

Standard Operating Procedure: Spinner

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Hardware Description and Principle of Operation

Brewer Science Spin Coater

The Brewer Science Cee stand-alone spin coater / hotplate is dedicated for the spinning of electron beam resists. The tool is capable of spin coating substrates up to 7" square or 200-mm round and features high torque for maximum ramping capability. You can also spin coat smaller size substrates (<1-cm through 200-mm) using a wide array of spin-coating chuck sizes. The precision hotplate has a temperature range from ambient to 300°C with resolution of +/- 0.1°C and uniformity of 0.3% across the working surface.

Two additional Brewer Cee spin coaters are located in the fume hoods in the lithography bay. Spin coater # 2 is dedicated for photoresist processing, and spin coater # 3 is dedicated to all other non-standard materials, such as spin-on glasses, PVA, PPC, charge spreading layers for e-beam, and 3D laser lithography resists. The tools are capable of spin coating substrates up to 7" square or 200-mm round and features high torque for maximum ramping capability. You can also spin coat smaller size substrates (<1-cm through 200-mm) using a wide array of spin-coating chuck sizes.

Material Requirements

Equipment: substrate, tweezers, wafer holder, chuck and photoresist/coating liquid

Personal Protective Equipment: nitrile gloves, safety glasses and face mask

Procedure

Estimated Time: <20 minutes

Preparation

1. Remove appropriate photoresist from fridge and place under spinner fume hood. Allow photoresist to warm to room temperature (30 minutes).
2. Set hot plates to appropriate baking temperatures and label the set temperature on the knob.
3. Lay down aluminum foil in spinner bowl.

Edit/Load Recipe

1. Press the **Edit** tab.
2. If editing an existing recipe:
 - a. Select **Load**, select the recipe to be edited, and press **ENTER**.

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- b. Select **Edit Recipe**.
 - c. Change the parameters and press **Save**. Enter recipe name and press **ENTER**.
 - d. If you are changing an existing recipe, press **Save** and press **ENTER** and press **Yes** to overwrite the old recipe.
3. If creating a new recipe:
 - a. Enter process parameters.
 - b. Select **Save**, enter recipe name and press **ENTER**.

Load Sample

1. Open spinner door.
2. Attach appropriate size chuck for the substrate to be coated. Align the notch on the inside of the chuck with the pin on the spindle shaft.
3. Select the **Run** tab and press **Run Spin Process**.
4. Select **Load** and select recipe you wish to run and press **ENTER**.
5. Center substrate onto the chuck using the wafer holder.
6. Turn vacuum on by selecting **HOLD**. Tap bottom side of the wafer to ensure a strong vacuum seal.
7. Close spinner door.
8. Press **OK** and press **Start Centering** to center wafer.
 - a. If substrate is not centered, turn off vacuum, remove substrate and re-center substrate with the wafer holder.
 - b. Turn on vacuum and select **Center**.
 - c. Repeat until wafer is centered.
9. Spray nitrogen gun on surface of the substrate to remove any contaminants.
10. Dispense photoresist or chemical onto the wafer.
 - a. Do not dispense an excessive amount. Covering <75% of the wafer is sufficient.
11. Select **Run** to run recipe.
12. When the recipe is complete, open the spinner door.
13. Remove substrate.

Cleanup and Waste Disposal

1. Remove wafer chuck.
2. Remove aluminum foil and dispose of the foil in the hazardous waste trash can.
3. Wipe down bowl, door and bench with acetone and dispose of wipes in the hazardous waste trash can.
4. Dispose of any used pipettes or swabs in the sharps container.

Emergency Stop

Critical

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- If the tool is smoking or a gas leak has occurred, press the EPO button if possible and leave the cleanroom.

Non-Critical

- Press **ABORT** on the screen to stop the recipe.

