

Teaching Lab Headway Spinner SOP

The Headway Photoresist Spinner is designed for manual application of photoresist and spin-on products. It accommodates miscellaneous substrates and wafers using an assortment of chucks. It permits accurate control of spin speed and spin time during the spin coating operation. In this lab, we use photoresist S1813 or AZ1512. They have same composition but are named differently due to different manufacturers.

Safety

- Safety glasses must be worn at all times when using this tool.
- The tool has exposed parts rotating at a very high speed. Never place hands or items near the chuck while it is rotating.

Wafer Preparation

To prepare wafer for processing:

1. Rinse the wafer with acetone (don't let acetone dry or it will create a film over the wafer).
2. Immediately rinse the wafer with Isopropanol (IPA) to remove acetone.
3. Rinse the wafer with large quantities of deionized (DI) water.
4. Blow-dry using dry nitrogen followed by a 1 min bake (100°C) to dehydrate the sample.

Spinner Operation

1. Turn the hotplate on using the green switch labelled “Power” (see Figure 1). Make sure that the temperature is set to 100°C, which is the bake temperature for the photoresist (S1813) used in this lab.

WARNING: Wait 20 minutes before using the hotplate. Note that the controller display shows the temperature setpoint, not the actual temperature. The display blinks until the setpoint temperature is reached and stops blinking when the desired temperature is achieved.



Figure 1. Hotplate.

2. Turn the spinner on by pressing the red power switch (see Figure 2).



Figure 2. Spinner Display

3. Turn on the vacuum pump by toggling the switch on the power cord (see Figure 3). Vacuum is required to hold the wafers in place while they are spinning.

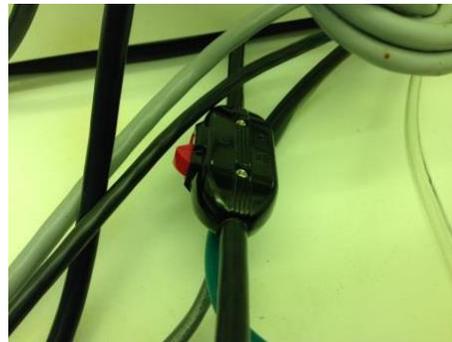


Figure 3. Toggle switch for spinner vacuum pump

4. The spinner has three vacuum chucks shown in Figure 4. Use the 20 mm chuck for 2 inch wafers, center chuck. The smallest (left) chuck should be used only if your sample is too small for the 20 mm chuck. The largest (right) chuck is for 3 inch wafers.



Figure 4 Different spinner vacuum chucks

5. Verify the chuck has an O-ring (see arrow Figure 5). Notice the flat spot on the spin motor shaft fitting. This will mate to the flat spot on the spin motor shaft.



Figure 5. Spinner chuck with O-ring

6. Push the chuck down **firmly** on the spin motor shaft.
7. Place a wafer **centered** on the chuck.
8. Adjust the spin speed dial to the desired rotation speed (RPM), see Figure 6.



Figure 6 Spinner display indicating spin speed dial

9. Start the spin motor by stepping on the foot switch located on the floor (see Figure 7). The back of the foot switch stops the spin motor.



Figure 7 Foot switch for turning spinner ON/OFF

10. If you hear a loud annoying sound when you press on the start switch, the sample is not vacuumed down properly. Before you call NRF Staff, check the following:
 - The vacuum pump is on.

- The backside of the sample is not contaminated and is very flat.
 - The chuck is sealed with a clean O-ring (it may be cleaned by squirting acetone inside the chuck) and pushed down hard on the motor shaft.
 - The chuck vacuum surface is clean. If not, clean it using acetone.
11. Turn the speed up until the motor rotates enough to see if the wafer is centered. Stop and start the motor while adjusting the wafer position. Adjust sample until it has no more than 2 mm of wobble.
 12. Turn the spin speed dial up (see Figure 6) until the desired spin speed is displayed.
 13. Set the spin timer on the right side of the controller. Note that for times greater than 900 second the spinner has to be stopped manually using the foot switch, since the timer is calibrated to measure a maximum of 900s.
 14. Dispense the PR on the wafer.

