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MOD 1

Standard Wafer Cleaning (Piranha Clean)

Purpose: To remove organic residues and complex heavy metal ions.

Equipment:

Sink 6: Sink6 consists of two temperature controlled baths in rear (piranha), two tanks in the middle (HF) and two rinse tanks on each front side of the sink.

Note: This is the pre-furnace clean sink for wafers with no metal on them. An additional sink8 cleaning prior to sink6 clean is required for wafers that have just had photoresist stripped from them. This extra sink8 clean is also required for non-MOS (MEMS) type process wafers. Please refer to Tystar/Tylan Furnace Overview Chapter 5.0 for more detailed information on MOS and non-MOS processing, and their required cleaning steps.

***Time of Execution*:** 20 minutes

***Summary*:**

(1) Add 100 ml of hydrogen peroxide to the 120ºC sulfuric acid bath just before cleaning wafers. This mixture is called 'piranha' and is sufficient to clean one 4" or 6" cassette filled with wafers at this sink.

(2) Wet wafers by immersing the cassette in the QDR (quick dump rinse, DI water tank) at the station.

(3) Immerse wafers in hot piranha for 10 minutes (standard pre-furnace clean).

(4) Dump rinse the wafers/cassette in QDR tank.

(5) Standard rinse/spin dry in SRD spinners.

Detailed Procedure:

(1) Put safety attire on (chemical-resistance gloves on top of surgical gloves, apron and face shield), while working at the acid sinks. Lab members need to also wear fresh poly gloves on top of other gloves to avoid cross contamination of the sink, transfer box/cassettes, and ultimately furnaces. This means you will need to have surgical gloves, chemical-resistant gloves and poly gloves on your hands while performing the pre-furnace cleaning step at sink6.

(2) Check that the temperature controllers of the piranha baths in the rear of Sink 6 are turned on and that the temperature setting is 120ºC. If not, turn on the heater by pressing the green TEMP CONT button. Temperature will be stabilized in about 30 minutes. The bath contains concentrated sulfuric acid.

(3) Move your wafers into one of the black STAT PRO 1000 Teflon® wafer cassettes marked as **sink6**.

(4) When the bath temperature is stable at 120ºC, and just prior to immersing the wafers into the bath, slowly add 100 ml of hydrogen peroxide to the bath. The piranha mixture should start bubbling immediately and should continue bubbling throughout the cleaning period.

Note: Perform an additional sink8 clean prior to sink6 cleaning, if wafers just had photoresist removed from them, and/or non-MOS process(es) are involved. Sink8 has white Teflon® wafer cassettes marked as sink8 available at that station.

(5) Wet wafers with DI water by immersing them in the QDR tank. This prevents bubbles from sticking to the wafer surface.

(6) Immerse cassette with wafers in the hot piranha bath for 10 minutes.

(7) Quick dump rinse your wafers followed by the spin rinse dry (SRD) as per MOD 2 instructions, following.

MOD 2
Standard Rinse – QDR & SRD

Purpose: To rinse to resistivity of 12 Mohm/square or higher prior to drying them.

Equipment: Fluorocarbon rinser/spinner (spindryer6) at sink6, for pre-furnace cleaning purpose, only.

Note: Additional clean in sink8 is required for a non-MOS process and/or post resist strip step for both non-MOS and MOS clean processes.

Time of Execution: ~ 10 minutes

Summary:

(1) Wearing new polyethylene gloves, move your wafers into the designated Teflon cassettes at the sink, and then place the cassette in the quick rump rinse (QDR) station.

(2) Press RESET (if status light is blinking) on the QDR station followed by START button to activate the dump rinse cycles.

(3) At sink6 only, monitor the resistivity by selecting the proper resistivity channel on the RESISTIVITY MONITOR control pad. This can be accomplished by pressing CHAN button (channel 1 for the QDR #1 on the left station, or channel #2 for the QDR #2 on the right station). Make sure that the Mohm-cm light is "on" when selecting this measurement mode. Water temperature or resistivity can be monitored on the same LED display by selecting/deselecting one or the other display mode via DSPLY button. Make sure your resistivity reading is 10 Mohm-cm or greater at the end of your dump rinse cycles, if necessary repeat the process to achieve proper reading.

(4) Remove the cassette from the QDR station and place it in the spin rinse dryer (SRD) station for the final rinse with the H-bar of the cassette facing in.

(5) Press start on the SRD station. The SRD will go through rinse and dry cycles. Final resistivity should be greater than 12 Mohm-cm for the SRD during its rinse cycles (applicable to pre-furnace clean, srdsink6, only)

Rinse Time:	3 minutes
Rinse Speed:	300 RPM
Dry Time:	4 minutes
Dry Speed:	2400 RPM

Take wafers out at the end of the SRD step, remove from the Teflon cassette into your cassette or transfer box at the station for furnace processing

MOD 3
Standard Oxide Dip

***Purpose*:** To remove thin oxide grown on Si during piranha clean.

***Equipment*:** Sink6.

Time of Execution: 10 minutes.

Summary:

(1) DI water rinse your wafers through one dump/rinse cycle (stop/reset after one rinse done)

(2) Dip wafers in HF (water:HF = 25:1 or water:HF = 10:1 at 25ºC, about 1 minute)

Please note some process sequence can not tolerate HF dip, in which case it can be skipped in the overall pre-furnace clean process, just receiving piranha in such cases.

