Sub-Protocol: Parylene C Coating

Description: This document details the protocol for coating silicon wafers (or similar materials) in Parylene C using a room temperature vapor deposition method.

Note: Items not allowed in chamber include wood or wood products, scotch tape, liquids, or any substance likely to off-gas while under vacuum.

MATERIALS

2% Micro-90 Solution
TexWipe Cloths
Parylene C Dimer
Parafilm
Aluminum Foil (Contaminant-Free/Vacuum Grade)
Scotch-Brite Pads

EQUIPMENT

Specialty Coating Systems PDS 2010 Labcoter 2 Parylene Deposition System
FTS Systems Flexi-Cool Mechanical Chiller and Cold Trap Probe
Rotating shelf
Digital scale
Boat form (metal tube)

PARAMETERS

Vaporizer heater: 175 °C
Pressure set point: Base (as measured during tool calibration) + 15 vacuum units (typically 35)
Pyrolysis heater: 690 °C

PROCESS

1. CLEAN AND SETUP (0.5 HOURS)

1.1. Consult log to estimate the amount of Parylene C dimer required for targeted coating thickness. Most current measurements as of 12/16/2024 suggest 32-34 grams for 10 microns across 12 4” silicon wafers. Dimer mass to thickness ratio is determined by loading of the chamber and will be different for tools using different shelving units.

1.2. Weigh out Parylene C dimer in cleanroom using the scale. Log mass to the tenth of a gram. Seal Parylene C dimer bottle with parafilm.

1.3. Fill out log-sheet. Every 5th run (i.e. runs numbered 5, 10, 15, etc.) consult maintenance schedule, document, and notify super-user.

1.4. Check cold-trap, vaporizer door, and chamber lid O-rings to make sure each is clean and will form a good seal. If necessary, clean chamber lid O-ring by using Kapton tape adhesive to remove residue. Replace any cracked or badly fouled O-rings and notify super-user to replace in inventory.
1.5. During normal setup and operation, do NOT remove chamber base L-gasket. The gasket should only be disturbed if the tool is unable to pump down to base vacuum and troubleshooting is required.
1.6. Wipe all interior surfaces of the machine (chamber lid, rotating table, bottom plate, baffle, etc.) and the cold trap probe with a TexWipe cloth wetted with Micro-90 solution. Do not wipe the shelf as this can trap fibers. Thoroughly dry all wiped surfaces.
1.7. Place the Flexi-Cool cold trap probe into the cold trap in the coating system.
1.8. Place the rotating shelf onto the base.
1.9. Place your wafers onto the shelves, flats facing inward. Each shelf can accommodate 2 4" wafers. Ensure no sample extends beyond the edge of the rotating table.
1.10. Carefully lower chamber around shelf and place chamber lid on top of chamber.

2. Construct Dimer Boat

2.1. Cut a rectangular piece of aluminum foil 11x4 inches in dimension and curl the foil around the outsider diameter of the boat form (metal tube). Face shiniest side of the foil toward boat form. Fold in the ends of the foil and remove boat from the form.

<u>The dimer boat must be no more than 7.5 inches long.</u>

2.2. Pour the Parylene C dimer pellets into the foil boat and load the boat into the vaporizer.

When loading the boat, place it only as far into the vaporizer tube as necessary and do not push the foil boat towards the back of the vaporizer tube.
2.3. Close and lock the vaporizer door.

3. Run Parylene C Coating System (min. 2 hours)

3.1. Twist the "Emergency Stop" button until it pops.
3.2. Push "Main Power" button. Wait until all the controllers on the display panel to activate and display current measurement readings.
3.3. Turn the "Vacuum" knob to "Vacuum". Initial vacuum reading should be around 1000 units. Press down on the lid for the first 20 seconds to help establish a good seal. The vacuum gauge should reach ~100 units in approximately 2 minutes. If not, there may be a leak, or an off-gassing sample.
3.4. Once the vacuum gauge reads below 100 units turn on the chiller. Wait a minimum of 45 minutes from this point before starting the deposition process.
3.5. Wait until the vacuum level has reached 5 units (or lower) AND 45 minutes have elapsed since turning on the chiller. Turn the "Furnace" and "Vaporizer" knobs to "Enable", and then press the "Process Start/Stop" button. The green button should now be illuminated.

3.6. Wait for deposition.

For coating to begin, all the following must occur:

a. The chamber gauge must reach 135 °C.
b. The furnace must reach 690 °C.
c. The vacuum reading must be less than 11.

3.7. If any of these conditions are not met, something is wrong. Abort the run and contact super-user.
3.8. The machine will run for several hours depending on the coating thickness. The run will stop automatically, and the tool will begin to cool down when the process is complete. This will be indicated by a blinking green light on the “Process Start/Stop” button.

4. Cool Down and Cleanup (~1 hour)

4.1. Wait until the vaporizer temperature is below 90 °C.
4.2. Turn off the chiller and wait > 5 minutes.
4.3. Press the “Process Start/Stop” button.
4.4. Turn the “Furnace” and “Vaporizer” knobs to “Disable”.
4.5. Turn the “Vacuum: knob to “Vent”. Wait until vacuum gauge reads ~1000 units.
4.6. Push the “Emergency Stop” button to power off coating system.
4.7. Carefully remove the cold trap probe from the system and place in the holder to warm.
4.8. Remove chamber lid.
4.9. Remove and store samples.
4.10. Peel Parylene C from the inside surfaces: chamber, chamber lid, rotating table, bottom plate, watch glass. If the Parylene C film is very thin (<3 microns) leave until the following run.
4.11. Open vaporizer and discard the used foil boat. Remove any Parylene C residue from the outside of the vaporizer tube using a plastic chisel. Clean the inside of the vaporizer tube using the tube brush. Vacuum out any residue.
4.12. Wipe the inside surfaces of the chamber (but not the vaporizer or shelf) with a TexWipe cloth wetted with Micro-90 solution.
4.13. Outside of the cleanroom scrub the cold trap probe completely clean using a green Scotch-Brite pad. Polish with a TexWipe cloth and Micro-90 solution. Any cloudiness or residue will lead to rust spots, which is good for neither the probe nor the pump. Return the chiller and cold trap to the cleanroom.
4.14. Log any issues or observations in the logbook.