NANOFABRICATION FACILITY
ADVANCED SCIENCE RESEARCH CENTER

Standard Operation Procedure:

Photo/EBL-resist Spinners

Section 1: Process Description

Brewer Science Spin Coater

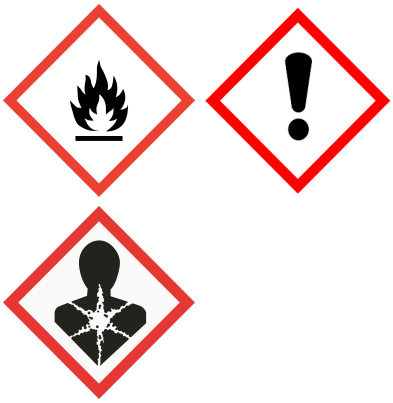
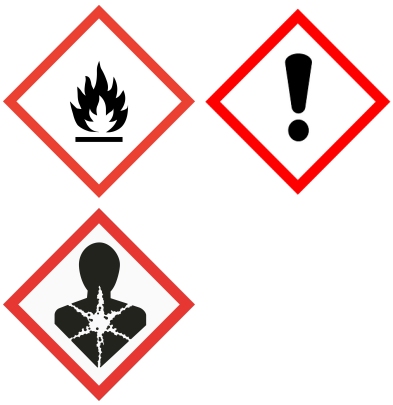
There are three Brewer Science Cee spin coaters in the Lithography Bay. Two are integrated into the spinner, one designated for “photoresists” and one designated for “photo/other resist. There is a third stand-alone spin coater with an integrated hotplate that is dedicated for the spinning of electron beam resists. The tool is capable of spin coating substrates up to 7” square

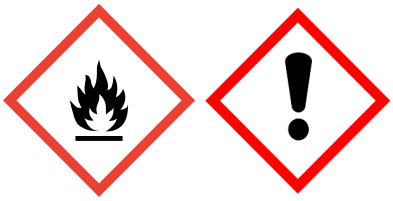
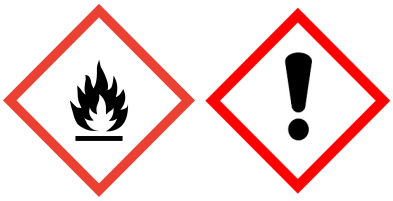
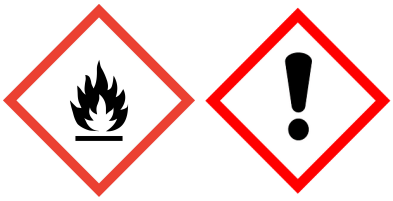
or 200-mm round and features high torque for maximum ramping capability. You can also spin coat smaller size substrates (<1-cm through 200-mm) using a wide array of spin-coating chuck sizes. The precision hotplate has a temperature range from ambient to 300˚C with resolution of +/- 0.1˚C and uniformity of 0.3% across the working surface.

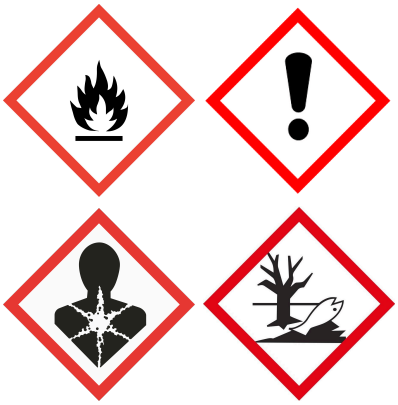
Two additional Brewer Cee spin coaters are located in the fume hoods in the lithography bay. Spin coater # 2 is dedicated for photoresist processing, and spin coater # 3 is dedicated to all other non-standard materials, such as spin-on glasses, PVA, PPC, charge spreading layers for e-beam, and 3D laser 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.

Section 2: Safety Protocols

Chemical Hazards

Hazardous Chemical	Hazard Sign	Hazard Statements
Isopropanol [Isopropyl alcohol; 2-propanol]		Highly flammable liquid and vapor Causes serious eye irritation May cause respiratory irritation May cause drowsiness or dizziness May cause damage to organs through prolonged or repeated exposure
Acetone [2-propanone; Dimethyl ketone]		Highly flammable liquid and vapor Causes serious eye irritation May cause drowsiness or dizziness May cause damage to organs through prolonged or repeated exposure Repeated exposure may cause skin dryness or cracking

