PDS 2010 Parylene Coater SOP

1 Scope

1.1 This document provides the procedures and requirements to deposit a parylene film, using the Specialty Coating Systems PDS 2010 Parylene Coater.

2 Table of Contents

3 Reference Documents

3.1 Referenced within this Document

3.1.1 None

3.2 External Documents

3.2.1 None

4 Equipment and/or Materials

4.1 100 ml Beaker

4.2 A-174™ (Silane coating for use as Adhesion Promoter)

NOTE: Chemical name is 3-(Methacryloyloxy)propyltrimethoxysilane

4.3 Aluminum Foil

4.4 Boat Form

4.5 Cryogenic Gloves

4.6 D.I. Water

4.7 Flexi-Cool FC100 Chiller

4.8 Isopropyl Alcohol, 99%

4.9 Liquid Nitrogen

4.10 Liquid Nitrogen Dewar, 4 liter capacity

4.11 Micro-90® Cleaning Fluid

4.12 Parylene Dimer DPX-C

4.13 Pipette

4.14 Potassium Permanganate

4.15 SCS PDS 2010 Parylene Coater (see Figure 1, Parylene Coater)

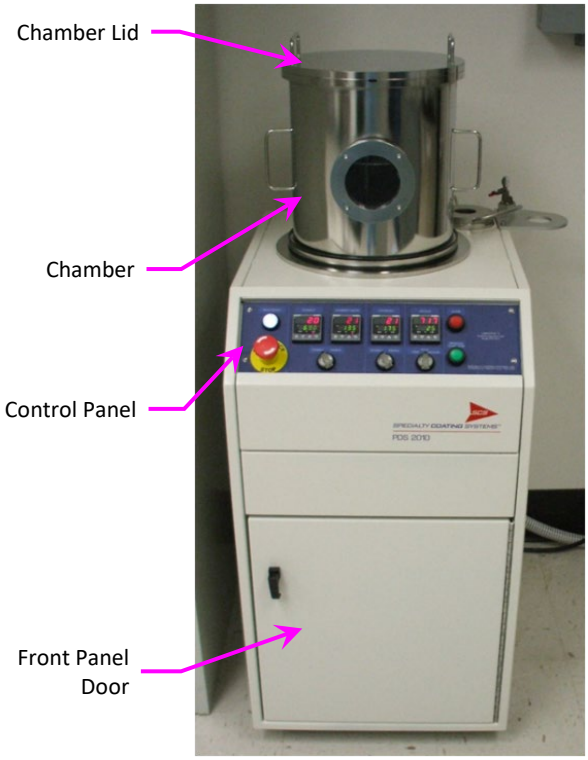


Figure 1, Parylene Coater

5 Safety

5.1 Follow all Nanofab safety procedures.

5.2 The use of razor blades is necessary to remove film coating from component surfaces.

5.2.1 Exercise extreme caution when using razor blades to prevent cuts and lacerations.

5.2.2 Never leave or store uncovered razor blades anywhere within the lab.

5.2.3 Discard razor blades only in designated "sharps" disposal bins.

5.3 When working with Liquid Nitrogen, the following Personal Protective Equipment is **ALWAYS** required:

5.3.1 Cryogenic gloves.

5.3.2 Safety glasses and/or a face shield.

6 Setup Procedures

6.1 Prepare Samples

6.1.1 Prepare samples prior to Parylene deposition as needed.

NOTE: Some samples may need to be treated with an adhesion promoter. When this is necessary, follow the procedures in section 8.3 Adhesion Promotion (Silane Coating).

