

Standard Operating Procedure:

RCA Clean

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Principle of Operation

To clean silicon wafers in preparation for high-temperature processing. RCA clean is a procedure for removing metal ions from silicon wafers. In the process it oxidizes the silicon and leaves a thin film of oxide on the surface of the wafer. If wafer proceeds to undergo thermal oxide processing, an HF or BOE clean should be added after the RCA-2 clean and before the spin rinse dryer to remove the native oxide layer.

Material Requirements

Equipment:

Substrate, three Pyrex bath containers, two thermometers, one polypropylene containers (for HF dip), PFA wafer carrier with handles, and fluorocarbon (CTFE) tweezers

- Note: A full set of dishes have been set aside for use with RCA cleaning. Do not use these dishes for any other purpose. Clean these dishes thoroughly before storing them.

Chemicals:

Hydrofluoric Acid (HF 48-51%), Hydrochloric Acid (HCl), Ammonium Hydroxide (NH₄OH 30%), Hydrogen Peroxide (H₂O₂ 30 %)

- Chemical Hazards
 - o HF: Liquid or vapors are serious health hazards, cause severe burns and bone loss, which may not be immediately painful or visible. Significant exposure (100 mL) can kill directly. Use extreme caution, HF is very hazardous, both acutely and long term.
 - o HCl: Liquid or vapors are serious health hazards and cause severe burns.
 - o NH₄OH: Liquid is extremely basic and corrosive. Exposure can cause severe burns.
 - o H₂O₂: Liquid or vapors are serious health hazards, and can cause severe burns. Peroxide is an explosive hazard and thus requires vented waste containers.

Personal Protective Equipment:

Trionic gloves on top of nitrile gloves, apron, safety glasses and face-shield

Procedure

RCA Clean Preparation

Set RCA-1 hotplate to >200°C to expedite heating. Set RCA-2 hotplate to 185°C to expedite heating. Note: *Don't set RCA-2 hotplate and RCA-2 hotplate both above 200°C.*

1. Triple rinse all beakers with DI water and spray dry with N₂ prior to beginning the process.
2. Put 2 L DI water in RCA-1 beaker (use top of DI water label on beaker as a fill line). Add 325 mL Ammonium Hydroxide (use top of Ammonium Hydroxide label on beaker as a fill line). Heat to 85°C.
3. Put 2 L DI water in RCA-2 beaker (use top of DI water label on beaker as a fill line). Add 325 mL Hydrogen Chloride (use top of Hydrogen Chloride label on beaker as a fill line). Heat to 85°C.

4. Load wafer(s) onto the wafer boat evenly across the boat.
5. Fill the Pyrex tank with DI water.

RCA-1 Clean ($\text{H}_2\text{O}_2:\text{NH}_4\text{OH}:\text{H}_2\text{O}$ - 1:1:5)

1. Add 325 mL Hydrogen Peroxide to RCA-1 beaker (use top of Hydrogen Peroxide label on beaker as a fill line).
2. Load the wafer boat into a beaker and soak for 10 minutes.
3. Remove the wafer boat from the RCA-1 beaker under flowing water and load the wafer boat into DI water tank.

HF Dip ($\text{HF}:\text{H}_2\text{O}$ - 1:100) [OPTIONAL]

The HF dip container will be set-up by staff and will be placed in the acid bench sink.

1. Remove the wafer boat from DI water tank under flowing water and transfer the boat to the HF dip.
2. Wait one minute.
3. Remove the wafer boat from the HF dip under flowing water and transfer the boat to the DI water tank.

RCA-2 Clean ($\text{H}_2\text{O}_2:\text{HCl}:\text{H}_2\text{O}$ - 1:1:5)

1. Add 325 mL Hydrogen Peroxide to RCA-2 beaker.
2. Load the wafer boat into the beaker and soak for 15 minutes.
3. Dispose of contaminated DI water in DI water tank, rinse, and refill with DI water.
4. Remove the wafer boat from RCA-2 beaker under flowing water and load the wafer boat into the DI water tank.

Spin Rinse Dryer

1. Remove the wafer boat from DI water tank under flowing water and load the wafer boat into the spin rinse dryer.
2. Turn on the Nitrogen line and press the power button.
3. Press **Start Screen** and press start.
4. When the process is complete, press the power button and turn off the Nitrogen line.
5. Remove the wafer boat from the spin rinse dryer.

Cleanup

1. Dip tweezers in RCA-1 beaker for 10 seconds, DI water tank for 10 seconds, RCA-2 beaker for 10 seconds, and DI water tank. Rinse clean and spray dry with the nitrogen gun.
2. Triple rinse DI water tank, thermometers, and wafer boat carriers and spray dry with N_2 gun.

3. Wait for RCA-1 and RCA-2 to cool to room temperature.
4. *If recycling RCA-1 and RCA-2:* cover tanks with plastic covers.
5. Pour the RCA-1 solution into the RCA-1 waste carboy.
6. Triple rinse the RCA-1 tank with DI water and spray dry with N₂ gun.
7. Pour the RCA-2 solution into the RCA-2 waste carboy.
8. Triple rinse the RCA-2 tank with DI water and spray dry with N₂ gun.
9. Return cleaned and dried labware to their proper location.
10. Wipe up any drips in the area with lab wipes and dispose of them in the appropriate trash container.
11. Store the Hydrochloric Acid in the acids cabinet, the Ammonium Hydroxide in the caustics cabinet and the Hydrogen Peroxide in the oxidizers cabinet.
12. Inspect all of the PPE to ensure it did not come in contact with the chemicals before returning it to its storage location.

Accident Procedure

Hydrofluoric Acid Contact

- Skin: Rinse affected area with water for 5 minutes, removing contaminated clothing during rinse. Apply generous amounts of calcium gluconate. **Get immediate medical attention.**
- Eye: Immediately flush with water for at least 20 minutes while lifting upper and lower eyelids occasionally. **Get immediate medical attention.**
- Ingestion: Do not induce vomiting. **Get immediate medical attention.**
- Inhalation: Remove to fresh air. Resuscitate if necessary. Take care not to inhale any fumes released from the victim's lungs. **Get immediate medical attention.**

Hydrochloric Acid, Ammonium Hydroxide and Hydrogen Peroxide Contact

- Skin: Remove contaminated clothing, rinse affected area with water for 10 minutes. **If there is a visible burn, get immediate medical attention.**
- Eye: Immediately flush with water for at least 20 minutes while lifting upper and lower eyelids occasionally. **Get immediate medical attention.**
- Ingestion: Do not induce vomiting. **Get immediate medical attention.**
- Inhalation: Remove to fresh air. Resuscitate if necessary. Take care not to inhale any fumes released from the victim's lungs. **Get immediate medical attention.**

Spills

If a small, contained spill occurs, such as inside the hood, wipe it up with chemical wipes and dispose of them in the proper trash container. If a large spill occurs, evacuate the area and notify the cleanroom staff.

Revision History:

- Version 0.0 – Created September 8th, 2017
- Version 1.0 – Revised May 22, 2025