Buffered Oxide Etch

INRF Application note
Process name: BOE

Overview
Buffered oxide etch is used to etch thin films of oxide or polysilicate glass (some have used it to etch cavities in glass). It is a buffered HF mixture that slows down and controls the attack rate of HF on oxide. This is a level-1 process and requires basic INRF safety certification. The use of dangerous chemicals requires that the user may not perform the process alone.

Time needed

You will need 45 minutes to prepare the mixture. Approximately 5 to 30 minutes is required for the etch process to complete, depending on the oxide thickness.

Materials needed

80 g Ammonium Fluoride (NH4F)
120 ml DI water
20 ml 49% hydrofluoric acid (HF)
Teflon or polypropylene beaker
Glass beaker
Hot plate and stirring bar

Preparation

Wear protective equipment, including eye protection (goggles) and extra thick nitrile gloves. BOE contains HF, a dangerous, toxic acid.

Procedure

Start with the NH4F (comes as a powder) and weigh out an 80g sample into a glass container. Add 120 ml DI water and mix to make a 40% solution. This takes a while to dissolve, so use a little heat and a stirring rod, and wait 30 minutes to an hour for the mixture to become clear. The total weight should be 200 g. Cool the solution to a tepid temperature.

Transfers the solution to a polymer beaker (Teflon or polypropylene). Add 20 ml of 49% HF to the 40% NH4F solution and stir to make the BOE. To make a weaker version, dilute with water (e.g., add 220 ml water for a 50% BOE). Pour the BOE into a safe Teflon or polypropylene container (NOT GLASS). Label the container “Buffered Oxide Etch. Danger: Contains Hydrofluoric Acid!” Add your name and the date.

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Use an etchant for oxide and glass. Use only poly beakers during the etch process. Do not heat poly beakers on hot plate. BOE may be used several times as long as contamination from wafer to wafer is not a concern.

Rinse beakers thoroughly with water when finished.

Clean up

Rinse all beakers, graduated cylinders, mixers and lab ware with cold water. Wipe up any spills. Rinse outer gloves and hang to dry. Dispose of any waste in appropriately labeled waste bottle.

Safety and emergency

All INRF safety and procedural regulations must be followed. Hydrofluoric acid (HF) is an extremely toxic and dangerous acid. Use of HF requires at least one other person in the clean room (buddy system). HF should be handled in a laminar flow bench, using two pairs of nitrile gloves (or neoprene) and eye protection. Any small spills should be wiped up immediately with wipes and rinsed. Dispose of the wipes in the corrosive waste container. DO NOT LEAVE the etchant unattended.

A special INRF Stand Operating Procedure for HF has been prepared. Follow the INRF SOP for HF exposure (summarized below).

In case of exposure **seek medical attention immediately!** For skin exposure, flush immediately with water for 5 minutes, followed by liberal application of calcium gluconate gel to the skin. Remove all clothing that are exposed before and while flushing with water. For eye exposure, flush eyes with water three times, 5 minutes each. Irrigate the eye repeatedly with 500-1000 ml of 1% calcium gluconate solution applied through a syringe. Call for prompt emergency room transport. Apply ice-water compresses during transport.

In case of large spill, follow the UNRF Standard Operating Procedure for Chemical spills.

References

W. Kern and J. Vossen, *Thin Film Processes,* Academic Press: New York, 1978, Ch V-1.

Northwestern University Office of Research Safety (ORS) safety documents, http://www.northwestern.edu/research-safety/index.htm.

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BOE Process
Checklist

Checklist for BOE process:

Wear safety gear: goggles and extra gloves

Mix 80 g NH_4F with 120 ml DI water in glass container. Use heat and stirring bar if necessary. Takes 30-45 minutes.

Transfer solution to poly beaker. Carefully add 20 ml of 49% HF and mix.

Store solution in poly container. Label with name, date, and the following "Buffered Oxide Etch. Danger: Contains Hydrofluoric Acid!"

Use as etchant for oxide and glass. Use only poly beakers during etch process. Do not heat poly beakers on hot plate.

Rinse all lab ware. Clean up area when finished.