6.2 Enable Coater

6.2.1 In Coral, enable the coater and complete all required data entry.

NOTE: Enabling the coater will release the interlock and activate the PROCESS START/STOP *button.*

6.3 Vent Chamber

6.3.1 Move the Vacuum switch to VENT (see Figure 2, Coater Control Panel).

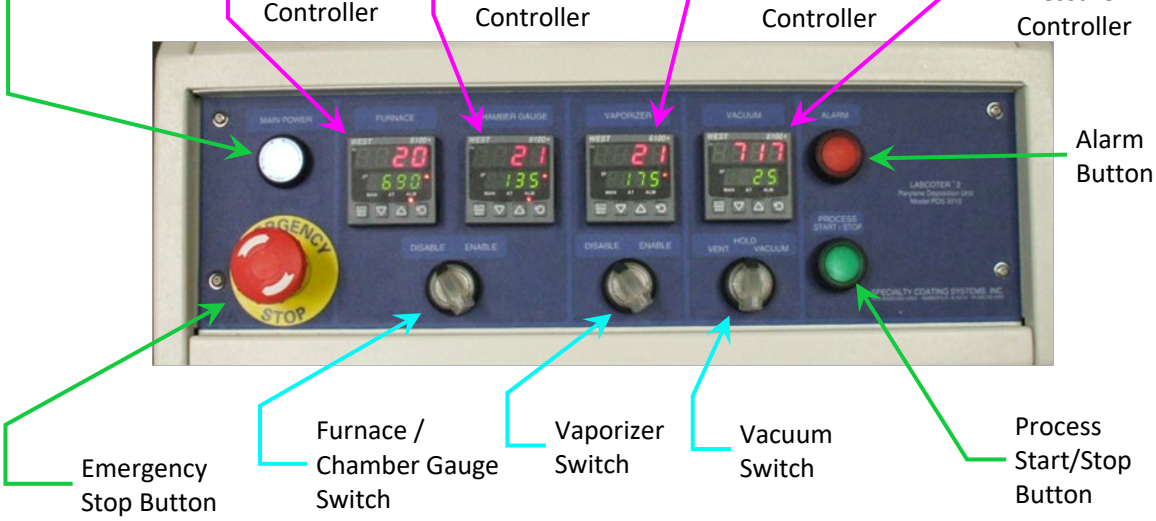


Figure 2, Coater Control Panel

6.4 Make Dimer Boat

6.4.1 Cut a rectangular piece of aluminum foil 11" X 5".

6.4.2 Place the foil piece on a flat surface with the shiny side up.

6.4.3 Get the boat form from its storage location.

6.4.4 Place the boat form lengthwise at the center of the foil piece (see Figure 3, Make Dimer Boat).

6.4.5 Roll the foil piece onto the boat form.

6.4.5.1 The foil should not extend beyond a half-circle.

6.4.6 Fold up the ends of the foil.

6.4.6.1 Keep the length of the boat between 7 – 7.5".

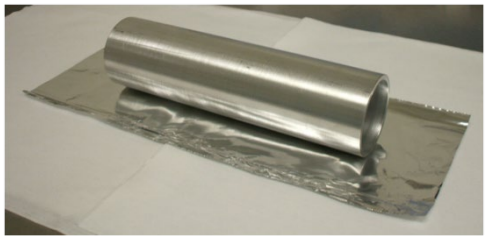
!!! WARNING !!!

The length of the dimer boat should not exceed 7.5" or the process may be affected.

!!! WARNING !!!

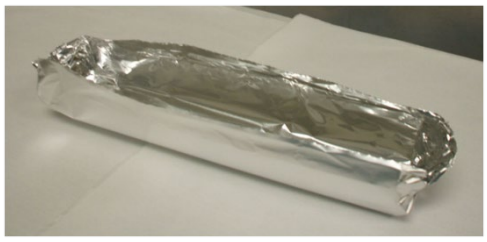
6.4.7 Remove the foil from the boat form.

6.4.8 Return the boat form to its storage location.



Place boat form on aluminum foil

Shape foil around form. Close ends.



Remove boat form. Ensure boat ≤ 7.5" long.

Figure 3, Make Dimer Boat

6.5 Weigh Dimer

6.5.1 Place the empty dimer boat on a digital scale.

6.5.2 Zero the scale.

6.5.3 Placing the dimer into the boat, load the desired amount of dimer.

NOTE: 1 gram of dimer will provide a coating layer approximately 0.6 µm (600 nm) thick.

