**RCA Hood Standard Operating Procedure**

**QUICK GUIDE**

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### CRITICAL PRECAUTIONS AND COMMON MISTAKES

- **DANGER: THIS EQUIPMENT USES HYDROFLUORIC ACID**
- ALWAYS wear personal protective equipment (PPE)
  - Splash goggles, thick, chemical resistant gloves and apron
- Know the location of safety equipment: safety showers, eyewash stations, relevant first aid material (calcium gluconate)
- NO METAL!!!!
  - Substrates having metal on them may not be cleaned at this bench. Only blank substrates are allowed without notifying MNFL Staff. RCA cleans or HF etches of other substrates require the permission of MNFL Staff.
  - Do not use metal tweezers only non-metal tweezers are allowed
  - MNFL provides cassette to hold 4” wafers during RCA cleaning or HF etching
  - Users are expected to provide their own Teflon cassettes, wafer dippers, holders and non-metal tweezers for RCA cleaning or etching other than 4” sample sizes
- Failure to follow procedures will result in contamination that will ruin your experiment and ruin the experiments of everybody after you
- RCA Hood is capable of handling up to 6” wafers cassettes.

### Tool condition for the next user

- The bench and tools must be cleaned to original state after use.
1. **Before you start**

1.1 Visually check the cleanliness of the baths. There should be no visible residue in any of the baths. If there is any residue, notify MNFL staff.

1.2 Make sure the Power On blue light is lit up.

1.3 Turn the Light Off/On switch to On position.

1.4 Ensure the fume hood is functioning properly:
   - Ensure the hood has a survey sticker with written pressure value,
   - Ensure the fume hood gauge is functioning and displays the adequate pressure. The pressure reading displayed on the fume hood Mini-Photohelic gauge should be within 20% of the sticker value.

1.5 Know the location of Emergency Off Button and in the event of an emergency, terminate the process by pressing it.

1.6 Make sure that empty carboys with required Waste Labels are in place.
1.7 Use only provided or approved by MNFL staff beakers and cassettes.
1.8 Wear PPE: splash goggles, chemical resistant gloves and apron.

1.9 Select that baths that you wish to use, inspect the bath, fill them with solutions as desired and power up the bath modules. Each module has an integrated electronic temperature controller, switches and status indicators. Always fill the baths with solutions prior to turning the baths on.

The hood consist of:
- DI and N₂ spray guns
- DI water Damp Rinser
- SC-1 heated bath
- SC-2 heated bath
- Piranha heated bath
- Silicon Nitride Etch Tank
- HF dip tank
2. RCA Clean Recipe

The RCA (Radio Corporation of America) clean is the standard set of wafer cleaning steps for removing contaminants from Si wafers before high-temperature processing such as oxidation, diffusion, CVD.

A preliminary clean-up treatment with a hot Piranha (H₂SO₄: H₂O₂) typically 3:1, 4:1, and 7:1 volume ratios can be used advantageously for grossly contaminated wafers having visible residues. In MNFL, Piranha should never be mixed in a less than 3:1 (H₂SO₄: H₂O₂) ratio, as increased amounts of Hydrogen Peroxide (H₂O₂) increases the explosion risk.

Step 1: SC-1 (5:1:1; DI H₂O: NH₄OH: H₂O₂) removes particles, organic residue and dissolves some metals
- Add DI water, then add the NH₄OH and start heating to set point (75-80 °C). When you are at or close to the set point temperature add H₂O₂. Let bath return to temperature and add wafers to the bath. Then, clean for up to ten minutes. Rinse in dump rinser three times and keep wafers wet.

Step 2 (Optional): Dip in 2% HF (50:1; DI H₂O: HF) for 10 – 20 sec to remove the thin oxide layer and immediately rinse in the dump rinse three times.

Step 3: SC-2 (6:1:1; DI H₂O: HCl: H₂O₂) removes metal ion impurities that form NH₄OH-insoluble hydroxides after SC1 and also eliminates metallic contaminants that were not removed by the first treatment
- Add DI water, then add the HCl and start heating to set point (75-80 °C). When you are at or close to the set point temperature add H₂O₂. Let bath return to temperature and add wafers to the bath. Then, clean for up to ten minutes. Rinse in dump rinser three times.

Step 4 (Optional): Dip in 2% HF (50:1; DI H₂O: HF) for 10 – 20 sec to remove the thin oxide layer and immediately rinse in the dump rinse three times.