Dispensing Photoresist on the Wafer

The PR can be dispensed on the wafer either before spinning has started (**static dispense**) or after spinning has started and reached the casting speed (**dynamic dispense**). The static dispense is a simpler method. However, uniformity of a film produced with this method is typically not quite as good as that produced with dynamic dispense. Nevertheless, this uniformity is sufficient for the teaching lab purposes. The dynamic dispense is usually performed for rotation speeds not exceeding 3000 rpm because at higher speeds the pipette centering, dispense rate, etc. become less forgiving.

Dispense Steps

1. Squeeze pipette bulb before submerging in liquid to load to prevent bubbles. Load the pipette with ONLY 1.5 ml of resist.
2. Dispense the photoresist:
 - For the static dispense:
 - i. Dispense PR on a static wafer. The dispensed PR should completely cover the wafer surface.
 - ii. Immediately press the start foot switch.
 - iii. Spin for desired time interval.
 - For the dynamic dispense, perform the following steps when the wafer is spinning at the casting speed:
 - i. Brace your arms against something stationary like the Plexiglas front of the hood.
 - ii. Hold the tip very close (3-5mm) to the center of the sample.
 - iii. Squeeze liquid out as a continuous stream and lightly let up on the bulb to create slight vacuum. Immediately move the pipette out of the spinner. It sounds harder than it is. The objective is to create a continuous stream that

snaps off clean (no dribbling) at the end. There should be no droplets before or after dispense.

Notes:

1. Do not squeeze out the entire content of the pipette when dispensing PR. Otherwise, you will dispense bubbles from the top of the pipette.
2. For photoresist spinning practice or when experimenting with spin speeds and thickness measurements, use the old bottle of S1805. Use the S1813 only if you are going to expose the photoresist.
3. The speed of the Headway spinner cannot be altered once the spinner is in motion, which makes things a little challenging. When more than one speed is available, it is best to dispense photoresist at a low speed (600-1000 rpm) and then immediately (within 2-3 seconds) switch to the casting speed.
4. If the spin time is too short, the produced film is thicker and less uniform than needed. The spin time depends on physical properties of PR (in particular, its viscosity) and can be estimated by a visual observation of the spin-coating process. This is done best in low light conditions (i.e. turn the overhead lamp off inside the hood). As the film thickness decreases during spinning, its color changes due to light interference. At initial stages of spin-coating, the color change is quite frequent due to substantial amounts of PR being spun off from the wafer by the centrifugal force. The frequency of the color change reduces with the spin time. When the sample has spun for about 10 seconds without color change, the film thickness and uniformity should be suitable for photolithography. For S1813 and S1805, the spin time of 1 minute is sufficient to ensure film smoothness at any speed above 1000 rpm.

Post-Processing

1. Remove the sample and verify that the backside of the sample is photoresist free. If your sample is round, it is probably clean. If it has corners, it most likely needs cleaning. Clean with a very lightly dampened acetone wipe or swab. Use very little acetone.
2. Inspect the wafer for uniformity in the yellow light. If it is not uniform, you can remove the PR with acetone, then rinse with IPA and DI water, blow-dry with nitrogen, bake on the hotplate at 100°C for 90 seconds, and try again.
3. Place the wafer DIRECTLY on the hotplate surface. Do not use an old silicon wafer or a wipe as a base for the new wafer on the hot plate. Bake for 90s to vaporize the solvent. Remove wafer and allow cooling for 30s.
4. Measure film thickness using Filmetrics. Remember to take at least 3 measurements at different sample points to compute the standard deviation to estimate smoothness of coating.

Shut Down

1. When finished, use acetone squirt bottle to flush out the spinner bowl. The bowl is connected to a drain bottle. Wipe the remaining acetone up with lab wipe. Place the wipe in the black plastic box behind the spinner, not in the red solvent waste container.
2. Clean any photoresist spills.
3. Turn off hotplate, spinner and vacuum pump when done.