495 PMMA A2, A4, A6 950 PMMA A2, A4 [contains: anisole; poly(methyl methacrylate]		Flammable liquid and vapor Harmful if inhaled Causes skin irritation Causes serious eye irritation May cause respiratory irritation
ma-N 2403 [contains: 1-methyl-2-pyrrolidone; n-butyl acetate; cyclohexanone]		Flammable liquid and vapor Causes skin irritation Causes serious eye irritation
ZEP 520A [contains: anisole]		Flammable liquid and vapor
AZ MiR 701 Photoresist [contains: ethyl lactate; n-butyl acetate]		Flammable liquid and vapor Causes skin irritation Causes serious eye irritation May cause respiratory irritation
AZ 1512, AZ 5214-E, AZ P4620 Photoresists		Flammable liquid and vapor Causes serious eye damage May cause respiratory irritation, drowsiness or dizziness
Megaposit SPR 220-3.0, 7.0 Photoresists [contains: ethyl lactate; anisole; 2-methyl butyl acetate; n-amyl acetate; 1,4-dioxane]		Flammable liquid and vapor Causes serious eye damage May cause respiratory irritation May cause cancer

Microposit S1813 Photoresist [contains: propylene glycol monomethyl ether acetate; methoxy-1-propanol acetate; 1,4-dioxane]		Flammable liquid and vapor May cause drowsiness or dizziness
AZ 125nXT-7A Photoresist [contains: 1-methoxy-2-propanol acetate; modified diacrylate; phenone derivative; triarylphosphine oxide]		Flammable liquid and vapor Causes skin irritation May cause an allergic skin reaction Causes serious eye damage May cause respiratory irritation, drowsiness or dizziness Toxic to aquatic life with long lasting effects
SU-8 2002, 2005, 2010, 2025, 2050, 2100 Photoresist [contains: epoxy resin; cyclopentanone; hexafluoroantimonate salt; propylene carbonate; triarylsulfonium salt]		Flammable liquid and vapor Causes skin irritation Causes serious eye irritation May cause an allergic skin reaction Suspected of causing genetic defects Toxic to aquatic life with long lasting effects

Physical Hazards

Hazard	Hazard Sign	Hazard Statements
High velocity spinning		High velocity objects can come loose from the spinner chuck if the vacuum fails while the spinner is in operation

Pressurized gas (for the hood spinners only)		Nitrogen guns in the hood are pressurized
Hotplate (for EBL spinner only)		Hotplate is set to 180℃ at all times and can cause severe burns

Routes of Exposure

There is a risk of skin or eye exposure when handling photoresists and solvents that can be mitigated by wearing proper PPE.

There is an inhalation risk when using photoresists and solvents, which must only be opened and handled under a fume hood to reduce or eliminate exposure.

There is a risk of skin or eye exposure from splattering photoresist when using it in the spinner that can be mitigated by wearing proper PPE and only operating the spinner with its lid closed.

There is a risk of substrates flying off the spinner chuck at a high velocity and hitting a user if the vacuum fails while the spinner is in operation, which can be prevented by only operating the spinner with its lid closed.

There is a risk of launching objects by spraying them with the nitrogen guns in the spinner hood that can be mitigated by always aiming the nitrogen gun into the spinner hood and away from people.

There is a risk of severe skin burns if the hotplate with the EBL spinner is touched, which can be prevented by never by using tweezer when handling samples on the hotplate and never touching it directly with hands or other body parts.

Personal Protective Equipment Requirements

Users must be wearing the nitrile cleanroom gloves required throughout the cleanroom at all times. It is also recommended that users wear a second pair of gloves over the first pair. It is very easy to get photoresist on gloves when applying resists to samples. Wearing a second pair of gloves makes it easier to remove, dispose of and replace soiled gloves.

Safety glasses are required when using the spinners.

Waste Disposal

Dispose of gloves and wipes soiled with photoresists or solvents in a red hazardous waste bin.

Dispose of any used pipettes or swabs in the sharps waste container.

Dispose of used or failed substrates in a sharps waste container.

Section 3: Process

Procedure

Estimated Time: <20 minutes

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

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 the 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**.

    b. Select **Edit Recipe**.

    c. Change the parameters and press **Save**. Enter the 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.

Clean[JS3] *up 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 the spinner 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

- 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.
    - 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.
    - 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.
    - 4” Chuck: Samples must be > 4” wafer
    - Pieces Chuck: Sample must cover o-ring

What to watch out for during operation

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

Spin-Coating Process Troubleshooting

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.

Shutdown:

1. No vacuum.

Reference Documents

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