Standard Operating Procedure:

Aluminum Etch

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Principle of Operation

To remove aluminum from a substrate – patterned or unpatterned.

Material Requirements

Equipment:

Substrate, glass beaker (for etchant), glass beaker (for rinse) and stainless steel tweezers

Chemicals:

Transene Aluminum Etchant Type A [contains: nitric acid, phosphoric acid, acetic acid]

- The etch rate will approximately double with every 10°C increase in temperature; stirring or agitation will increase the etch rate.
- The etch rate will be reduced by approximately 50% by adding 1 part DI water to 2 parts etchant.
- Recommended Operating Temperatures: 20-80°C (30-40°C most common)
- Etch Rate at 25°C: 30Å/sec
- Etch Rate at 40°C: 80Å/sec
- Select Compatible Materials: Silicon oxide, gold, nichrome
- Select Incompatible Materials: Aluminum oxide, silicon nitride
- Compatible Plastics: HDPE, PP, Teflon, PFA, PVC

Transene Aluminum Etchant Type D [contains: sodium-m-nitrobenzene sulfonate, phosphoric acid, acetic acid]

- The etch rate will approximately double with every 10°C increase in temperature; stirring or agitation will increase the etch rate.
- The etch rate will be reduced by approximately 50% by adding 1 part DI water to 2 parts etchant.
- Recommended Operating Temperatures: 20-80°C (30-40°C most common)
- Etch Rate at 25°C: 30Å/sec
- Etch Rate at 40°C: 125Å/sec
- Select Compatible Materials: Silicon oxide, gold
- Select Incompatible Materials: Aluminum oxide, silicon nitride
- Compatible Plastics: HDPE, PP, Teflon, PFA, PVC

Personal Protective Equipment:

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

Procedure

Aluminum Etch

1. Get two glass beakers that will fit your samples for processing from the “Acid Supplies” drawer in the glassware rack to the left of the hood – one should be labeled “Water Only” and the other should be labeled “Acids Only”.
2. Rinse both beakers with DI water prior to beginning the process.
3. Stand the beaker labeled “Water Only” to be used for rinsing the sample on a cleanroom wipe in the hood and fill it with DI water so that the water level will cover the entire substrate.
4. Blow the beaker labeled “Acids Only” semi-dry and place it on a cleanroom wipe in the hood.
5. Carefully pour the Aluminum Etchant into the “Acids Only” beaker so that there is enough liquid to cover your submerged sample.
6. If you plan to heat the etch, place the beaker of Aluminum Etchant on the hotplate and bring it up to temperature, setting the hotplate temperature to at least 10°C higher than your target temperature. *You will need to monitor the temperature of the etchant with a glass thermometer placed in the etchant in order to be accurate.*
7. Calculate the etch time for your sample. You will need to know the thickness of your aluminum layer.
    a. At 25°C, the aluminum will etch at a rate of approximately 180 nm/min.
    b. At 50°C, the aluminum will etch at a rate of approximately 660 nm/min or higher depending on the etchant type.
8. Place your sample into the etchant using tweezers and soak it for the appropriate amount of time calculated in the previous step. Agitation of the etchant will help to accelerate the etch.

DI Water Rinse

1. When the etch is complete, remove your sample from the etchant with tweezers and transfer the sample carefully to the DI water rinse beaker. Make sure to leave the tweezers in the rinse beaker as well.
2. Let the sample and tools soak in DI water for 1 minute.
3. Remove the sample from the rinse beaker with the tweezers.
4. Rinse the sample with DI water in the hood sink, holding it in the water stream for approximately 10 seconds or more.

Sample Dry

1. After the water rinse is finished, blow the sample dry with the N_2 gun.
2. After getting most of the water off, you can dry the samples more in an oven or on a hotplate, if allowable for your sample.
3. Inspect sample for traces of un-etched aluminum. If features are small, use an optical microscope. **DO NOT use a microscope, or any other equipment in the facility while**

wearing the hood PPE. If more etch time is required, place wafer back into the etchant for another 30 seconds while agitating. Repeat rinse and dry procedures.

Cleanup

1. The etchant may be used for multiple etches. For temporary storage (<1 day), place a watch glass over the etchant beaker and store on fab wipes in the back of the hood. Make sure there is a label with your name, the date and chemical contents next to it, and leave the Badger slot for the hood enabled while your chemicals remain in the hood.
2. Dump the etchant waste into the waste container designated for acids in the back of the hood.
3. Rinse the beaker with DI water multiple times (typically 3 times or more) in the sink and then blow it as dry as possible with the nitrogen gun. **DO NOT pour rinse water in the waste containers.**
4. Dump the DI rinse beakers into the sink in the hood. **DO NOT pour rinse water in the waste containers.**
5. Rinse the beaker with DI water multiple times (typically 3 times or more) in the sink and then blow it as dry as possible with the nitrogen gun.
6. Return all glassware to its proper storage location.
7. Wipe up any splashes or drops of fluid in the hood with wipes and dispose of them in the proper trash bin.
8. Store the Aluminum Etchant in the Nitric Acid Cabinet.
9. Inspect all of the PPE to ensure it did not come in contact with the etchant before returning it to its storage location.

Accident Procedure

Contact

- Skin: Remove contaminated clothing, wash skin with soap and water. **If there is any irritation, get immediate medical attention.**
- Eye: Immediately flush with water for at least 15 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

Small Spill Within the Hood

If a small spill occurs and is fully contained within the hood:

- Wipe up the spill using appropriate wipes and dispose of them in the designated waste container.
- If wipes are insufficient, use the absorbent pads stored in the bottom right corner of the hood.
- If you are unsure how to clean up the material or feel uncomfortable doing so, **notify staff immediately**.

Medium or Large Spill Within the Hood - Always staff

If the spill requires neutralization or use of an absorbent pillow from the spill kit:

- **Notify staff immediately.**
- If the spill occurs **after hours**, contact cleanroom staff and post a message on Slack to alert other users **not to use the hood** until it has been properly cleaned and cleared by staff.

Any Spill Outside the Hood

If a spill occurs outside the hood:

1. **Notify cleanroom staff immediately.**
2. **Evacuate the immediate area** (typically the entire bay containing the hood).
3. If the spill occurs **after hours**, contact cleanroom staff and post a message on Slack to alert others. The cleanroom will remain closed until staff can safely manage the spill.

Revision History:

- Version 0.0 – Created September 8th, 2017
- Version 1.0 – Revised May 22, 2025
- Version 1.1 - Revised June 26, 2025