Kenneth L. Marshall
LLE Chemical Hygiene Officer
About this training

- **Hydrofluoric acid (HF) and ammonium bifluoride** (ABF) are primarily used at LLE to strip hard oxide coatings from optics and etch MLD gratings
  * Ammonium bifluoride is also known as “Ammonium hydrogen fluoride” or “Buffered Oxide Etch (BOE)

- Employees who handle **HF and ABF must** be trained on the hazards of these chemicals, required personal protective equipment (PPE) and what to do in the event of an exposure or a spill.

- Emergency exposure treatment and Safety Data Sheets (SDS) for these chemicals **must** always be kept in the immediate work area and reviewed regularly before use.

**Use Buffered Oxide Etch in place of HF whenever possible**
Outline

• Hazards

• Safe work practices

• Personal Protective Equipment (PPE)

• Skin exposure

• Eye exposure

• Inhalation

• Ingestion

• Spill clean-up

• Waste disposal

• Summary
Exposure can cause delayed injury and symptoms

- HF or ABF can penetrate deeply into the skin before dissociating (initially painless), causing delayed injury and symptoms. These symptoms can include:
  - Destruction of tissue
  - Decalcification of bone
  - Cardiac arrhythmia
  - Liver or kidney damage
  - Death
Exposure to fluoride-containing acids can have serious health consequences

- Inhalation of fumes at low concentration can irritate the eyes, nose and respiratory tract.

- Inhalation at high concentration can cause death from an irregular heartbeat or from fluid buildup in the lungs.

- Ingestion of only a small amount of highly concentrated solutions will affect major internal organs and may be fatal.

- Eye exposure may cause prolonged or permanent visual defects, blindness, or total destruction of the eye.

* For a more detailed list of signs, symptoms and health effect of exposure visit: https://emergency.cdc.gov/agent/hydrofluoricacid/basics/facts.asp
Only qualified and experienced personnel should handle HF or ABF

Protective Measures:

- *Always* work inside a fume hood

- *Always* wear all the required Personal Protective Equipment (PPE)

- *Never* use HF or ABF when working alone or after hours

- All personnel working with (or near those working with) HF or ABF should be aware of the hazards of these chemicals and the emergency procedures necessary in case of an accident/exposure

*Always* wash hands thoroughly after handling HF or ABF
Special precautions must be taken when storing hydrofluoric acid and ammonium bifluoride

Protective Measures (continued):

• Always place HF and ABF on a low protected shelf in a secondary container or other location where it will not be accidentally spilled or knocked over

• HF and ABF must always be stored in heavy-walled plastic containers.

• Never store these chemicals in glass bottles
Safety Data Sheets and Calgonate Gel must be located in the immediate vicinity of HF or ABF use.

* Acute Toxicity (fatal or toxic)
* Corrosive
* Health Hazard

Everyone using HF or ABF must be trained on its properties, procedures for use, emergency response, and disposal.
When working with hydrofluoric acid or ammonium bifluoride the following PPE is required

- Chemical splash goggles and a face shield
  - Safety glasses with side shield DO NOT provide adequate protection
- Long-sleeved, buttoned lab coat, full-length pants, and closed-toed shoes
- Neoprene or Nitrile (22 mil) or other hydrofluoric acid resistant gloves
  - Do NOT wear latex gloves
- An apron made of natural rubber, neoprene or Viton is also required

Ensure that all PPE is fully functional with no tears or holes prior to use
Any person exposed to HF or ABF must seek immediate medical assistance

For skin exposure:

• *Immediately* and continuously wash all affected areas with water for 5 minutes

• The victim’s buddy must call an LLE Receptionist to have the Medical Emergency Response Team paged and 911 called.

• After rinsing, use a properly gloved hand to apply Calgonate Gel by massaging it into the skin. (If Gel is not available, continue to rinse with water for at least 15 minutes)

• Re-apply Calgonate Gel continually every 10-15 minutes until medical treatment is given by a physician or EMT

Users of HF or ABF must verify Calgonate has not expired before starting work
Eye Exposure

**Any person exposed to HF or ABF must seek immediate medical assistance**

For eye exposure:

- Immediately flush eyes for at least 15 minutes with cool flowing water. Hold the eyelids open and away from the eye during irrigation.