!!! WARNING !!!

Never exceed 30 grams of dimer.

!!! WARNING !!!

6.5.4 Record the dimer weight in Coral.

6.6 Load Dimer

6.6.1 Check the temperature of the vaporizer.

6.6.2 **If the temperature is greater than 40°C,** DO NOT PROCEED.

6.6.2.1 Wait until the temperature is below 40°C.

!!! WARNING !!!

If the vaporizer temperature is above 40°C, the dimer will begin to vaporize.

!!! WARNING !!!

6.6.3 Open the front door of the coater (see Figure 1, Parylene Coater).

6.6.4 Release the latch for the vaporizer door (see Figure 4, Vaporizer Door).

6.6.5 Open the vaporizer door.

6.6.6 Insert the loaded dimer boat into the vaporizer.

6.6.7 Insert the boat only far enough to close the vaporizer door.

NOTE: This is necessary to prevent premature vaporization of the dimer.

6.6.8 Close and latch the vaporizer door.

6.6.9 Close the front door of the coater.

Figure 4, Vaporizer Door

6.7 Prepare Chiller

NOTE: The Flexi-Cool FC100 chiller is the primary cold trap chiller. The manual cold trap thimble can be used when the FC100 is unavailable.

6.7.1 Flexi-Cool FC100 Chiller

!!! WARNING !!!

The flexible delivery line for the chiller is sensitive and can be damaged. Always handle the cold finger carefully.
The minimum curvature allowed is a 6 inch (15cm) radius.

!!! WARNING !!!

6.7.1.1 Clean Cold Finger

6.7.1.1.1 Ensure the cold finger is securely placed in the cold finger holder (see Figure 5, Cold Finger).

6.7.1.1.2 Using a razor blade, gently scrape the surface of the cold finger to remove any build up.

6.7.1.1.3 Wipe the surface with a clean room wipe.

6.7.1.1.4 Spray the surface of the cold finger with the Microsoap solution.

6.7.1.1.5 Using a clean room wipe, spread the Microsoap solution evenly across the entire surface of the cold finger.

6.7.1.1.6 Carefully place the cold finger in the cold trap housing.

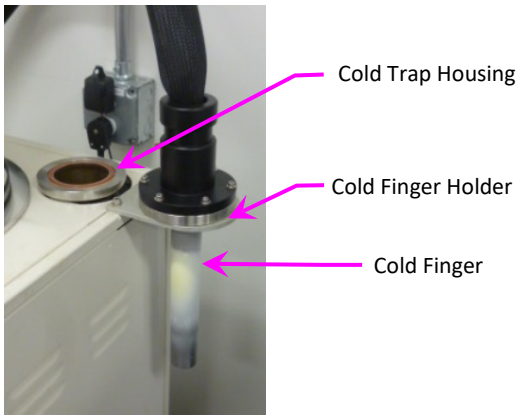


Figure 5, Cold Finger

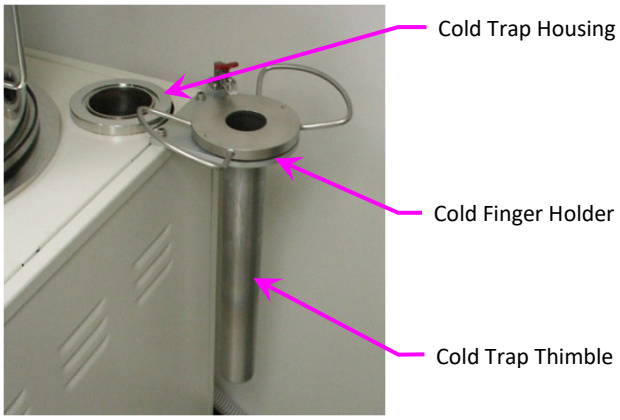


Figure 6, Cold Trap Thimble

6.7.2 Cold Trap Thimble

6.7.2.1 Clean Cold Trap Thimble

6.7.2.1.1 Remove the cold trap thimble from the cold trap housing (see Figure 6, Cold Trap).

6.7.2.1.2 Place cold trap thimble in the holder.

6.7.2.1.3 Using a razor blade, gently scrape the surface of the cold trap thimble to remove any build up.

6.7.2.1.4 Wipe the surface with a clean room wipe.

6.7.2.1.5 Spray the surface of the cold trap thimble with the Microsoap solution.

6.7.2.1.6 Using a clean room wipe, spread the Microsoap solution evenly across the entire surface of the cold trap thimble.