Note: Etch rate of fresh chemicals = 200 A/minute (25:1); 500 A/minute (10:1); adjust etch time according to oxide thickness.

(3) Standard QDR & SRD (see MOD 2).

Detailed Procedure:

(1) Put proper safety attire on (chemical-resistance gloves on top of surgical gloves, apron and face shield), while working at the acid sinks. Poly gloves (clear gloves) must be worn on top of all the other gloves you are wearing at sink6.

(2) If necessary (contaminated solution or sink), aspirate the HF solution from the tank,.DI rinse ten times and replenish with fresh HF (5).

(3) Load wafers into a white Teflon® cassette in sink8 or black STATPro1000 cassettes at sink6.

(4) Quick dump Rinse your samples (wafers) at the QDR station (one dump/rinse cycle), before HF dip.

(5) For water:HF = 25:1, fill dip tank with 6000 ml DI water, add 240 ml HF. For water:HF = 10:1, fill dip tank with 6000 ml DI water, add 600 ml HF. ONLY VLSI Grade HF is allowed in sink6!

Note: Solution should be mixed ten minutes before use. These HF concentrations are usually prepared in advance by the process staff and are regularly replaced.

(6) Dip wafers into the HF bath for the total amount of time needed for your process.

Note: Etch rate = 200 A/minute (25:1) and 500 A/minute (10:1).

(7) Standard QDR followed by SRD as per MOD 2 instructions.

Note: If removing oxide after piranha clean, RINSE wafers for 1 minute in the QDR station, before dipping them in the HF tank. Failure to do so will contaminate the HF bath!

MOD 4
Standard Dehydration Bake

Purpose: To dehydrate wafers that cannot be HMDS vapor primed.

Equipment: VWR convection oven

***Time of Execution*:** 30 minutes (at least)

Summary:

(1) Temp = 120ºC

(2) Time = 30 minutes (at least)

Detailed Procedure:

(1) Below the convection oven are Teflon® cassettes for use in this oven. The cassettes are stamped with VWR to identify them. Do not use the sink cassettes for this process, and do not take the VWR cassettes into the VLSI area as this may lead to contamination. Load wafers into a VWR cassette and place a plastic insert in it that has been labeled with your name and the date (use the write-on tape).

(2) Put the cassette in the oven at 120ºC for at least 30 minutes. If the oven is unavailable and you have performed the standard pre-furnace clean on your wafers (MOD 1), then you can do a dehydration bake in Tystar3 (non-MOS processes) or Tystar2 (MOS processes) at 750ºC for 10 minutes.

Note: If wafers can be spun directly after a furnace step, this procedure an be precluded. When appropriate, it is always suggested that wafers be HMDS treated (MOD 6) and spun with PR directly out of the furnace.

MOD 5

Dehydration Bake or Anneal for Old Lab processed wafers

Purpose: To dehydrate old lab processed wafers that cannot receive HMDS or need an anneal step.

Note: Gold contaminated wafers from the old lab are not allowed in the VLSI area.

Equipment: YES vacuum oven.

Time of Execution: 40 minutes

Summary:

(1) Temp = 200ºC - 450ºC range depending on your process tolerance (recipes are available in vacoven).

(2) Time = 30 minutes bake time.

Detailed Procedure:

(1) Enable the YES vacuum oven on the wand. Read YES vacuum furnace chapter for more details regarding its operation.

(2) Check the chamber pressure on the convectron gauge.

Note: Make sure oven pressure is 760 Torr, so that you can open the chamber door (if not, dial thumb wheel to 2 and press Start. It will inject N2 into the chamber to vent the oven).

(3) Make sure the thumbwheel is set at 1. If not, change to 1.

(4) Load samples into oven.

Note: You may use a metal cassette, quartz or graphite boat, when loading wafers. Two 4" black anodized aluminum cassettes are provided. NEVER use a plastic (including Teflon™) cassettes nor put plastic in this oven. If you need to use other fixtures for your samples, get permission from Bill Flounders or Sia Parsa.

(5) Press **PROF** button until the desired program number is selected on the Partlow temperature controller.

(6) Press the **OPERATOR PANEL** button until the **PROCESS PARAMETER SELECT PANEL** page is displayed on the QUICKPANEL, touch screen panel. Indicate required process parameters. See YES vacuum oven manual for more details.

(7) Make sure the touch screen displays **READY TO PROCESS** before starting the process. If not, press the **OPERATOR PANEL** to return to the main status screen manual and the **READY TO PROCESS** will display.

(8) Press the big black **START** button on the system controller.

Note: To start the process, DO NOT press the **RUN/HOLD** button on the Partlow. Doing so will do nothing.

(9) When a message on the touch screen said that the process is complete, press the big red **RESET** button on the system controller.

Note: The wait time for the chamber to ramp down to set point, may take many hours. Therefore, you can vent the chamber when the temperature drops to 120°C on your cooling step (abort your process). You can vent the chamber by setting the thumbwheel to 2 and press the big black **START** button. Do not open the oven with temperature >150ºC. You can be seriously burned if the chamber is open when too hot.

Note: You may press the big red **RESET** button anytime to abort your process. Load your wafers in the boats using the MOS clean vacuum wand.

(10) Unload your wafers.

Note: Use the high temperature dedicated mitts to unload the anodized cassette when it is hot. Careful! You must have a good grip on the cassette when unloading it.

