

# RCA-1 Cleaning Standard Operating Procedure

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## 1. Purpose and application

The purpose of this clean is to remove organic contamination and particles from your Si wafers. It will rapidly attack most organic materials and some metals. This clean should not be used to strip resist – use acetone for that purpose. Use the RCA Standard Clean 1 as a final “polishing” clean to remove the last residues or to clean new wafers before you start processing.

**Extreme danger:** Peroxide reacts violently (explosively) with organic solvents such as acetone and isopropanol. If you somehow mix peroxide with acetone or isopropanol (for example by using the wrong waste bottle) it is going to explode violently. TAKE EXTREME CARE NOT TO MIX PEROXIDE WITH ORGANIC SOLVENTS!

Pressurization danger for peroxide waste: Peroxide waste evolves oxygen gas which can pressurize and break the waste bottle, the bottle must have a vented cap to allow pressurization to be released [1].

Only fresh solution should be used.

## 2. Equipment, Chemicals and Supplies

RCA-1 is composed out of three chemicals,  $\text{NH}_4\text{OH}:\text{H}_2\text{O}_2:\text{H}_2\text{O}$  (1:1:5)

1. Ammonium Hydroxide (28 %)
2. Hydrogen Peroxide (30 %)
3. DI water

Ammonium hydroxide (28%) is purchased from VWR International B.V.

<https://ie.vwr.com/store/product/2345623/elch51151931>

Hydrogen peroxide (30%) is purchased from VWR International B.V.

<https://nl.vwr.com/store/product/706316/waterstofperoxide-30-emprove-essential-ph-eur-bp-usp>

## 3. Personal Protective Equipment (PPE)

The following equipment should be used:

- Eye protection: Safety glasses and face shield required.
- Protective gloves: Black neoprene gloves. Check gloves for leaks before use.

- Protective clothing or equipment: Apron.

## 4. Operational Procedures

1. Get three glass beakers or envelopes which will fit your sample and place them in the bench.
2. Write down your name and type of chemical for every beaker/envelope.
3. Fill two beaker/envelopes with DI water such that it will cover your sample. DI water is used for rinsing the etchant.
4. Create a 5:1:1 solution of deionized water (5 parts), 28 % ammonium hydroxide (1 part), and 30 % hydrogen peroxide (1 part). The chemicals should be added in the order listed.
5. Example: A 1000 ml beaker works well for a 4" wafer:
  - Add 625 ml of DI water to the beaker
  - Add 125 ml of 28 % ammonium hydroxide
  - Add 125 ml of 30 % hydrogen peroxide
6. The mixture will become warm. Be careful when you handle it.
7. If you plan to heat the etch (recommended) set up an au bain-marie with a hotplate in the hood. Put the beaker/envelope filled with etchant in the au bain-marie (use a holder when you use an envelope) to bring it up to a temperature of 70°C. Use an temperature sensor housed within a glass enclosure to measure the temperature of the etchant. **Direct heating of inorganic mixtures at temperatures higher than 80 °C is only allowed in day time and only after personal approval of the set-up by the KN staff.**
8. When the solution is at temperature, immerse your sample in the beaker using the Teflon wafer holder for 10 minutes. Leaving the wafer holder in the beaker will stop big bubbles from forming at the surface. *If etchant at the surface becomes saturated and fresh etchant cannot reach the surface, then etching will slow down. Agitation can be used to bring etchant to the surface and promote etching.* In this case use a magnetic stirrer and carefully swirl your etchant to accelerate the etch and improve uniformity.

### DI Water rinse

1. When the etch is complete, transfer the sample carefully to the first DI water rinse beaker/envelope and move the sample for 5 mins in DI water.
2. If you use tweezers to move the sample, make sure you rinse your tweezers as well.
3. Transfer the sample to the second DI rinse beaker, and rinse for another 5 mins while moving your sample.

### Sample dry

1. After the water rinse is finished, remove your samples and blow them dry with the N<sub>2</sub> gun.

### Clean-up

1. The etchant should not be used for multiple etches. Once heated the solution is only effective for 30 minutes.
2. Turn off the hotplate.
3. Allow the solution to cool for three hours before disposal. There should be no bubbles left in the solution after this amount of time.

4. When the solution is at room temperature, pour it carefully over the other two beakers/envelopes filled with DI water.
5. Use the venturi to remove the waste from all the two beakers/envelopes.
6. Rinse all the beakers/envelopes three times with DI water.
7. Turn all the beakers/envelopes upside down, wash the outside with DI water and blow them dry with the N<sub>2</sub> gun.
8. Return all labware to its proper location.
9. Clean the area and rinse it with DI water.
10. Wash your black gloves and leave them in the bench.

## 5. Primary Hazards

Hydrogen peroxide is an explosive chemical. Never leave the RCA process unattended. Do not store the hydrogen peroxide near the hotplate or any other source of heat.

Ammonium Hydroxide: Liquid is extremely basic and corrosive. Exposure can cause severe burns.

## 6. Engineering Controls to Prevent and Mitigate Hazards

Carry out the procedure in a wet bench. Store bottles of chemicals (sealed tightly) in the inorganic cabinets. Work area should contain an eye wash, safety shower and a bottle of diphoterine. Check where you could find this in your neighbourhood.

The chemical are in the high risk category:

- Working with HIGH risk inorganic chemicals is not allowed in the after hours.
- A buddy must be present at all times.

## 7. First Aid and Emergency Procedures

Eye Contact: Immediately flush with diphoterine while lifting upper and lower eyelids occasionally (use the complete 500 ml for one eye and remove contact lenses if possible). After using diphoterine, flush with water for at least 20 minutes. Get immediate medical attention. Press the evacuation button.

Skin Contact: Remove contaminated clothing, wash skin with diphoterine. After using diphoterine, flush with water for at least 15 minutes. If there is a visible burn, get immediate medical attention. Press the evacuation button.

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. Press the evacuation button.

Ingestion: Do not induce vomiting. Get immediate medical attention. Press the evacuation button.

In case of a spill: Press the evacuation button.

In case of a fire: Press the fire button.

## 8. Literature

- [1] R. White, "Standard Clean 1 (RCA Organic/Particle Clean)," 7 July 2015. [Online]. Available: [http://engineering.tufts.edu/microfab/documents/SOP\\_RCA-SC1.pdf](http://engineering.tufts.edu/microfab/documents/SOP_RCA-SC1.pdf). [Accessed May 2018].