6.7.2.1.7 Place the cold trap thimble in the cold trap housing.

6.7.2.2 Obtain Liquid Nitrogen

6.7.2.2.1 Obtain the liquid nitrogen dewar.

6.7.2.2.2 Using cryogenic gloves, fill the dewar with liquid nitrogen.

7 Parylene Deposition Procedures

7.1 Open Chamber

7.1.1 After the chamber has been vented, remove the lid from the chamber.

7.1.2 With the handles down, carefully place the lid on the loading table.

NOTE: Scratches on the interior surface will prevent a good vacuum seal.

7.1.3 Remove the loading fixture from the chamber (see Figure 7, Removing Loading Fixture).

7.2 Inspect Components

7.2.1 Visually inspect the surface of the chamber, baffle, lid, and loading fixture.

7.2.2 **If any peeling, blistering, or flaking is seen,** contact the lab staff for cleaning instructions.

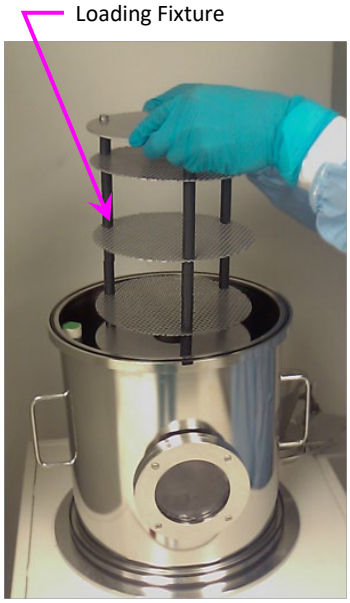


Figure 7, Removing Loading Fixture

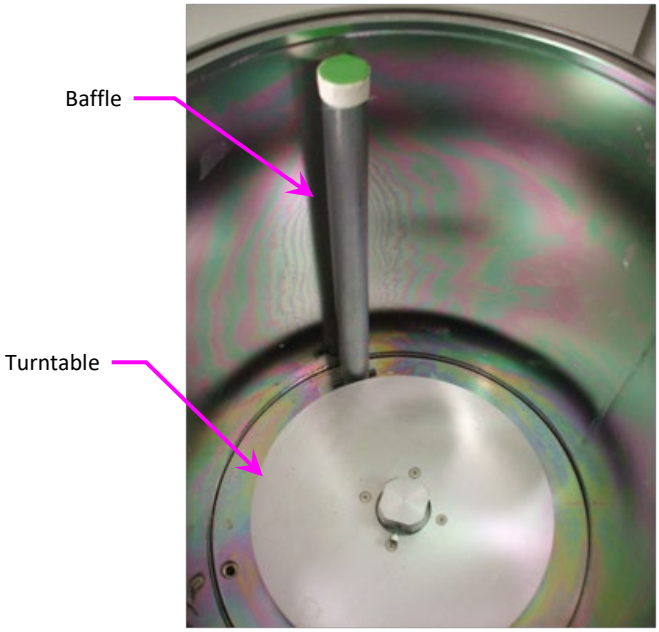


Figure 8, Chamber Interior

7.3 Check Baffle Installation

7.3.1 Ensure the baffle is installed with the holes facing the chamber wall (see Figure 8, Chamber Interior).

7.4 Load Samples/Parts

7.4.1 Load the samples/parts onto the loading fixture.

7.4.1.1 Each of the three levels may be used.

7.4.1.2 Additional test samples may be necessary to measure deposited film thickness.

NOTE: Multiple samples/parts may be loaded on each level, with a minimum spacing of ½".