(11) Leave the oven pumped down when not in use. Set thumbwheel to 0 (pump down) and press **START** button

MOD 6
Standard Photoresist Coating Procedure

A. HMDS TREATMENT OF WAFER SURFACE

Purpose: To improve photoresist adhesion to the wafer surface especially for wafers coated with oxide.

Equipment: primeoven

Time of Execution: 35 minutes

Summary:

(1) Vacuum prime wafers with HMDS for 5 minutes.

Detailed Procedure:

(1) Place your wafers in a Teflon® cassette.

(2) Place the cassette in the primeoven and close door securely.

(3) Verify that the thumbwheel switch is set to 0.

(4) Press the black START button.

(5) The system will now begin the automatic pump/purge/prime sequence followed by a prime sequence.

(6) When the cycle is complete, the COMPLETE light will flash and the system will alarm. Press the red RESET button to silence the alarm.

(7) Open the door, remove the cassette, and close door.

Note: The process dehydrates as well as vapor primes, so dehydrating the wafers first in the VWR oven is not necessary for the YES oven HMDS prime process. The wafers should NOT be put through more than one complete prime cycle; over priming will cause resist adhesion problems. The wafers can be left up to 3 weeks before coating with resist.

B. PHOTORESIST COATING

***Purpose*:** To spin coat wafers with specific photoresist as per follows:

(1) To spin coat a 1.3 µm OCG 825 (G-line positive) photoresist layer onto 4" wafers.

(2) To spin coat a 1.1 µm of OiR 10i (I-line positive) photoresist layer onto 4" wafers.

(3) To spin coat 10 µm of thick resist, SPR 220-7.0 photoresist layer onto 4" wafers, See MOD 29.

Equipment: SVG Wafer Track

Time of Execution: 2 minutes/wafer (I-line & G-line resists), 7 minutes/wafer for thick resist (longer bake).

Summary:

Note: Wafers must first have been dehydrated and/or HMDS treated.

(1) For OiR 10i resist execute program #1, on svgcoat 1 and 2 (SVG coat tracks 1&2) :

(a) Dispense photoresist for 1.5 seconds dynamically at 500 rpm.

(b) Spread at 500 rpm for 1.5 seconds.

(c) Spin at 4100 rpm for 30 seconds.

(d) Soft bake at 90ºC for 60 seconds.

(e) Cool on cold chuck for 3 seconds.

(2) For OCG 825, G-line resist execute program #2, on svgcoat 1 and 2:

(a) Dispense photoresist for 1.5 seconds dynamically at 1000 rpm.

(b) Spread at 500 rpm for 1.5 seconds.

(c) Spin at 5000 rpm for 30 seconds.

(d) Soft bake at 90ºC for 90 seconds.

(e) Cool on cold chuck for 3 seconds.

(3) For Rohm Hass SPR 220–7.0 resist execute program #8, on svgcoat 1 and 2:

(a) Statics dispenses photoresist for 1.5 seconds.

(b) Spread at 300 rpm for 3.0 seconds.

(c) Spin at 1800 rpm for 30 seconds.

(d) Soft bake at 115ºC for 300 seconds.

(e) No cooling on cold chuck.

Detailed Procedure:

(1) Enable either svgcoat1 (Track #1) or svgcoat2 (Track #2).

(2) Verify that power to the system is ON.

(3) Adjust hot plate temperatures to desired set points.

(4) Verify that the track is in AUTO mode; the LED next to the word AUTO will be illuminated. If not, press this switch to toggle through the other options (SINGLE and MANUAL) until AUTO is selected.

(5) Select the desired dispense program (see coater program table, below).

Note: There are 2 separate display windows on the control panel: COATER and OVEN. To select the dispense program, the COATER display must be selected. When the COATER display is selected, an asterisk appears at the left of the COATER display and when the OVEN display is selected, a plus sign appears at the left of the OVEN display. You can toggle between the two using the STATION SELECT button on the control panel keyboard. With the COATER display active, press the PROGRAM SELECT button on the control panel keyboard to toggle through the available programs (1-9). Alternatively, you can press the desired program number key followed by the PROGRAM SELECT button to select the program.

(6) Verify that the correct oven program is selected for your desired resist (refer to bake program listed in the table below). As with the dispense program, the OVEN display must be active in order to select different programs.

(7) If necessary, press INDEX RESET button to bring indexers to their starting positions (fully up). Note that if you press the INDEX RESET button, you must lift the cassettes completely off the elevator and then replace them in order to proceed.

(8) Load an empty cassette onto the receive indexer (right side) and the cassette containing your wafers and 3 dummy wafers on the send indexer (left side). Make sure that the cassettes are properly seated on the indexers.

(9) Press the START button. The receive cassette will lower and the send cassette will lower until it senses a wafer. The wafer will then be transported to the spindle station for the dispense procedure, then to the bake station for soft baking, and finally to the chill plate and receive cassette.

Note: If the machine alarms at any point during the coating process, silence the alarm by depressing the CLEAR button. The machine state can be checked using the diagnostics feature as follows:

(10) Press the DIAGNOSTIC SELECT key on the control panel. The display will show the following prompt:

SELECT MODE 1 – 2

(11) Press 1 to display the present machine state. The machine state diagnostic messages for the upstream indexers and processing stations are displayed in the upper display window. Machine state messages for the downstream sensors are displayed in the lower display window.

(12) When all wafers have been coated and loaded into the receiving wafer cassette, depress the INDEX RESET button to bring the cassette up to its fully raised position.

