

# Aluminum Etch using Aluminum Etchant Type D

## Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)

Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)  
(617)627-3246 (From off-campus or from a cell phone)

Tufts Emergency Medical Services are at x66911.

Revised: October 27, 2014

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*Aluminum Etchant Type D offers compatibility with Cu, Fe, Ni and GaAs device, which Aluminum Etchant Type A doesn't.*

**Warning:** Avoid contact with skin and eyes. Do not ingest. Do not breathe the vapors. Vapors are moderately irritating to the mucous membranes and respiratory track and can cause excessive tearing. Work carefully in the hood with goggles, face shield and trionic gloves.

### 1. Material Requirements:

- 1.1 Equipment: One glass Petri dish, two glass beakers (for rinse), stainless steel tweezers, PTFE (Teflon) wafer holders or sample holders.
- 1.2 Chemicals: Transene Aluminum Etchant Type D (contains 5-10wt% Sodium-M-Nitrobenzene Sulfonate, 55-65% Phosphoric Acid, 1-5% Acetic Acid, and 20-39% Distilled Water)
  - 1.2.1 Hazards associated with chemicals:
    - 1.2.1.1 This material is corrosive to the eyes, skin and mucous membranes and causes irritation and burns. Vapors severely irritate the respiratory track. Swallowing results in damage to mouth esophagus, and gastrointestinal tract.
    - 1.2.1.2 Do not mix with strong oxidants or organic materials.
    - 1.2.1.3 **Do not heat above 50°C.**
- 1.3 Engineering Controls: Conduct procedure in ventilated fume hood. Store bottles of chemicals (sealed tightly) in cabinets with secondary containment. Work area should contain an eye wash and safety shower.
- 1.4 Personal Protective Equipment: Trionic gloves on top of nitrile gloves, apron, goggles, and face-shield.

### 2.0 Procedure:

#### Complete all processes in the fume hood.

#### 2.1 Aluminum Etchant Type D: (Transene lists 240nm/min @25 °C and 1200nm/min @50 °C)

- 2.1.1 Get two water rinse beakers which will fit your samples (A 1000 mL beaker works for a single 4" wafer.) **Do this first.** If something goes wrong, you want the water available to quench the reaction.
- 2.1.2 Stand the rinse beakers on a few fab wipes in the hood, and fill them with deionized water such that the water level will cover the entire sample.
- 2.1.3 Place a couple fab wipes in a pile in the hood. Get a glass Petri dish that will fit your samples for processing (you should find one labeled "Aluminum Etchant – Type D" on the shelves). Put it on the fab wipes in the hood.
- 2.1.4 Carefully pour some of the Transene Aluminum Etchant Type D into the Petri dish such that the dish is a little over half full.

- 2.1.5 If you plan to heat the etch (recommended) set up a hotplate in the hood at 60 C. We expect the temperature of the bath to be at least 10 C lower than the temperature of the hotplate.
- 2.1.6 Put the Petri dish on the hotplate to bring it up to temperature. Best practice would be to measure the bath temperature with an immersion-type thermocouple or thermometer.
- 2.1.7 Calculate the etch time for your sample. You will need to know the thickness of your aluminum layer. At 50°C, the Al will etch at a rate of approximately 1200 nm/min, while at 25°C the Al will etch at only 240nm/min. This may not be exact and is highly susceptible to temperature! Testing it for yourself is a good idea.
- 2.1.8 Put your wafer into the etchant and soak for the appropriate amount of time calculated in the previous step. Careful swirling of the Petri dish will accelerate the etch and improve uniformity.

#### **DI Water rinse: 6 mins**

- 2.1.9 When the etch is complete, transfer the sample carefully to the first DI water rinse beaker. You may choose to use the PTFE wafer holder to hold the wafer once in the rinse.
- 2.1.10 If you used tweezers to move the sample, make sure you leave them in the rinse beaker to rinse as well.
- 2.1.11 Let the sample and tools soak in DI water for 3 mins.
- 2.1.12 Transfer the sample to the second DI rinse beaker, and rinse for another 3 mins.