7.5 Install Loading Fixture

7.5.1 Place the loading fixture at the center of the turntable.

7.5.2 Ensure the fixture does not touch the baffle.

NOTE: There should be approximately ¼" between the baffle and the fixture.

7.6 Replace Chamber Lid

7.6.1 Carefully place the chamber lid on top of the chamber.

7.6.2 Ensure the lid rests evenly on the chamber.

7.7 Start Process Cycle

7.7.1 Press the green PROCESS START/STOP button.

NOTE: The green button light must be ON.

7.7.2 Move the Furnace/Chamber Gauge switch to ENABLE.

7.7.3 Move the Vaporizer switch to ENABLE.

7.7.4 Move the Vacuum switch to VACUUM.

7.8 Wait for Pressure

7.8.1 Wait for the pressure to reach 100 mTorr or less.

7.9 Start Cold Finger (Flexi-Cool FC100 Chiller Only)

7.9.1 **If using the Liquid Nitrogen Cold Trap Thimble,** skip to 7.10 Liquid Nitrogen (Cold Trap Thimble Only).

7.9.2 **If using the Cold Finger,** turn on the Flexi-Cool FC100 Chiller (see Figure 9, Flexi-Cool FC100 Chiller).

7.9.3 Proceed to 7.11.Alarms.

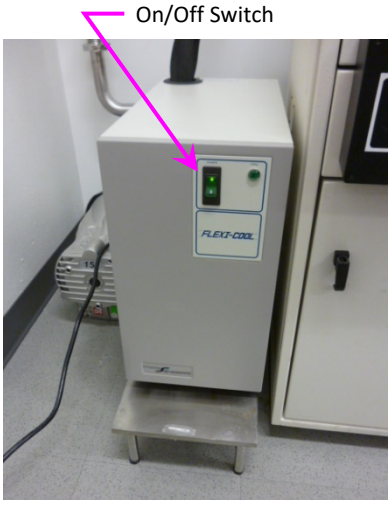


Figure 9, Flexi-Cool FC100 Chiller

Figure 10, Cold Trap Funnel

7.10 Liquid Nitrogen (Cold Trap Thimble Only)

7.10.1 **If using the Cold Finger,** return to 7.9 Start Cold Finger (Flexi-Cool FC100 Chiller Only).

7.10.2 **If using the Cold Trap Thimble,** obtain a Liquid Nitrogen Dewar with liquid nitrogen.

7.10.3 Place the funnel in the cold trap thimble (see Figure 10, Cold Trap Funnel).

7.10.4 Wearing cryogenic gloves, slowly and carefully add liquid nitrogen to the cold trap thimble until it nearly reaches to top of the thimble.

7.10.5 Monitor the level of liquid nitrogen throughout the process cycle.

7.10.6 Add liquid nitrogen, as necessary, to keep the level within 3" of the top of the cold trap thimble.

7.11 Alarms

NOTE: An alarm can occur during deposition only. An audio alarm will sound and the red alarm button will flash a sequence every 5 seconds (see Figure 2, Coater Control Panel*). If the problem is not corrected within 5 minutes, the deposition cycle will be automatically aborted.*

7.11.1 To silence the alarm, push the red alarm button.

7.11.2 Count the number of times the red alarm button flashes within the 5 second sequence.

7.11.3 Notify the lab staff of the alarm and the number of flashes.

7.12 Process Completion

7.12.1 Wait for the process to complete.

NOTE: The PROCESS START/STOP button will flash green when the process is completed.

7.12.2 Press flashing PROCESS START/STOP switch.

7.12.3 Move the Furnace/Chamber Gauge switch to DISABLE.

7.12.4 Move the Vaporizer switch to DISABLE.

7.12.5 **If using the Flexi-Cool FC100 chiller,** turn the chiller off.