(13) Remove all your wafers and replace the cassette back on the receiving platform.

Coater Programs

Program (#)	Resist Type	Spin Speed (RPM)	Refractive Index	Thickness (µm)
***1**	OiR 10i (I-Line)	4100	Default value ~1.631	~1.1
*2	OCG 825 (G-Line)	5000	Default value ~1.631	~1.3
3	OiR 10i (I-Line)	2000	Default value ~1.631	~1.6
4	OCG 825 (G-Line)	2200	Default value ~1.631	~2.0
5	OiR 10i (I-Line)	1300	Default value ~1.631	~2.0
6	OiR 10i (I-Line)	820	Default value ~1.631	~2.8
7	None			
**8	SPR 220 - 7.0 (Broadband)	1800	Default value ~1.631	~10.0
9	Edge Bead Removal (EBR)	600	Default value ~1.631	N/A

* Standard Programs
** Standard Thick Resist Program:

Note1: Must run EBR program #9 before softbake on coater 1.

Note2: If decided not to perform edge bead removal (EBR), then softbake must be done on hotplates in Y1 to prevent coater track's bake station contamination.

Oven (soft bake) programs

Program (#)	Bake Temp. (ºC)	Bake Time (sec.)	Chill Time (sec.)
***1**	90	60	6
2	90	90	6
3	90	120	6
7	90	180	6
**8	115	300	0
9	No Bake	0	0

* Standard Program
** Standard Thick Resist Program

Note: For the thick resist process, users must adjust program #8 bake temperature to 115ºC manually and then return to 90ºC, after finishing the softbake process.

MOD 7

Standard Photoresist Development

A. POST EXPOSURE BAKE (PEB)

Purpose: To improve the photoresist profile following exposure on gcaws1 stepper (I-line resist).

Equipment: svgdev

Time of Execution: 1.5 minutes per wafer

Summary: 1 minute hotplate bake at 120ºC

Detailed Procedure:

(1) Load wafers in the send cassette on the SVG develop track (svgdev).

(2) Following the detailed procedure in section B, select dev program #8 and bake program #1.

(3) Press START. Wafers will be sent to the hotplate for a 1 minute bake at 120ºC (bypasses the coat).

(4) When process is complete, remove cassette and wafers.

Note: This process is strongly recommended whenever you use the I-line stepper to expose wafers; it will improve the photoresist sidewall profile and resist adhesion for submicron lines and spaces. It is not necessary when using the G-line stepper (gcaws2).

B. PHOTORESIST DEVELOPMENT

Purpose: To develop exposed OCG 825 coated wafers with OCG 934 developer 2:1 (premixed); to develop exposed OiR 10i coated wafers with OPD HPRD 4262 developer (premixed); to develop exposed thick resist (SPR22-7.0) coated wafers with Rohm Haas MF-26A developer (premixed).

Equipment: svgdev

Summary:

Note: There are total of 6 resist developer programs available on this track for I-line & G-line resists. No Developer program available for thick resist on this track. Perform post exposure bake (PEB), if

necessary. Refer to general resist parameters chapter for more details on developer type, develop time needed for I-line, G-line and thick resists.

(1) Program 1 is the standard developer program for I-line (OiR 10i) resist.

(2) Program 2 is the standard developer program for G-line (OCG 825) resist.

(3) No developer program available for the thick resist (SPR-220-7.0), which can be manually developed at sink5.

Detailed Procedure for I-line & G-line Resist Developing:

(1) Enable the svgdev.

(2) Verify that the power to the system is ON.

(3) Verify that the SVG is in AUTO mode; the LED next to the word AUTO is illuminated.

(4) Select your desired developer program, as per resist type noted in the SVGDEV table, below.

(5) If necessary, press INDEX RESET button to bring indexes to their starting positions.

(6) Load an empty cassette onto the receive indexer and the cassette containing your wafers onto the send indexer.

(7) Press the START button. The send cassette will lower until it senses a wafer; the receive cassette will lower to wait for the wafers.

(8) When all wafers have been developed, press the INDEX button to return the receive cassette to its starting position.

(9) Remove your wafers and return the cassette to the platform.

(10) Disable the svgdev.

Detailed Procedure for Thick Resist Developing:

Note: For single wafer developing or very small group of wafers, use a shallow beaker instead of the recommended bath at sink5, and follow the instruction in steps 4-10, below.

(1) Enable the sink5.

(2) Remove the Teflon cassette currently in one of the spin rinse dryers station at sink5 (4" or 6").

(3) Place your wafers in the Teflon cassette.

(4) Place enough developer in the extra developer tank available at the front side of sink5 station. Make sure to DI rinse/drain the tank a few times, before filling it up with Rohm Haas MF-26A developer (developer for SPR-220-7.0 resist).

(5) Depending on the pattern density and the exposure used for your application, you may need to develop your exposed resist for 3-15 minutes. Agitate the solution (gently move your cassette/wafer/s up and down) to ensure uniform development.

(6) Once done with the develop step, immediately rinse your wafers (cassette) in the quick dump rinse (QDR) tank at the station.

(7) Place the cassette in the spin rinse dryer (SRD) next to sink5 for additional rinse followed by a dry step.

(8) Remove wafers from the SRD and out of the Teflon cassette.

(9) Return the Teflon cassette back into the SRD.

(10) Aspirate the developer and rinse/drain the tank.

(11) Disable sink5.

