

RCA Clean

INTRODUCTION:

Contaminants present on the surface of silicon wafers at the start of processing, or accumulated during processing, have to be removed at specific processing steps in order to obtain high performance and high reliability semiconductor devices, and to prevent contamination of process equipment, especially the high temperature oxidation, diffusion, and deposition tubes. In 1970, the RCA Laboratories developed a cleaning procedure for silicon semiconductor device fabrication technology, which has become the industry standard; it uses several reagents containing hydrogen peroxide.

The RCA cleaning procedure has three major steps used sequentially:

- I. **Organic Clean:** Removal of insoluble organic contaminants with a 5:1:1 H₂O:H₂O₂:NH₄OH solution.
- II. **Oxide Strip:** Removal of a thin silicon dioxide layer where metallic contaminants may accumulated as a result of (I), using a diluted 50:1 H₂O:HF solution.
- III. **Ionic Clean:** Removal of ionic and heavy metal atomic contaminants using a solution of 6:1:1 H₂O:H₂O₂: HCl.

The RCA cleaning technique does not attack silicon, and only a very thin layer of silicon dioxide is removed (in II) in the process. The procedure was also designed to prevent replating of metal contaminants from solution back to the wafer's surface. In MTL this procedure is only used for residue removal, after gross organic and/or metal layers have been previously removed by other specific methods.

SAFETY: Take this safety section seriously!! We'll perform this procedure in a fume hood.

The chemicals used for RCA cleaning are all dangerous if you get in contact with them. They are not carcinogens. The MSDS sheets for all of these chemicals can be found in the yellow MSDS binder outside of Meyer 425. HF acid is very dangerous; HF burns are particularly hazardous. An insidious aspect of HF burns is that there may not be any discomfort until long after exposure. These burns are extremely serious and may result in tissue damage. If you contact HF, flush the area well and be sure to work under and around your finger nails. Finger nails and cuticles are the classic areas where people receive burns, having washed off the HF without washing under their nails. If washed off within a few minutes of exposure, HF may do no harm. Remember, HF may not produce any burning sensation until after it has already done damage. All HF burns should be looked at by a physician.

Acid protective gear **MUST** be worn when working at this station. Lab coats, acid-proof gloves (atop the normal clean room gloves), and an acid face mask (with the face shield **DOWN**) worn over safety glasses, are all required. **ALWAYS** know the location of the nearest eye wash and safety shower.

In the case of chemical exposure, call for help to the person nearest you and tell the instructor or TA. While you are speaking to the person nearest you, get to the nearest shower or eyewash as fast as possible. Exposure of the eyes requires flushing with water for at least 15 minutes. As a precaution, all exposures to the eye will require a visit to an emergency room for a check up. Exposure of the skin requires immediate removal of all contaminated clothing. Rinse under the shower for 15 minutes.

SOLUTION PREPARATION:

Need 4 (clean and dry) 1000ml polypropylene beakers. One beaker for each step plus one beaker for rinsing.

Need a teflon carrier for sample and a teflon rod.

Each will be prepared made in 1000 ml polypropylene beakers.

A. **Organic Clean** solution of DIH₂O:NH₄OH:H₂O₂ (5:1:1)

*** **Always** add reactive compounds(acid/base) to water ***

a.) 625mL DIH₂O

b.) 125mL NH₄OH

c.) 125mL H₂O₂

DIH₂O = Deionized Water
NH₄OH = Ammonium Hydroxide
H₂O₂ = Hydrogen Peroxide
HCL = Hydrochloric acid

Stir solution with clean teflon rod. Place beaker into the temperature-controlled water bath and adjust the power to maintain the solution at 75 °C.

B. **Oxide Strip** solution of DIH₂O:HF (50:1)

C. **Ionic Clean** solution of DIH₂O:HCl: H₂O₂ (6:1:1)

*** **Always** add reactive compounds(acid/base) to water ***

a.) 690mL of DIH₂O

b.) 115mL of HCl

c.) 115mL of H₂O₂

Stir solution with clean teflon rod. Place beaker into the temperature-controlled water bath and adjust the power to maintain the solution at 75 °C.

D. Fill a 1000 ml beaker with **DI water** for rinsing.

PROCEDURE:

1. Place wafer(s) on teflon carriers.
2. Submerge the carrier with wafer in the **Organic Clean** solution for 10 minutes.
3. Remove carrier from the bath and rinse wafer in the DI water beaker for 1 minute.
4. Submerge the carrier with wafer in the **Oxide Strip** solution for 15 seconds.
5. Remove carrier from the bath and rinse wafer in the DI water beaker for 1 minute.
6. Submerge the carrier with wafer in the **Ionic Clean** solution for 10 minutes.
7. Remove carrier from the bath and rinse wafer in the DI water beaker for 1 minute.
8. Remove carrier from the DI water beaker and blow dry with nitrogen.

9. Take wafer to next processing step or place in a carrier box.

CLEAN UP: Pay especial attention to cleanup procedure!

1. Turn off water baths and allow to cool.

2. Dispose of **Organic Clean** in container marked '**Basic Waste**'. Rinse beaker twice with DI water and dispose of similarly.

3. Return the **Oxide Strip** to the original container. Rinse beaker twice with DI water and dispose of in container marked '**Acid Waste**'.

4. Dispose of **Ionic Clean** in container marked '**Acid Waste**'. Rinse beaker twice with DI water and dispose of similarly.

5. Manually rinse the work area with DI water, wipe it with kimwipes, and rinse the rubber gloves that you have been wearing.

6. Remove the protective clothing.