7.13 Vent Chamber

7.13.1 Move the Vacuum switch to VENT.

7.13.2 Wait for the chamber to vent.

7.13.3 The Vacuum Pressure Controller will display approximately "980".

7.14 Cold Finger/Cold Trap Thimble Removal

7.14.1 **If using the Flexi-Cool FC100 Chiller (Cold Finger),** follow the procedures in section 7.14.3 Cold Finger.

7.14.2 **If using the Liquid Nitrogen Cold Trap Thimble,** follow the procedures in section 7.14.4 Clean Cold Trap Thimble.

7.14.3 Cold Finger

7.14.3.1 Carefully remove the cold finger from the cold trap housing.

7.14.3.2 Place the cold finger in the cold finger holder.

7.14.3.3 Wait for the frost to melt from the cold finger.

7.14.3.4 Using a razor blade, gently scrape the surface of the cold finger to remove any build up.

7.14.3.5 Wipe the surface with a clean room wipe.

7.14.3.6 Spray the surface of the cold finger with the Microsoap solution.

7.14.3.7 Using a clean room wipe, spread the Microsoap solution evenly across the entire surface of the cold finger.

7.14.4 Clean Cold Trap Thimble

7.14.4.1 Remove the cold trap thimble from the housing.

7.14.4.2 Using the required PPE and a funnel, pour the residual liquid nitrogen into the dewar.

7.14.4.3 Place the cold trap thimble in the holder.

7.14.4.4 Wait for the frost to melt from the cold trap thimble.

7.14.4.5 Using a razor blade, gently scrape the surface of the cold trap thimble to remove any build up.

7.14.4.6 Wipe the surface with a clean room wipe.

7.14.4.7 Spray the surface of the cold trap thimble with the Microsoap solution.

7.14.4.8 Using a clean room wipe, spread the Microsoap solution evenly across the entire surface of the cold trap thimble.

7.15 Unload Chamber

7.15.1 Remove the lid from the chamber.

7.15.2 Carefully place the lid with the handles on the loading table.

NOTE: Scratches on the interior surface will prevent a good vacuum seal.

7.15.3 Remove the loading fixture from the chamber.

7.15.4 Remove the samples/parts from the loading fixture.

7.15.5 Visually inspect the surface of the chamber, baffle, lid, and loading fixture.

7.15.6 **If any peeling, blistering, or flaking is seen,** contact the lab staff for cleaning instructions.

7.16 Remove Dimer Boat

7.16.1 Open the front door of the coater.

7.16.2 Release the latch for the vaporizer door.

7.16.3 Open the vaporizer door.

7.16.4 Remove the empty dimer boat from the vaporizer.

7.16.5 Discard the empty dimer boat.

7.16.6 Close and latch the vaporizer door.

7.16.7 Close the front door of the coater.

7.17 Measure Film Thickness

7.17.1 Measure the thickness of the deposited film.

NOTE: This will normally be done using a profilometer.

7.18 System Standby

7.18.1 Place the loading fixture in the process chamber.

7.18.2 Carefully place the chamber lid on top of the chamber.

7.18.3 Ensure the lid rests evenly on the chamber.

7.18.4 Place the cold trap cover on the cold trap housing.

7.18.5 Move the Vacuum switch to VACUUM.

7.18.6 Wait for the pressure to reach 100 mTorr or less.

7.18.7 Move the Vacuum switch to HOLD.

7.19 Disable Coater

7.19.1 In Coral, disable the coater and complete all data entry, including process measurement data.

NOTE: Disabling the coater will activate the interlock and disable the PROCESS START/STOP button.

8 Supplemental Procedures

8.1 System Start-up

NOTE: Follow these procedures only if the tool has been powered down.

8.1.1 Release the Emergency Stop button by turning it clockwise, or pulling it out (see Figure 2, Coater Control Panel).

8.1.2 Press the white Main Power button.

NOTE: The computer will initialize and the vacuum and temperature controllers will illuminate.

8.2 Mixing Microsoap Spray

NOTE: These procedures are only necessary when more Microsoap spray is needed.