SVGDEV Programs

Developer Programs					
Programs	**Developer(s)**	**Resist(s) Developed**	**Puddle**	**Dev. Time** (sec)	**Comments**
*1	OPD 4262	OiR 10i	Single	60	Standard I-Line Develop
*2	OCG 934 2:1	OCG 825	Double	2 × 30	Standard G-Line Develop
3	OPD 4262	OiR 10i	Single	30	Half-Time I-Line Develop
4	OCG 934 2:1	OCG 825	Single	30	Half-Time G-Line Develop
5	OCG 934 2:1	OCG 825	Double	2 × 38	25% G-Line over-develop
6	Rinse	None	None	None	Rinse and Spin Dry
8 (PEB)	None	None	None	None Bake	Post-Exposure

*Standard Develop Programs

Bake Programs			
Program (#)	**Bake Temp.** (°C)	**Bake Time** (sec)	**Chill Time** (sec)
1 (PEB)	120	60	6
2	120	90	6
3	120	120	6
*9	No Bake	0	0

Dispenser Assignments			
Developer	**Resist**	**Dispenser**	**Toggle Position**
OPD 4262	OiR 10i	Stream (DV-ST)	N. A.
OCG 934 2:1	OCG 825	Spray (DV-ST)	(not used)

C. INSPECTION

Purpose: To check for clear development and correct line width.

Equipment: Microscope and linewidth

Detailed Procedure:

(1) Inspect wafer under microscope for clear development and correct line width. Critical dimensions (CD) can be measured on linewidth. Be sure to use the yellow filter or your resist will be exposed!

(2) If development is satisfactory, go to the next step in your process flow path.

(3) If development is not satisfactory, develop again or carry out the following:

(a) Resist stripping, as per MOD 12 and/or MOD 11 instructions.

(b) Wafer Cleaning After Resist Removal, as per MOD13 instructions.

(c) Standard Dehydration Bake, as per MOD 4 instructions.

(d) Standard Photoresist Coating Procedure, as per MOD6 instructions.

(e) Resist Exposure.

(f) Standard Photoresist Development, as per MOD6 instructions.

MOD 8
Standard Hard Bake

Purpose: To drive out solvent in photoresist before etching or ion implantation.

Equipment: VWR convection oven

Time of Execution: at least 30 minutes

Summary: Bake wafers at 120ºC

Detailed Procedure:

(1) In a drawer underneath the VWR oven tabletop are Teflon® cassettes specifically for use in hard bake. Load the wafers into one of these cassettes. Label a plastic insert (using the write-on tape) with your name and date and insert in cassette.

(2) Put cassette with wafers in VWR oven for at least 30 minutes.

MOD 9
Standard De-Scum Procedure

Purpose: To remove resist residue in normally cleared areas

Time of Execution: 3 minutes per set of 4 wafers

Equipment: Technics-C

Summary:

(1) Vent the system and place wafers in chamber.

(2) Pump system down to base pressure (~35 mTorr).

(3) Introduce oxygen into chamber.

(4) Strike plasma by turning on power to 50 watts. Set time for 1 minute.

(5) Turn off power, then gas.

(6) Pump down chamber to remove reacted gases.

(7) Vent chamber and remove samples.

Detailed Procedure:

(1) The status of the machine should be as follows:

Mode:	Manual
SOL'N (Solenoid):	Closed
Vent:	Off
Power:	Toggle Off, Knob Pegged Counterclockwise
Gas #1:	Off
Gas #2:	Off

Occasionally the solenoid which controls the vacuum pump is left open. If this is the case, close it before enabling the system.

(2) Once you are ready to introduce your sample, vent the chamber by toggling the VENT switch. Be sure that the SOL'N is closed when you do this. It will take about 15 seconds for the chamber to fill. Once at atmospheric pressure, open it carefully - the top is very heavy - and place your wafers on the plate. Close the top carefully, being sure not to allow it to fall.

(3) Oxygen for photoresist descum is connected through GAS #1.

(4) To start the vacuum pump, leave the vent ON, and toggle the solenoid (vacuum pump) switch open. After 2 or 3 seconds, close the vent switch to allow the pump to lower the pressure of the chamber.

(5) You can watch the pressure drop as the system comes under vacuum. When the system reaches base pressure, introduce oxygen into the chamber by toggling the GAS #1 switch (be sure the O switch on the PD module is up). The pressure in the chamber will rise as gas flows in, and then stabilize.

(6) Once gas flow into the chamber is stable and at the desired pressure, (~300 mTorr - this is preset) strike a plasma by switching the POWER toggle on and turning the dial clockwise until 50 Watts is reached. The plasma is visible through the window on the front of the chamber. Begin timing your run for 1 minute.

(7) Once the run is complete, turn off the power, then the gas. Always turn off the power before turning off the gas.

(8) Allow the chamber to pump down to base pressure to sweep all potentially harmful gases out of the chamber.

(9) Turn off the vacuum pump by switching the SOL'N toggle to closed position. Now you may vent the chamber. Again, remember not to vent the chamber until the SOL'N has been closed.

(10) The chamber will now come up to atmosphere and sample can be removed.

(11) Once the sample has been removed, close the chamber and start the vacuum with the vent open. After a couple of seconds, close the vent and allow the chamber to pump down to base pressure. Close the SOL'N. Be sure that gas switches and power are off.

