



Lab Manual

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Cleaning Procedures

1.0 Introduction

All cleaning procedures must be performed correctly, otherwise wafers and labware are likely to become contaminated rather than clean. Never touch a wafer with your hands, and always use clean tweezers. Use stainless steel tweezers for non-acid work and Teflon[®] holders for acid work. Use DI water only for any cleaning and rinsing in the lab.

2.0 Cleaning Laboratory Ware

Correct and thorough cleaning of Pyrex, Teflon[®] or polypropylene ware (beakers, petri dishes, wafer boxes, thermometers, stirring rods, etc.), is very important. All cleaning is to be done in the Chemical Room of the Old Lab (Room 432C and cleaned at sink432C.)

- 2.1 Scrub all items to be used in the lab in **Nova Clean NC-1** with a brush.
- 2.2 Rinse thoroughly in running DI water for two minutes.
- 2.3 Perform the **water break** test: Submerge the item in DI water and observe the film of draining water.

On a clean surface it will remain unbroken and fairly uniform. Contaminants will cause breaks or sharp irregularities such as **islands** to appear in the color fringes and droplets remain on the surface.

- 2.4 Allow to drain and dry chemical ware in the oven on an aluminum foil sheet, under an IR lamp or with a nitrogen gun.

3.0 Cleaning Tweezers

3.1 Degrease

Degrease all new stainless and Teflon[®] tweezers as follows prior to cleaning:

- ▶ 5 minutes rinse in acetone
- ▶ 1 minute rinse in running DI water

3.2 Cleaning

3.2.1 Metal and Teflon[®] Tweezers - Removal of Organics

Use acetone as per Section 3.1, to remove residual organic contaminants.

4.0 Wafer Handling & Cleaning

To minimize contamination from the tweezers, never allow the rinse or dip to touch the tweezers before it touches the wafer. Rinse or blow-dry toward the tweezers.

4.1 Standard Wafer Cleaning in the VLSI Area

(Removal of residual organic and metal contaminants)

- 4.1.1 Piranha clean for 10 minutes at sink6.
- 4.1.2 Rinse wafers in the sink6 QDR (quick dump/rinse) which is currently set for two dump/rinse cycles.
- 4.1.3 Final rinse until water resistivity reaches 10 megohm-cm.

4.1.4 Place in the sink6 SRD (spin-rinse/dryer) for a final rinse and dry cycle. Water resistivity should reach 12 or more after this step.

4.2 Thin Oxide Film Removal

Dip in 10:1 H₂O : HF until front and back of wafer dewet. Pulling the wafer from the water leaves an absolutely water free surface with only a drop or two on the lowest edge. If this test fails, reclean.

4.3 RCA Clean (widely used in industry)

*This procedure is optional.

RCA-1 - Removes organic residues

5 H₂O (DI Water)
1 NH₄OH (Ammonium Hydroxide)
1 H₂O₂ (Hydrogen Peroxide)

RCA-2 - Removes metallic residues

6 H₂O (DI Water)
1 HCl₂ (Hydrochloric Acid)
1 H₂O₂ (Hydrogen Peroxide)

Process

5 min. in RCA-1 at 70°C
5 min. in DI water rinse
5 min. in RCA-2 at 70°C
DI water rinse to 10 megohm-cm

5.0 Quartzware Cleaning Procedure

Hydrofluoric acid (HF) is extremely dangerous. Always wear chemical-resistant gloves on top of your surgical gloves, rubber apron and eye protection (safety goggles plus face shield) when you work with it. Test your gloves for leaks by inflating them with the N₂ gun to twice their size and immersing in a water bath. If any bubbles of escaping gas are observed throw the glove away.

- 5.1 For all quartzware, it is essential that oils (from fingerprints) or other organic contaminants be removed by wiping with trichloroethane followed by acetone.
- 5.2 The cleaning solution consists of 5% HF : 95% DI water.
- 5.3 Rinse well in DI water. Dry under IR lamp or in oven.