- **Victim must** be taken to the doctor (preferably an eye specialist) while continually irrigating the eyes during transport.
Inhalation Exposure

Any person exposed to HF or ABF must seek immediate medical assistance

If a large volume of gas is inhaled:

- Immediately move the victim to fresh air and call for medical attention
- Keep the victim warm, quiet, and comfortable

If breathing has stopped, a trained responder can begin CPR after ensuring that:

- The Medical Responder will not also be exposed to HF
- The mouth and throat are free of foreign material

The victim must be examined by a doctor and held for observation for at least 24 hours after exposure
Ingestion

Any person exposed to HF or ABF must seek immediate medical assistance

If acid is ingested:

• Drink large amounts of water as quickly as possible to dilute the acid
  • Do NOT induce vomiting

• Drink several glasses of milk or several ounces of Milk of Magnesia, Mylanta, Maalox, or similar product; or eat up to 30 Tums (Calcium Carbonate), Caltrate or other antacid tablet.
In the event of a spill....

1. Alert personnel in the immediate area, supervisor, and the Chemical Hygiene Safety Officer.
2. Obtain the Calgonate Spill Kit
3. Don the appropriate PPE
4. Contain spill by spreading Kolor-lock neutralizing powder outside spill area, working inwards
5. Isolate spill area by delineating with caution tape and posting signage (ex. Danger: HF spill)
6. Allow sufficient contact time as recommended by the manufacturer
7. Verify that neutralization is complete by using PH strips included in the spill kit
8. Collect all clean-up waste in a sealed plastic container. Label “HF clean-up waste” with a Chematix Waste Tag and place in the Hazardous Waste Collection Area
9. Rinse off all PPE used during clean up with copious amounts of water
Calgonate Spill Kit Contents

Instructions

- HF ACID SPILL
  NEUTRALIZATION AND CLEAN UP

Follow these instructions for the neutralization and cleanup of Hydrofluoric Acid spills:

1. **Evacuation and Neutralization**
   - Evacuate the area around the spill.
   - Neutralize the spill using the proper method.

2. **Personal Protective Equipment (PPE)**
   - Wear appropriate PPE such as gloves, goggles, and protective clothing.

3. **Spill Response**
   - Use the Calgonate Spill Kit to contain and neutralize the spill.
   - Use a neutralizer to safely neutralize the spill.

4. **Cleanup**
   - After neutralization, clean the spill area thoroughly.
   - Dispose of contaminated materials in accordance with regulations.

PPE

- Gloves
- Safety glasses
- Respirator

Treatment

- Calgonate Emergency Spill Kit
- Antacid Calcium Carbonate
- Antacid Calcium Carbonate Packet

Neutralizer and Clean-up

- Neutralizer
- Clean-up tools
- Clean-up supplies
HF and ABF can only be used in approved locations and where Calgonate and spill kits are present

- Familiarize yourself with the location and contents of the HF spill response supplies

- In labs where HF or ABF is utilized, use Kolor-Safe Kolor-Lock to clean up any unidentifiable spilled liquid as if it were HF or ABF

Users must obtain approval from the Chemical Safety Officer for any new locations where these materials will be used
Spill response supplies are located near each HF or ABF work area

Rm 1210 – under the disposable glove dispensers, attached to the hood where all HF/ABF work should be handled

Rm 112D – adjacent to the first aid kit & safety shower
Spill response supplies are located near each HF or ABF work area

Rm 1430 – near safety shower, directly across from hood where all HF/ABF should be handled

Rm 2234 – center of room, on top of lab bench, central to all areas of lab
Waste Disposal

Hazardous waste containers must be properly stored and labeled

All HF and ABF waste **must**:

- have an accumulation start date label affixed to the container
- be labeled with a Chematix Waste Tag
- **be stored in heavy-walled plastic containers**
- be stored in secondary containment
Accidental exposure to HF or ABF can have serious consequences, including death

- Achieving and maintaining a safe working environment is everyone’s responsibility
- Know the Standard Operating Procedures (SOP) for the chemicals you are working with
- Only experienced, qualified personnel should handle these chemicals
- Always work with a buddy and never after-hours
- Use all required, properly-fitting PPE for every experiment every time
- Know what to do and who to call when something goes wrong

When uncertain about proper procedure or operational safety: STOP and ASK!
Before starting work…

• Complete the on-line **C_006 Quiz**:
  • Sign (handwritten, not typed) the results page that will be emailed to you
  • Deliver signed form to the “Safety” Mailbox in the LLE East lobby, or email to safety_training@lle.rochester.edu

• Submit **LLE Safety Suggestions** any time

Use any web browser to access these links on the LLE Safety Zone, “Training” tab

You must complete the C_006 quiz to satisfy your training requirement
New employees must obtain signature of Chemical Safety Officer after completing quiz