MOD 10
Photoresist Removal

Purpose: To remove photoresist on wafers, the following cases are considered:

A: Removing soft photoresist from wafers with NO metal layer on them after any etch step OR reworking such wafers at any photolithography step (stripping resist from non-metalized wafers).

B: Removing soft photoresist on wafers with metal layers on them (metalized wafers).

C: Removing hardened (long hard baked or implanted or etched) photoresist on wafers with NO metal on them.

D: Removing hardened (long hard baked or implanted or etched) photoresist from wafers with metal on them.

CASE A

Purpose: To remove soft photoresist on resist coated wafers with no metal on them.

Equipment: Sink5 (PRS-3000 baths) or plasma ash followed by sink8 (piranha bath)

Summary:

(1) Do MOD 11 PRS-3000 bath and/or MOD 12 Plasma Ashing of Photoresist (technics-c and matrix) to remove all of the resist from your sample.

(2) Do MOD 13 piranha clean after resist removal is done.

Detailed Procedure:

Explained in MOD 11, MOD 12, and MOD 13.

CASE B

Purpose: To remove soft photoresist on wafers coated with aluminum or refractory metals. Please note, other metals including; noble metals (Gold, silver) and copper are not allowed in the VLSI sinks or in sink5, as well as any of the process equipment in the VLSI section of the lab.

Note1: Most metals can get attacked by piranha, therefore ARE NOT allowed in sink6 or sink8. Wafers with aluminum and refractory metals should be cleaned in the PRS-3000 solution or get ashed (O2 plasma cleaned) in the matrix or technics-c machines.

Note2: Refractory metals are metals with melting points above 1500ºC (Molybdenum**,** Tungsten, Tantalum, Rhenium and niobium)

Note3: Noble metals do not easily get corroded by oxygen: Some are highly diffusive in Si, therefore, can negatively impact fabricated MOS device performance. This means noble metals (Ag, Au, Ir, Os, Pd, Pt, Rh, Ru), especially gold are not allowed in the VLSI area/sinks (sink6 - sink9). Gold is also not allowed in Sink5.

Equipment: Sink5 (PRS-3000 bath), matrix or technics-c asher.

Summary:

(1) Do MOD 12 plasma ashing of the photoresist to adequately remove all this material from your wafers.

and/or

(2) Do MOD 12 PRS-3000 Resist Stripping. Please be aware that aluminum surface may get impacted (pitted) by the PRS-3000 solution, cases have been reported in the past!

Detailed Procedure:

Explained in MOD 11 and MOD 12.

CASE C

Purpose: To remove the photoresist from wafers with NO metal on them that have been hardened by plasma etching or by implantation or because the baking time has been too long.

Equipment: Technics-c or matrix, sink8

Summary:

(1) Do MOD 12 Plasma ashing of photoresist in technics-c or matrix asher, and if necessary increase the ash time to ensure complete resist removal (Max. 10 minutes).

(2) Do MOD 13 wafer cleaning of wafer with no metal on them in sink8 for 10 minutes, after the resist has completely been removed from the wafers (non-metalized wafers only).

Detailed Procedure:

Explained in MOD 12 and MOD 13**,** if needed additional MOD 14.

CASE D

Purpose: To remove the photoresist on wafers with metal on them that have been hardened by plasma etching or by implantation or because the resist baking time may have been too long.

Equipment: Technics-c or matrix, Sink5 (PRS-3000),

Summary:

(1) Do MOD 12 plasma ashing of photoresist in technics-c or matrix asher, and if necessary increase the ash time to ensure complete photoresist removal (Max. 10 minutes) .

(2) Do MOD 11 wafer cleaning after the resist removal in sink5 PRS-3000 solution.

Detailed Procedure:

Explained in MOD 12 and MOD 11.

Note: If resist is somehow hardened beyond the point that the above MOD 12 procedure cannot strip it, then perform an additional MOD 14 to remove such hardened photoresist. You may also increase the ash time for the ash step, if necessary (Max. 10 minutes).

MOD 11
PRS-3000 Resist Stripping

Purpose: To remove soft photoresist from wafers.

Equipment: Sink5, srdsink5

Summary:

(1) Strip resist in sink5 PRS-3000.

(2) Spin dry wafers in srdsink5.

(3) Do MOD 13 wafer cleaning after resist removal for wafers with no metal on them.

Detailed Procedure:

(1) Enable sink5 and srdsink5 on the wand.

(2) Lift cover off the PRS-3000 bath and put it aside.

(3) Load wafers to be cleaned into a Teflon® cassette; use appropriate cassette handle for the cassette you choose.

(4) Put wafers in 80ºC PRS-3000 photoresist stripper quick soak bath or long soak bath. Leave the handle on the cassette to prevent accidental breakage of your wafers by the next user, who may not clearly see if there is a cassette in the bath (PRS-3000 with dissolved resist in it looks murky, therefore it is hard to see objects inside it).

Note: Quick soak bath is for stripping resist up to 20 minutes assigned to the task of stripping soft baked resist. Long soak bath is for stripping resist from 20 minutes to 8 hours. Long soak bath can be used for stripping resist on resist bonded wafers, hard baked resist wafers, and resist etched in a plasma chamber.

(5) Pull cassette out of PRS-3000 photoresist stripper bath when you are finished with stripping the resist, and put it in the water filled QDR tank.

(6) Replace cover on the PRS-3000 bath.

(7) Press the STOP/RESET button on the QDR, and then press the START button.

(8) When the water rinse is finished, press the STOP/RESET button.

