Date	Originator	Description of Changes
0	28 06 2010	Stephen Naylor	Draft
1	21 07 2010	Stephen Naylor	Added Brian Baker’s recommended changes