8.2.1 Pour 15 ml of Micro-90® Cleaning Fluid into an empty spray bottle.

8.2.2 Add 660 ml (22 fluid ounces) of de-ionized water.

8.2.3 Close bottle.

8.2.4 Shake the bottle for approximately 30 seconds to thoroughly mix the solution.

8.3 Adhesion Promotion (Silane Coating)

NOTE: This procedure is optional to improve adhesion of the parylene to the substrate. It is not normally necessary.

9 Mix the Adhesion Promotion Solution

NOTE: The Adhesion Promotion Solution is a mixture of DI Water, 99% Isopropyl Alcohol (IPA), and A-174™. The ratio is 100:100:1 (DI Water : IPA : A-174™).

9.1.1.1 Obtain a container and determine the total chemical volume needed to fully immerse the samples (for example, 200 ml total).

9.1.1.2 Divide the total volume by 2 to calculate the amount of DI water and 99% Isopropyl Alcohol (IPA) to use (for example, 100 ml each).

9.1.1.3 Divide the total volume by 200 to calculate the amount of A-174™ Adhesion Promoter to use (for example, 1 ml).

9.1.1.4 Add the DI water (½ the total volume) to the container.

9.1.1.5 Add the IPA (½ the total volume) to the container.

9.1.1.6 Add the A-174™ Adhesion Promoter ($\frac{1}{200}$ the total volume) to the container.

9.1.1.7 Thoroughly stir the solution for a minimum of 30 seconds.

9.1.1.8 Wait a minimum of 2 hours before using the solution.

9.1.1.9 Use the solution within 24 hours of mixing.

NOTE: ***If the solution is not used within 24 hours,*** *it will not be effective and must be discarded (as a solvent).*

9.1.2 Verify Solution

9.1.2.1 Using a pipette, place 6 – 10 ml of the mixed solution into a clean, dry 100 ml beaker.

9.1.2.2 Carefully add 3 – 4 grains of potassium permanganate to the beaker.

9.1.2.3 Gently swirl the beaker contents for 15 – 30 seconds.

9.1.2.3.1 Do NOT mix the contents in any other way.

9.1.2.4 Observe the color of the contents.

9.1.2.4.1 **If the contents turn a yellow-brown color**, the adhesion promotion solution is acceptable and may be used.

9.1.2.4.2 **If the contents turn a bright pink color,** the adhesion promotion solution is bad and must be discarded.

9.1.2.5 Discard the pipette.

9.1.2.6 Discard the contents as a solvent.

9.1.2.7 Thoroughly rinse the beaker with IPA.

9.1.3 Preparing Sample

9.1.3.1 Submerge the samples for 30 ± 5 minutes in the adhesion promotion solution.

9.1.3.2 Remove the samples from the solution.

9.1.3.3 Allow the samples to air dry for 30 ± 5 minutes.

9.1.3.4 Submerge the samples in IPA.

9.1.3.5 Agitate the samples for 30 ± 5 seconds.

9.1.3.6 Remove the samples from the IPA, allowing the chemical to drain from the sample (45 ± 15 seconds).

9.1.3.7 Ensure the samples are completely dry before placing on the loading fixture.

9.1.3.7.1 **If the samples are not coated with parylene within 30 hours,** repeat all procedures in section 8.3 Adhesion Promotion (Silane Coating).

9.1.3.8 Discard the IPA.

10 Process Notes

10.1 Alarm Codes

Code Number (Flashes)	Cause
1	Vaporizer temperature too high
2	Gauge tube temperature out of range
3	Furnace temperature out of range

11 Revision History

Rev	Date	Originator	Description of Changes
5	10 Jun 2019	Tony Olsen	Reformat document for easier reading. Add Note to ensure green start light is ON when process begins.
4	08 Sep 2015	Tony Olsen	Update with instructions to use Flexi-Cool FC100 chiller.
3	19 Mar 2015	Tony Olsen	Update after move to SMBB and replacement of oil pump with dry pump.
2	18 Jan 2012	Tony Olsen	Replace references for log sheet to Coral. Add sections to Enable/Disable Coral.
1	14 Sep 2009	Tony Olsen	Initial Release.