(9) Take the cassette handle off. Blow dry (N2 gun) the wafers, if you use the 1/2 size Teflon® cassette, otherwise, transfer the 4" full Teflon® cassette in the top spin dryer or for your 6" wafers use the bottom spin dryer of srdsink5. Make sure the H-bar is facing in.

(10) Press the START button on the appropriate unit on srdsink5. This recipe will rinse and spin dry the wafers.

(11) At the end of the cycle, the spin dryer will stop.

(12) Remove the cassette when the spin dryer stops completely and then unload the wafers.

(13) Disable sink5 and srdsink5 on the wand.

(14) Do MOD 13 wafer cleaning procedure to remove resist residues, if necessary (non-metal wafers).

Note: Only staff are allowed to drain and change sink5 PRS-3000 baths.

MOD 12
Plasma Ashing of Photoresist

Purpose: To remove hardened photoresist post etch or implantation step, using the oxygen plasma.

Equipment: Technics-C or matrix asher

Summary:

Note: Please refer to technics-C and Matrix asher manual for details on recipes and the etch rate to be used.

A – Technics-C Plasma Asher

(1) Vent the system and place wafers in chamber.

(2) Pump system down to base pressure (~35 mTorr).

(3) Introduce oxygen into the chamber.

(4) Strike plasma by turning on power to 300 watts. Set process time, as needed for complete photoresist stripping, then run the process.

(5) Turn off power, then gas.

(6) Pump down chamber to remove reacted gases.

(7) Vent chamber and remove samples.

B – Matrix Plasma Asher

(1) Vent the system.

(2) Place your wafers in the cassette.

(3) Load the cassette on the stage.

(4) Run the standard ashing recipe.

(5) Remove the cassette and unload your wafers.

(6) Put system back in standby mode.

Detailed Procedure:

Technics-C Operation in Auto Mode

(1) Start with the machine in manual mode. All valves should be closed.

(2) Vent the chamber by toggling the VENT switch up. It will take ~15 sec for the chamber to fill. Once it is at atmospheric pressure, lift/open the chamber door carefully, and place your wafers on the plate. Close the chamber lid. Toggle the VENT switch off.

(3) Toggle the mode switch to auto mode (up).

(4) Toggle the SOL'N and VENT switches ON (up).

(5) You can watch the pressure drop as the system comes under vacuum. When the system reaches ~30 mtorr, you can introduce the gas you wish to use into the chamber by toggling the appropriate gas switches as follows.

(6) Turn on the gas1 switch (up) on the PD module and toggle GAS #1 (O2) on the PE module

(7) Toggle the switch power ON and turn the dial clockwise six turns from the eleven o'clock position. Each turn is 50 Watts for the total power needed (300 Watt).

(8) Set the desired time. Standard time is five minutes.

(9) Press **Start/Stop** switch to start.

(10) Once the cycle is completed, the machine will **beep**, and the **Start/Stop** button will light up. Press **Start/Stop** again to silence the **beep**.

(11) If loading more wafers, wait until the system is vented to continue.

(12) Once the cycle is completed, after unloading the last wafers, turn all switches off, starting with the power switch. Bring the power dial to zero.

(13) Bring the system to **Manual** mode.

(14) Toggle the SOL'N switch and pump the system down to base pressure.

(15) Close the SOL'N, and disable the technics-c.

Technics-C Operation in Manual Mode

(1) The status of the machine should be as follows:

Mode:	Manual
SOL'N (Solenoid):	Closed
Vent:	Off
Power:	Toggle Off, Knob Pegged Counterclockwise
Gas #1:	Off
Gas #2	Off

Occasionally the solenoid which controls the vacuum pump is left open. If this is the case, close it before enabling the system.

(2) Once you are ready to load your sample, vent the chamber by toggling the VENT switch. Be sure that the SOL'N is closed when you do this. It will take about 15 seconds for the chamber to fill. Once it is at atmospheric pressure, open it carefully (the top is very heavy), and place your wafers on the plate. Close the top carefully, being sure not to allow it to fall.

(3) Oxygen for photoresist ashing is connected through Gas #1.

(4) You are now ready to start the vacuum pump. Leaving the vent ON, toggle the solenoid (vacuum pump) switch open. After 2 or 3 seconds, close the vent switch to allow the pump to lower the pressure of the chamber.

(5) You can watch the pressure drop as the system comes under vacuum. When the system reaches base pressure, introduce oxygen into the chamber by toggling the GAS #1 switch. The pressure in the chamber will rise as gas flows in, and then stabilize.

(6) Once gas flow into the chamber is stable and at the desired pressure, (270-280 mTorr - this is preset) strike a plasma by switching the POWER toggle on and turning the dial clockwise until

300 Watts is reached. The plasma is visible through the window on the front of the chamber. Begin timing your run.

(7) Once the run is complete, turn off the power, then the gas. Always turn off the power before turning off the gas.

(8) Allow the chamber to pump down to base pressure to be sure all potentially harmful gases have been swept out of the chamber.

(9) Turn off the vacuum pump by switching the SOL'N toggle to closed position. Now you may vent the chamber. Again, remember not to vent the chamber until the SOL'N has been closed.

(10) The chamber will now come up to atmosphere and you may remove your sample.

(11) Once your sample has been removed, close the chamber and start the vacuum with the vent open. After a couple of seconds, close the vent and allow the chamber to pump down to base pressure. Close the SOL'N. Be sure that gas switches and power are off.

(12) Disable Technics-C.

C – Matrix

(1) Enable the Matrix asher.

(2) Check the operator console and see if it is in standby mode, then exit by pressing the **EXIT** key. Wait until chamber is vented and main operating page is displayed.

(3) Load your wafers in the designated input cassettes, available at the station (4" or 6").

(4) Adjust the cassette receiver (stage) to accept your desired wafers size (4" or 6") by placing the input cassette on the stage and adjusting the knobs on the stage.

(5) Press **RUN** in the run option screen (standard recipe), and it will take you to the next screen.

(6) Press **HOME** to reset the cassette on this screen or use the Up and Down key under the move cassette option submenu to position your first wafer in front of the pick and place wafer transport, starting with the lowest desirable wafer slot in the cassette.

(7) Press **AUTO** or **SINGLE** to start the ash process. This will automatically process your wafers or one wafer at a time depending on your selected mode of operation.

(8) After you are done ashing, remove the wafer cassette.

(9) Press the **STANDBY** key to leave the machine in the standby mode with chamber isolated from the atmosphere.

Note: The Matrix standard recipe ashes for 1.5 minutes. Repeat the process if the wafers are not clean after the first ash. Please refer to **Matrix 106 Resist Removal System** chapter manual for more detailed information.

MOD 13

Wafer Cleaning After Resist Removal

Purpose: To clean wafers of resist residue after resist has been stripped by PRS-3000 stripper, plasma ashing, or hardened photoresist stripping (MODs 11, 12, 14) on wafers with no metal layer on them.

Equipment: Sink 8 and Fluorocarbon, QDR and spin/dry (srdsink8) for wafers with no metal layer on them.

(1) Sink8 cleaning can be performed on wafers with no metal layer on them (non-MOS and MOS) that have gone through PRS-3000 photoresist stripping and/or plasma ash processes (photoresist removal). Sink 8 piranha bath is reserved specifically for cleaning resist residue that may have been left behind by the ash process.

Note: All wafers going into the furnace must be cleaned again in Sink 6 (pre-furnace clean), MOD 1.

(2) Be sure to use the cassettes and handles numbered for the appropriate sink. Do not mix cassettes and handles between sinks 6, 7 and 8 or other sinks.

Detailed Procedure:

Please refer to sink8 operation manual.

MOD 14
Photoresist Stripping of Hardened Resist

Purpose: To remove hardened photoresist on wafer after high energy implant or plasma etch.

Note: Photoresist can normally be removed using plasma ashing (MOD 12). Only in cases of abnormally high implant doses or harsh plasma etches does the resist become hard enough to warrant this treatment.

Equipment: The ultrasonic bath and the sink432C (Chem Room).

Resist Strippers: The lab currently has the following standard resist stripper available: PRS-3000 (J.T. Baker). Processing parameters are detailed in Table 1.

Note: Any resist stripping should be done under an operational fume hood and protective clothing should be worn at all times.

Summary:

(1) Heat up two 1000 ml beakers filled with resist stripper to desired temperature (65ºC max.) in the ultrasonic bath (be sure to fill bath with water).

(2) Immerse wafer in first beaker for 5 minutes. Transfer to second beaker and immerse for 5 minutes.

(3) Rinse thoroughly in DI water.

(4) Do MOD 12 plasma ashing of photoresist in technics-c or matrix asher, if necessary.

(5) Do MOD 13 wafer cleaning procedure after resist removal on wafers with no metal layer on them.

Detailed Procedure:

(1) Turn on the temperature controller to the ultrasonic bath, which is at the left of sink432C to your desired temperature (Max. 65ºC).

(2) Check that the temperature setting is correct. It will take 30-60 minutes to stabilize at this temperature.

(3) Transfer your wafer to a single white Teflon® wafer holder.

(4) Turn on the ultrasonic agitation and immerse holder and wafer in the first beaker for 5 minutes when the temperature is stabilized. Transfer the wafer to the second beaker and immerse for 5 minutes. The first bath should remove the bulk of the resist, while the second bath cleans up any remaining traces of photoresist.

(5) Remove the wafer from the bath. Inspect your wafers visually for resist residue. Repeat step 4 if necessary.

(6) Rinse wafer thoroughly with flowing DI water.

(7) Turn off temperature controller if you do not expect anyone to use it within the next hour.

(8) Do MOD 12 Plasma Ashing of Photoresist in technics-c or matrix asher, if necessary.

(9) Do MOD 13 wafer cleaning procedure after resist removal only for those wafers which do not have any metal layers on them (skip piranha clean on wafers with metal layers on them).

Disposal:

Please Note PRS-3000 can be used many times over, however, once ready for disposal, you should pour it in a marked plastic bottle, logged in as PRS-3000 in the chemical disposal cabinet in the old lab for pick up. Please do not aspirate this chemical.

Table 1 - Resist Strippers

Stripper	Substrates	Bath Temp Type	Agitation	DI water Rinse
PRS-3000	All	Positive	25-65ºC	Yes
Microposit 1165	All	Positive	25-80ºC (Max.)	

Note1: PRS-3000 is the standard photoresist stripper currently available in sink5.

Note2: Required temperature will depend on previous resist processing conditions. Very **hard** resist will require the higher temperatures for successful removal. Please ask process engineering staff for permission, and do not exceed flash point temperature of the stripper (refer to MSDS spec sheets in the lobby).