Place wafers into Spin Rinse Dry

3. Fill Volumes for full cassette with 4” wafers

SC-1 (5:1:1)
- 5000 ml DI H₂O
- 1000 ml NH₄OH
- 1000 ml H₂O₂

SC-2 (6:1:1)
- 5400 ml DI H₂O
- 900 ml HCl
- 900 ml H₂O₂

Piranha 3:1
- 5100 ml H₂SO₄
- 1700 ml H₂O₂

Diluted HF 50:1
- 6000 ml DI H₂O
- 120 ml HF

4. DI Water Damp Rinser

4.1. Prior to using, press the Rinse Cycle Start/Reset button to flush the bath.
4.2. Add cassette with wafers to the bath and remove the handle.
4.3. Make sure that bath is covered with a lid before starting the rinse cycle.
4.4. Press Rinse Cycle Start/Reset button. When rinse cycle is complete, there is a buzzer that indicates that cycle complete.
5. SC-1 Bath
5.1 First check if the empty carboy for this bath is in place.
5.2 Add DI water, then add Ammonium Hydroxide (NH₄OH).
5.3 Let the bath warm on its own for 5 min and press the Heat On button. The heater is set to 80 °C. The heater will not turn on if you are below the liquid level limit (red line).
5.4 When you are at or close to the set point temperature add Hydrogen Peroxide (H₂O₂). Let bath return to temp 75-80 °C.
5.5 Add wafers to the bath and keep them inside for desired time.
5.6 Remove the cassette with wafers and rinse it in the Damp Rinser before processing to any other bath. Make sure to remove the handle and rinse the handle with DI water before processing to any other bath. Cover Damp Rinser tank with a lid before starting the rinse cycle.
5.7 Turn the power off by pressing the Heat Off button.
5.8 The ammonium hydroxide solution drains to the sanitary drain Sump after cooling to room temperature.
5.9 Rinse the bath with DI water after draining the solution.
6. **SC-2 Bath**

6.1. First check if the empty carboy for this bath is in place.

6.2. Add DI water, then add Hydrochloric Acid (HCl).

6.3. Let the bath warm on its own for 10 min and then press the Heat On button. The heater is set to 80 °C. The heater will not turn on if you are below the liquid level limit (red line).

6.4. When you are at or close to the set point temperature add Hydrogen Peroxide (H₂O₂). Let bath return to temp 75-80 °C.

6.5. Add wafers to the bath and keep them inside for desired time.

6.6. Remove the cassette with wafers and rinse it in the Damp Rinser before processing to any other bath. Make sure to remove the handle and rinse the handle with DI water before processing to any other bath. Cover Damp Rinser tank with a lid before starting the rinse cycle.

6.7. Turn the power off by pressing the Heat Off button.

6.8. The hydrochloric acid solution drains to the sanitary drain Sump after cooling to room temperature.

6.9. Rinse the bath with DI water after draining the solution.
7. **Piranha Bath**

7.1. First check if the empty carboy for this bath is in place.

7.2. To make Piranha bath, fill the bath with Sulfuric Acid (H₂SO₄) and add Hydrogen Peroxide (H₂O₂). Mixing Piranha solution will generate heat.

7.3. Let the bath warm on its own for 10 min and then press the Heat On button. The heater is set to 80 °C. If you turn the bath heater on without letting the solution to warm up by its own, you will overshoot the target temperature by ~30°C.

7.4. Add wafers to the bath and keep them inside for desired time.

7.5. Remove the cassette with wafers and rinse it in the Damp Rinser before processing to any other bath. Make sure to remove the handle and rinse the handle with DI water before processing to any other bath. Cover Damp Rinser tank with a lid before starting the rinse cycle.

7.6. Turn the power off by pressing the Heat Off button.

7.7. The Piranha solution drains to the sanitary drain Sump after cooling to room temperature.

7.8. Rinse the bath with DI water after draining the solution.
8. **HF Dip Tank**

8.1. First check if the empty carboy with correct label for this tank is in place.
8.2. Keep HF TANK DRAIN valve closed.
8.3. Fill the tank with desired volume of water and HF.
8.4. Add wafers to the bath and keep them inside for desired time.
8.5. Remove the cassette with wafers and rinse it in the Damp Rinser. Make sure to remove the handle and rinse it with DI water. Cover Damp Rinser tank with a lid before starting the rinse cycle.
8.6. Open the HF TANK DRAIN valve to drain the HF solution into the carboy.
8.7. Rinse the tank with DI water after draining the solution into the carboy.
   - If the carboy overfills, the Carboy High Level Indicator will light red and pneumatic valve allowing fluid into the carboy will close. Contact the MNFL Staff to change out the full chemical waste carboy.
9. Spin / Rinse Drying
The system is currently set up to handle a full cassette of 4” wafers. Ensure your wafers are loaded into a Teflon cassette (with the H-bar) that fits inside the chamber.
   9.1 Open the nitrogen valves
   9.2 Press the POWER switch on the front panel to turn on the controller.
   9.3 Put in the wafer cassette with the H-bar facing the chamber door.
   9.4 Close the chamber door.
   9.5 Press the green START button to initiate processing.
   9.6 Once the process is complete remove cassette with your wafers.
   9.7 Place back the empty cassette with the H-bar facing the chamber door.
   9.8 Turn the power OFF and close N2 valves