6.0 Tystar Dummy Cleaning Procedure

6.1 Wafer Identification

All dummy wafers are specific to a furnace and should be scribed on the back with the furnace number. Each furnace deposits a different film as follows:

- tystar9 and tystar17: silicon nitride
- tystar11 and tystar12: doped and undoped silicon dioxide
- tystar10 and tystar16: doped and undoped polysilicon

Each film requires a different method of removal as described below. If you are unsure what film/s is/are on a dummy wafer, contact Sia Parsa, Process Engineering Manager.

6.2 Tystar9 (Silicon Nitride)

6.2.1 Make sure that the dummies are scribed on the back with the tystar name. If not, scribe TYSTAR9 on the back.

- 6.2.2 Load wafers into a sink7 cassette and dip in 5:1 HF for about 15 seconds. (If necessary, fill the left non-MOS bath at sink7 with the 5:1 BHF. Rinse the wafers thoroughly in the sink7 non-MOS clean QDR.
- 6.2.3 Place cassette in phosphoric acid bath located in the right side heated bath of sink7.
- 6.2.4 Turn the heater on and check that the set point is at 160°C.
- 6.2.5 Leave the cassette in the bath for about 24 hours. (Longer may cause surface damage to wafer characterized by a clouding of the smooth surface and recognizable polish marks. Damaged wafers should be thrown out.)
- 6.2.6 Remove, rinse, and dry the wafer cassette.
- 6.2.7 At this point the wafers may be stored for piranha cleaning in the original tystar dirty box. If so, label the box accordingly.
- 6.2.8 Standard piranha clean in sink8 then sink6.
- 6.2.9 Place clean, stripped dummies in clean tystar9 dummy box.

6.3 Tystar10 and tystar16 (Polysilicon)

- 6.3.1 If the dummies are new, dummies must be scribed on the back with the tystar name. If not, scribe them.
- 6.3.2 Dummies to be reworked must be sorted. Those with obvious stress lines should be discarded.
- 6.3.3 Make special silicon etch if not made already 2200ml Water:2200ml Nitric Acid:90ml HF. This should be made in the left heated bath at sink7. If the etch is already made up, add 15ml HF prior to etching.
- 6.3.4 Turn on the heater. The setpoint should be around 80-85°C. The heater greatly increases the etch rate. Place cassette of dummies in etch. The time of the etch will vary but it should never exceed 7 minutes. The sacrificial nitride layer may etch away resulting in surface damage. Surface damage is characterized by a clouding of the smooth surface and recognizable polish marks. The etch is very nonuniform so look out for thinning of the nitride layer. The etch is done when the wafers are brilliantly colored purple or yellow.
- 6.3.5 Remove, rinse, and dry the cassette. Inspect the wafers. If the wafer color is a light blue or the shade of a bare wafer, set wafer aside to be coated with nitride.
- 6.3.6 At this point the wafers may be stored for piranha cleaning in the original tystar10 or tystar16 dirty dummy box. If so, label the box accordingly.
- 6.3.7 Standard piranha clean in sink8 then sink6.
- 6.3.8 Place clean, stripped dummies in the clean tystar10 or tystar16 dummy box.
- 6.3.9 After a standard clean, dummies not previously coated with nitride or those that need to be recoated, should be coated in tystar17 (tystar10 dummies only!) or tystar18 (tystar16 dummies only!) using the recipe SNITC with a deposition time of 50 minutes. Place dummies in the CLEAN tystar11 or tystar16 dummy box.

6.4 Tystar11 and tystar12 (LTO & PSG)

- 6.4.1 Make sure that the dummies are scribed on the back with the tystar name. If not, scribe them.
- 6.4.2 Dip in 5:1 BHF (sink8) until wafers dewet. This usually takes at least 30 minutes. The time may be longer if the wafers have a very thick film on them. (The etch rate of fresh 5:1 BHF is about 1000Å/min.)
- 6.4.3 Remove and rinse the cassette.

6.4.4 At this point the wafers may be stored for piranha cleaning in the original tystar12 or tystar20 dirty dummy box. If so, label the box accordingly.

6.4.5 Standard piranha clean in sink8 then sink6.

6.4.6 Place clean, stripped dummies in CLEAN tystar11 or tystar12 dummy box.

Note: If you do not have the time to clean the dummies in both sinks 8 and 6, do not just clean them in sink8 and put them back into the dirty box. This defeats the cleaning you just did. If you find it necessary to split up the cleanings, use a separate clean box. Do not use the clean tystar box.

6.5 Tystar17 (Low Stress Nitride)

Note: Tystar17 dummies are to be replaced every 4 weeks. Calendar mail will be sent as a reminder.

6.5.1 Retrieve new dummies.

6.5.2 Scribe the tystar number on the back of the dummies.

6.5.3 Standard piranha clean in sink8 then sink6.

6.5.4 Place clean dummies in CLEAN tystar17 box or directly into tystar17.

7.0 Dummy Unload Procedure

7.1 Furnace Status

Check the status of the furnace. It must be in the standby mode before you can unload the dummies. You can check the status at the furnace itself by pressing the STATUS (7) key, or by accessing the tycom on the wand under Equipment Communication--Tystar furnace interface. For tystar9 the standby program is called **9STNBYA**. For tystar11, it is called **11STNBYA**, for tystar12 the standby program is called **12STNBYA**, and for tystar16 it is called **16STNBYA**. tystar20 and tystar18 are not monitored through the tycom, but have their own display panels. (See the tystar18 and tystar20 manual, Chapter 5.9 for procedures.)

7.2 Venting the Furnace

The furnaces will be under vacuum in the standby mode, and will need to be vented to atmosphere in order to open them. This can be done at the furnace by pressing the ACK (acknowledge) button on the furnace control panel. For tystar9 the ACK button must be pressed twice, for the other two furnaces only once. You should here a loud **squealing** sound from the back of the furnace as the furnace begins to vent. You can also check that the furnace is backfilling (venting) by pressing the STATUS button until the time countdown is displayed. The backfill step counts down for 00:07:00 (7 minutes), except for tystar16 where it backfills for 00:04:00. Soon after the furnace begins venting, a loud alarm will sound. This is silenced by pushing the appropriate ALARM ACK button below the furnace control panels. When the seven minutes are up, the furnace will alarm to indicate the END of the process, and you can silence this alarm by pressing the ACK button. Located on the TYSTAR Furnace Controller Panel are the controls for retracting and sending in the cantilever holding the wafer boats. This is labeled BOAT CONTROL and has 3 buttons labeled IN, OUT, and STOP. Press the OUT button to bring the cantilever out of the furnace.

7.3 Unloading the Dummies

For tystar9, the wafers are held in quartz cassettes. Remove all the dummies using the vacuum wand and place in the quartz cassette at the furnace until the dummies cool. When the dummies are cool, place them in the box labeled for dirty dummies. These can now be cleaned according to the Dummy Clean Procedure. For tystar11, tystar12, and tystar16 the wafers are held in quartz cages. The top portion of the cage must be removed using the quartz-tipped fork-like tool found

at the furnaces. Place the tool with the lid in the metal plate holder located at the furnaces. The dummies can now be removed and placed in the quartz cassettes to cool. When they have cooled, place them in the appropriately labeled dirty dummy box, and later clean them according to the procedures outlined for dummy cleaning. Replace all dummies with clean ones.

7.4 Returning the Furnace to STANDBY

Press the IN button on the BOAT LOAD CONTROL panel to return the cantilever to the furnace (make sure that the cantilever is in completely). Press the RUN button on the furnace control panel to start the standby program. Press the STATUS (7) button until the panel displays the standby recipe name (9STNBYA for tystar9, 11STNBYA for tystar11, 12STNBYA for tystar12 16STNBYA for tystar16). Report on the WAND in the comments section for each furnace that clean dummies have been installed in the furnaces.

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