#### **2.2 Sample dry:**

- 2.2.1 After the water rinse is finished, remove your samples and blow them dry with the air gun.
- 2.2.2 After getting most of the water off, you can dry the samples more in an oven at 120 °C or on a hotplate at 150 °C.
- 2.2.3 Inspect wafer for traces un-etched aluminum. If features are small, use an optical microscope. If more etch time is required, place wafer back into the Petri dish with the etchant for another 30 seconds while swirling. Repeat rinse and drying procedure.

#### **2.3 Cleanup**

- 2.3.1 The etchant may be used for multiple etches. For temporary storage (< 1 day), place the top of the Petri dish over the etchant and store on fab wipes in the back of the hood. Make sure the dish is clearly labeled “Aluminum Etchant Type D” and has your name and the date on it.
- 2.3.2 When you are finished using the etchant, dispose of it in a HDPE or glass bottle, label “Al Etch Type D” with the red hazardous waste tag. List the four components: Sodium-M-Nitrobenzene Sulfanate, phosphoric acid, acetic acid, and water on the waste tage. The aluminum etch waste can be mixed with nitric acid, acetic acid, HF, HNA, and Cr etchant. Keep the bottle in the satellite accumulation area (under the hood). If a waste bottle already exists, use that one, otherwise start a new one.
- 2.3.3 Rinse the Petri dish once with DI water, and dump it into the Al Etch waste bottle.
- 2.3.4 Dump the first DI rinse beaker into the Al Etch waste bottle.
- 2.3.5 Dump the second DI rinse beaker into the 5 gallon HDPE “Dilute Acid Waste” container.
- 2.3.6 Rinse all three containers a second time with with DI water. This time, dump them into the 5 gallon HDPE “Dilute Acid Waste” container.
- 2.3.7 Return all labware to its proper location. The Petri dish and the beaker can drip dry on fab wipes in the hood or on the shelves.

2.3.8 Wipe up any drips in the area with chemical wipes and dispose in the acid trash.

## 2.4 Storage

2.4.1 Store Etchant in the "Acid" cabinet.

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## 3.0 Waste Disposal:

3.1 Aluminum Etchant Type-D waste:

3.1.1 Solid waste should go in the acid waste bin.

3.1.2 Liquid waste should go in the Al Etch waste bottle. This container can be glass or HDPE. The aluminum etch waste can be mixed with nitric acid, acetic acid, HF, HNA, and Cr etchant. Label "Al Etch Type D" with the red hazardous waste tag. List the four components: Sodium-M-Nitrobenzene, phosphoric acid, acetic acid, and water on the waste tag.

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## 4.0 Accident Procedures:

4.1 Contact: Read MSDS prior to working with any chemical to familiarize yourself with the symptoms of exposure and recommendations for treatment.

4.1.1 Aluminum Etchant Type-D:

4.1.1.1 Skin contact: Remove contaminated clothing, wash skin with soap and water. **If there is any irritation, get medical attention. Don't be shy. Tufts Emergency Medical Services are at x66911.**

4.1.1.2 Eye contact: Immediately flush with water for at least 15 minutes while lifting upper and lower eyelids occasionally. **Get immediate medical attention. Call Tufts Emergency Medical Services are at x66911.**

4.1.1.3 Ingestion: Do not induce vomiting. **Get immediate medical attention. Call Tufts Emergency Medical Services are at x66911.**

4.1.1.4 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. Call Tufts Emergency Medical Services are at x66911.**

4.2 Spill:

4.2.1 If a small, contained spill occurs, such as inside the hood, wipe it up with chemical wipes and dispose of in the acid trash container.

4.2.2 If a large spill occurs that you are not comfortable cleaning up:

4.2.2.1 Evacuate the lab and notify the Tufts emergency services (x66911) immediately. Clean up should only be performed by authorized personnel according to MSDS guidelines. Notify the faculty advisor.

**If at any time you feel a situation is dangerous, do not hesitate to call the safety office (x73246, Peter Nowak) or the faculty supervisor (x72210, Robert White).**

**Report all accidents (injuries, major spills, fires) to the safety office at x73246 (Peter Nowak) and the faculty supervisor at x72210 (Robert White). For emergencies, call Tufts Emergency Services at x66911.**