Allowed Activities

- Solvent clean substrate.
- Process multiple chemicals on one substrate.
 - o Be sure to press **Hold** in between recipes. Vacuum will turn off at the end of a complete recipe.
- Temporarily bond pieces to a 4" wafer and process the stack.
- Use of an adhesion promoter.
 - o Substrate surface should be hydrophobic for resist to coat well and adhere to the substrate.
 - If the surface has oxide or OH-groups, HMDS works well.
 - HMDS can be spin coated on but must be preceded by a dehydration bake at 120°C for 60 seconds.
 - If no oxygen is present, a dehydration bake at 120°C for 60 seconds on a hot plate works.

Disallowed Activities

- Users cannot use samples smaller than the chuck.
 - o 4" Chuck: Samples must be > 4" wafer
 - o Pieces Chuck: Sample must cover o-ring

What to watch out for during operation

- If wafer is wobbling during the process, it is off center.
- Make sure the vacuum is on and the substrate is detected by the software.

Common Troubleshooting Tips

- If vacuum is weak, remove the chuck and turn on the vacuum by pressing Hold. Dispense 3-4 drops of acetone with the dropper into the vacuum opening on the spindle shaft and blow the nitrogen gun down the vacuum opening.

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- o Be careful to not get solvent anywhere but inside the vacuum opening.

Spin-Coating Process Troubleshooting

Film too thin

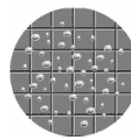
Spin speed too high	Select lower speed
Spin time too long	Decrease time during high speed step
Inappropriate choice of resin material	Contact resin manufacturer

Film too thick

Spin speed too low	Select higher speed
Spin time too short	Increase time during high speed step
Exhaust volume too high	Adjust exhaust lid or house exhaust damper
Inappropriate choice of resin material	Contact resin manufacturer

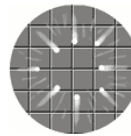
AIR BUBBLES ON WAFER SURFACE

Air bubbles in dispensed fluid (resin)
 Dispense tip is cut unevenly or has burrs or defects



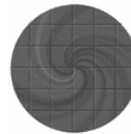
COMETS, STREAKS, OR FLARES

Fluid velocity (dispense rate) is too high
 Spin bowl exhaust rate is too high
 Resist sits on wafer too long prior to spin
 Spin speed and acceleration setting is too high
 Particles exist on substrate surface prior to dispense
 Fluid is not being dispensed at the center of the substrate surface



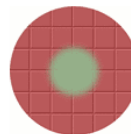
SWIRL PATTERN

Spin bowl exhaust rate is too high
 Fluid is striking substrate surface off center
 Spin speed and acceleration setting is too high
 Spin time too short



CENTER CIRCLE (CHUCK MARK)

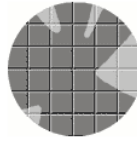
If the circle is the same size as the spin chuck,
 switch to a Delrin spin chuck



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UNCOATED AREAS

Insufficient dispense volume

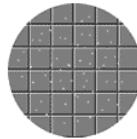


PINHOLES

Air bubbles

Particles in fluid

Particles exist on substrate surface prior to dispense



Poor reproducibility

Variable exhaust or ambient conditions	Adjust exhaust lid to fully closed
Substrate not centered properly	Center substrate before operation
Insufficient dispense volume	Increase dispense volume
Inappropriate application of resin material	Contact resin manufacturer
Unstable balance in speed / time parameters	Increase speed / decrease time or visa versa

Poor Film Quality

Variable exhaust or ambient conditions	Adjust exhaust lid to fully closed
Substrate not centered properly	Center substrate before operation
Insufficient dispense volume	Increase dispense volume
Inappropriate application of resin material	Contact resin manufacturer
Unstable balance in speed / time parameters	Increase speed / decrease time or visa versa

When to call staff?

- There is no vacuum.

Badger Criteria

Report Problem:

1. Vacuum is weak.
2. Software is not responding.
3. O-ring is missing from the pieces chuck.

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Shutdown:

1. No vacuum.

Reference Documents

- <https://www.brewerscience.com/processing-theories/spin-coat/>

Revision History: