|  |
| --- |
| Hazard Control Plan |

Hydrofluoric Acid Use – [Your Lab Name]

**TEMPLATE INSTRUCTIONS: Some sections will require more or less detail depending on your procedure. Send completed HCPs to ehrslaba@ehrs.upenn.edu for upload to your lab’s document section in BioRAFT. EHRS will review HCPs on your request; however, the supervising faculty member is responsible for ensuring that a thorough hazard assessment has been performed. Replace red text with your text in this template. Delete this message when submitting your HCP.**

# Purpose

• • •

A Hazard Control Plan (HCP) is a standard operating procedure for a specific process performed in your laboratory or department. The HCP describes the hazardous materials or equipment in use and details the controls that will be put in place to minimize risk of exposure, injury, and other incidents. While the HCP may also include experimental procedures, its purpose is primarily to document the hazards and controls for the process. An HCP is typically written for procedures with particularly high hazards or when new hazards are introduced for the first time. A hazard assessment must be repeated, and the HCP amended whenever changes are made to the process.

Hazard Control Plan

Hydrofluoric Acid Use – [Your Lab Name]

Date HCP Prepared: *[Date]*

HCP Prepared by:

|  |  |
| --- | --- |
| Name | *[Name]* |
| Position/title | *[Position/title]* |
| Email address | *[Email]* |
| Phone number | *[Phone number]* |
| Supervising Faculty Member | *[Faculty member’s name]* |
| Department | *[Department name]* |
| Contributors | *[Names]* |

Location of Process:

|  |  |
| --- | --- |
| Building | *[Building]* |
| Room number | *[Room]* |
| EHRS hood number (if applicable) | *[3-4 digit EHRS ID Hood Numbers]* |
| Other location information | *[Other location info, including storage, if applicable]* |

### References:

*[Insert literature or research notebook references for this procedure here. Specify which procedure in the* *paper is the one you will be following, e.g. “Method 3, page 1427”]*

*[Specify here if there are any parts of the procedure you will be modifying in your experiment, e.g. using a different solvent, a different substitution on a molecule, or different reaction conditions such as temp]*

*[Insert references/links to equipment manuals for any equipment you will be using in the procedure. We recommend uploading equipment manuals to your lab’s Documents section in BioRAFT and linking to that page for easy reference and access by lab members and EHRS.]*

# General Description

[Brief, General Description of Process Including Research Goal/Outcome.]

# Scope and Limitations

This Hazard Control Plan applies to the equipment, chemicals, and tasks described herein. Any deviation in materials, pressures, temperatures, or other operational parameters specified in this HCP must be evaluated for new potential hazards and necessary controls before implementation of the changes.

**Describe any limitations in scope that are specific or important to this hazard control plan (if applicable).**

# Hazard Identification

The following chemical and physical hazards have been identified for this process/equipment. [put “x” in box next to hazards]

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Chemical** |  | **Physical/Other** |
|  | Carcinogens |  | Ionizing radiation |
| X | Corrosive Liquids |  | Radioactive materials |
|  | Perchloric Acid |  | Lasers |
|  | Engineered Nano Materials |  | UV light sources |
|  | Flammable Chemicals |  | Inert compressed gases |
|  | Hazardous Gas (Flammable, Oxidizing, Corrosive, Toxic) |  | Electrical Hazards |
| X | Highly Toxic Chemicals |  | Heavy material handling equipment |
| X | Irritants |  | Working at Heights (4 foot or higher) |
|  | Explosive compounds |  | High heat |
|  | Peroxide formers |  | Open Flame |
|  | Pyrophoric chemicals |  | Lithium Batteries |
|  | Strong Oxidizers |  | Noise hazards |
|  | Water Reactive Chemicals |  | Particulates from machines and operations |
|  | Cryogens and Dry Ice |  | Pressure and Vacuum vessels |
|  | Teratogens and/or reproductive hazards |  | Robotic Machinery |
|  | Exothermic reaction/Other chemical reactivity hazards |  | Shop equipment |
|  |  |  | Biological Hazards |
|  |  |  | Exposed blades, needles, etc. |
|  |  |  | Aquatic Hazard |
|  |  |  |  |

# Training Requirements

*Training beyond the standard EHRS lab safety training is required for hazardous lab processes. Hands-on training by a senior lab member experienced in the use of hydrofluoric acid is required before new lab members can perform experiments with HF or its salts. All researchers conducting this experiment must read and understand the applicable SOPs and Fact Sheets in Penn’s Chemical Hygiene Plan.*

*After completing the training, the new lab member must obtain approval from the PI prior to commencing work. No researcher may work independently with the hazardous material described in this HCP until the Principal Investigator (or their designee) has ensured that the researcher:*

* *Has completed all required EHRS laboratory safety training programs.*
* *Understands the hazards of the materials and risks of the processes involved.*
* *Has read and understands the contents of the related SOP(s) and/or Fact Sheets on the hazard (available on* [*EHRS’s website*](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan#paragraph-1016)*) and this task-specific Hazard Control Plan.*
* *Demonstrates the ability to execute their work according to the requirements in the related SOP(s) and/or Fact Sheets on the hazard (available on* [*EHRS’s website*](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan#paragraph-1016)*) and this task-specific Hazard Control Plan.*
* *All group members must be educated on the hazards of HF, even those who do not use HF. Training will be provided to all lab workers on the location and use of the hydrofluoric acid response kit. The names of those who have been trained will be documented in a location (physical or digital) accessible to all lab members.*

# Tasks, Hazards, and Controls

Describe **each step of the procedure** that involves a hazardous material or procedure. **Replace the use of “should be/do” statements with “must be/do” statements as much as possible**; this reduces the risk of someone misinterpreting “should” statements as optional instructions.

(See Appendix B for an example task description)

***Hazard-Control Table Instructions: (Delete these instructions before submitting your draft)***

(See Appendix B at the end of this document for an example of a completed table)

* *Fill in the Hazard (e.g. Flammable Chemical, or Toxic Gas, etc.) in the top row.*
* *Enter the Risk (e.g. Fire, or Illness/Death due to inhalation).*
* *Enter the Risk Factors (e.g. For Fire: Strong oxidizers, open flames; For Illness/Death from inhalation: Leaks in tubing, inadequate post-reaction purge time).*
* *Define the likelihood and severity of the Risk.*
  + ***See Appendix A at the end of this document for definitions of Risk likelihood and severity levels (High(H), Medium(M), and Low(L)).***
* *Fill-in any hazard controls that are in place or will be put in place. (You do not need to enter a control for each category.)*
  + ***See Appendix B at the end of this document for an example of a completed Hazard Control Table.***
* *It is most efficient to group materials that have similar hazard controls in place, and/or quenching procedures. This way, the fewest number of tables must be written. (e.g. most flammable gases have the same controls, so it is best to create a “Flammable Gas” table).*
* *If a material has multiple hazards (e.g. Carbon Monoxide is toxic and flammable) and you have other materials that fit one or both hazards, writing tables for both hazards (e.g. “Toxic Gases” and “Flammable Gases”) is sufficient.*
* *If a material has multiple hazards (e.g. Carbon Monoxide is toxic and flammable) but no other materials fit one of the hazard types (e.g. Carbon Monoxide is your only toxic gas, you have other flammable gases), you may specify extra controls for that material in one hazard table, rather than writing another table (e.g. include “Use a handheld CO detector to detect leaks when working with CO” in your “Flammable Gases” table).*

***Duplicate the table (or delete excess tables) as many times as is necessary for each hazard and risk of each step.***

1. **[Task Name]**

[Task Description/General Procedure]

[Photos]

|  |  |  |  |
| --- | --- | --- | --- |
| **Hazard: Highly toxic and corrosive chemical (Hydrofluoric acid)** | | | |
| **Risk** | **Likelihood** | **Severity** | **Risk Factors** |
| Serious burns to eyes or skin from hydrofluoric acid exposure. HF can penetrate the skin and lead to deep tissue destruction. | M | H | Chemical spill/splash.  Contact with contaminated surfaces.  Using funnels/vessels made of material incompatible with HF. |
| **Controls** | | | |
| **Administrative [work practices]** | -Do not work alone. Another lab member must be available to assist in case of emergency.  -Notify lab mates before working with HF.  -Check that the fume hood is not in alarm and is pulling air before conducting this experiment.  -Label the area where HF is stored and used; a warning sign labelled “Hydrofluoric Acid Use in This Area” must be present near the workspace to alert other lab members of the work taking place.  -Wipe down the working area with a damp paper towel after the experiment.  -Clean up any spill immediately. Ensure that no puddles or droplets are on the work surface when done.  -Immediately change gloves if they become contaminated.  -As soon as possible after completing task, remove gloves and wash your hands.  -Thoroughly rinse all labware immediately after use.  -Do not perform any other procedures in the fume hood until all HF work is complete, the waste has been collected, and equipment and materials have been cleaned, properly discarded, or removed from the area. | | |
| **Engineering** | -Conduct this task only inside of a working chemical fume hood.  -Use the chemical fume hood sash as a barrier to shield your face and as much of your body as possible while performing this task.  -Use PTFE vessels to contain HF solutions; HF etches glassware. | | |
| **Personal Protective Equipment** | -Standard lab attire (long pants, fully-enclosed shoes, etc.)  -Single 8-mil-thickness nitrile gloves, 100% cotton lab coat, an HF-resistant lab apron, and safety goggles (not glasses) must be worn properly **at minimum** when conducting the reaction.  -[EHRS-Recommended PPE: face shield, HF-resistant gloves, and HF-resistant arm sleeves (if not already a part of the glove).]  -Neoprene is a common HF-resistant material for PPE, but always check with the manufacturer for HF resistance before purchasing. | | |
| **Other mitigating factors**  **(inherent risk reduction)** | -A hydrofluoric acid exposure response kit must be available near fume hood ####, where this work takes place.  -The lab will routinely check the expiration date of the calcium gluconate in the exposure kit and will replace the tube as needed. | | |

**Link to Penn Chemical Hygiene Plan Fact Sheet and SOPs for these hazards:**

[Fact Sheet: Hydrofluoric Acid | https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets/fact-sheet-hydrofluoric-acid](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets/fact-sheet-hydrofluoric-acid)

[SOP: Acutely Toxic Chemicals | https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-acutely-toxic](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-acutely-toxic)

[SOP: Corrosives | https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-corrosives](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-corrosives)

1. **[Task Name]**

[Task Description/General Procedure]

[Photos]

|  |  |  |  |
| --- | --- | --- | --- |
| **Hazard: [Name Hazard Here]** | | | |
| **Risk** | **Likelihood** | **Severity** | **Risk Factors** |
| [Enter risk here] | H, M, or L | H, M, or L | [Enter risk factors here – conditions or actions that would increase risk] |
| **Controls** | | | |
| **Administrative [work practices]** |  | | |
| **Engineering** |  | | |
| **Personal Protective Equipment** |  | | |
| **Other mitigating factors**  **(inherent risk reduction)** |  | | |

**Link to Penn Chemical Hygiene Plan SOP for this hazard:** [If applicable, include the link to the relevant [SOP](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-cryogens-and-dry) or [Fact Sheet](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets) from [Penn’s CHP](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan#paragraph-1016)]

***Continue adding tasks and hazard-control tables as necessary to describe all hazardous steps of the process.***

**Other Considerations**

**(Not specified elsewhere in this HCP)**

**Equipment Manual Safety Warnings**

*[Equipment manuals often come with a “Safety” or “Safety Messages” section that summarizes the “to-dos” and “not-to-dos” regarding the equipment. If a safety manual is available for a piece of equipment used in the procedure specified in this HCP, locate the “Safety” or “Safety Messages” section and copy the contents to here.]*

**[Storage and Transport](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan" \l "paragraph-945)**

*[Identify specifically where and how hazardous materials will be stored and transported in your lab.]*

**[Waste Disposal](https://ehrs.upenn.edu/health-safety/regulated-waste/chemical-waste)**

*All HF waste and rinses of HF-contaminated material must be collected in a dedicated, clearly labeled plastic container compatible with HF; the HDPE containers provided by EHRS are suitable for this purpose. After use, HF waste containers must be securely closed and transferred to the satellite waste accumulation area. Use a hazardous-waste tag to label the container with all of the constituents of the mixture, noting the presence of Hydrofluoric Acid. EHRS staff needs this information to avoid placing incompatible materials inside the same container. Contact EHRS’s EHS Technicians to pick up the waste container as necessary using the* [*Chemical Waste Pickup Form*](https://ehrs.upenn.edu/health-safety/regulated-waste/chemical-waste/chemical-waste-pickup-form) *on the EHRS website.*

*EHRS will take unwanted (full, used, or empty) reagent containers as hazardous waste. Place a yellow waste tag on the container and submit it to EHRS’s EHS Technicians using the online form* [*here*](https://apps.ehrs.upenn.edu/secure/fm/COLLECTIONS/index.php)*. If you are concerned that a reagent bottle will deflagrate/detonate/etc. if moved for waste pickup, contact* [*chem\_waste@lists.upenn.edu*](mailto:chem_waste@lists.upenn.edu) *for advice.*

[**Building/Lab Specific Emergency Procedures**](https://ehrs.upenn.edu/emergency-info)

*[Indicate where the* ***nearest eyewash and safety shower*** *are located. Refresh the lab group on the* ***emergency phone numbers*** *and* ***evacuation procedures****. Include any special* ***emergency response or spill clean-up instructions*** *for this particular process.]*

*[****Consider “what-if” scenarios*** *- is there something external that could fail, such as loss of running water, loss of fume hood exhaust, etc. impact the safety of your operation? How would you respond if you were mid reaction, or could not easily get to your reaction to stop it? Provide a brief overview of some relevant scenario(s).]*

In case of skin exposure to hydrofluoric acid / a solution containing HF:

* Quickly remove all contaminated clothing while using the safety shower or other available source of water.
  + In the case of eye exposure, use an emergency eyewash instead.
* Immediately flood the affected body area in cold water for at least 5 minutes.
* The victim should self-apply calcium gluconate to the affected areas.
  + Note the time when the calcium gluconate was first applied to the skin; this will be useful information for the medical examiners.
  + If the victim is unable to apply the calcium gluconate, assisting lab members must only help after equipping the HF-resistant or disposable gloves found in the HF first aid kit **(the first aid kit is found in [location])**. This is to avoid cross-contamination of the assistant.
* Call 511 for emergency transport to the hospital (University City campus). Ideally, those assisting the victim should do this while the victim performs the previous steps.
* Tell the dispatcher the following information:
  + There is a person that has been exposed to Hydrofluoric Acid and type of exposure (skin or eyes),
  + Location of exposed individual,
  + Send an officer and ambulance,
  + Ask the dispatcher to notify the HUP Emergency Department that a person with exposure to *hydrofluoric acid* is being transported to the Emergency Department.
* The victim may put on the disposable gown in the HF kit when ready if their clothing was contaminated and previously removed.
* The exposed individual must be escorted to the hospital by the medical responders.
* A copy of the Safety Data Sheet (SDS) and Health Hazard information from the first aid kit must be also taken to the hospital.
* After the medical response has been requested, **Contact the EHRS office** at 215-898-4453 (24 hours, 7 days/week) to report the incident.
* **Do not attempt to clean up any other spilled HF on equipment, contaminated clothing, etc.** Wait for EHRS assistance.

*During a fire emergency, the University of Pennsylvania’s Division of Public Safety – Fire and Emergency Services (FES) emphasizes safe evacuation as top priority. While evacuating, shut the fume hood sash (if applicable) and close doors behind you. Notify emergency services of the fire and its location by either of the following methods:*

* ***Pulling the nearest fire alarm manual pull station*** *while you evacuate the building, or*
* *If on the* ***Philadelphia campus,****calling* ***215-573-3333, or 511****from a campus phone.*
* *If at* ***New Bolton Center or Morris Arboretum & Gardens calling 911****.*

*Incipient fires with a* ***mundane*** *fuel source (e.g. pure flammable solvents, nonhazardous lab trash) may be fought to assist oneself or another to evacuate, or to control a small fire. In case of a small, incipient fire of this nature, a [specify class] fire extinguisher can be found in [location]. Only fight such a fire if:*

* *You have received hands-on training at Penn on how to use a portable fire extinguisher.*
* *It is safe to do so, and the fire is not located between you and your exit.*
* *The fire is still contained to the original fuel source and has not begun to spread.*
* *You are not alone.*
* *The appropriate type of extinguisher is available.*

*Do not feel compelled to fight a fire if you are not comfortable doing so. Evacuation is always an acceptable option.*

*After notifying emergency services of a fire, please notify EHRS of the fire at* ***215-898-4453****.*

*In case of an incident which causes life-threatening or otherwise severe injury in need of immediate medical care, call 215-573-3333 or 511 from a Penn campus phone. For injuries that are not immediately life-threatening, or are otherwise minor, rinse any contaminated areas in the sink, safety shower, or eyewash (as appropriate) for at least 15 minutes, then seek treatment at one of the following locations:*

***Faculty and Staff:***

***Go to Occupational Medicine:*** *HUP RAVDIN 2nd floor, 34th & Spruce Streets*

*Hours: 8:30am - 3:30 pm  
Phone: 215-662-2354*

*An appointment is not required for a new injury or exposure.*

***Go to Emergency Service at HUP or Penn Presbyterian after hours:***

*HUP:  Pavilion (1 Convention Avenue)*

*Penn Presbyterian: Myrin Building (51 N 39th St.)*

***Students:***

***Go to Student Wellness during hours:*** *3535 Market Street, Suite 100  
215-746-3535*

***Go to Emergency Service at HUP or Penn Presbyterian after hours:***

*HUP:  Pavilion (1 Convention Avenue)*

*Penn Presbyterian: Myrin Building (51 N 39th St.)*

***Do not hesitate to call EHRS for assistance with compressed gas leaks, spills, or exposure concerns. 24-hour EHRS on-call phone number: 215-898-4453***

***Contact Penn Police (511 from a Penn campus phone or 215-573-3333) if there is a fire, imminent risk of fire, an injury requiring an ambulance, or if there is a hazard that may affect others in the building.***

Optional attachments:

* Safety Data Sheets
* Operation Manuals for Equipment
* Experimental Procedure
* List of Individuals Trained and Authorized on this Procedure

**Appendix A: Definitions of Risk Likelihood and Severity Level**

**Likelihood**

**----------------------------------------------------------------------------**

**Low:**

To the best of your knowledge, this has not happened in the past with the same or similar equipment/material/location.

*And*

This would not be expected to occur under normal operating conditions.

*And*

This would only be expected to occur in the event of a rare upset condition.

**----------------------------------------------------------------------------**

**Medium:**

To the best of your knowledge, this has not happened in the past with the same or similar equipment/material/location.

*And*

This would not be expected to occur under normal operating conditions.

*And*

This would be expected to occur under reasonably anticipated upset conditions.

**----------------------------------------------------------------------------**

**High:**

This is known to have happened in the past with the same or similar equipment/material/location.

*And/or*

This could occur under normal operating conditions.

*And/or*

This could occur under reasonably anticipated upset conditions.

**----------------------------------------------------------------------------**

**Severity**

**----------------------------------------------------------------------------**

**Low:**

This would not cause an injury or exposure that would require medical evaluation or treatment.

*And*

No permanent damage to equipment or facility would result.

*And*

Damage would not result in downtime of more than a few hours.

**----------------------------------------------------------------------------**

**Medium:**

Injuries or exposures would not exceed first-aid level treatment and would not result in any lost workdays due to injury.

*And/or*

Minor equipment or facility damage would result.

*And/or*

Damage would result in downtime of a few hours or more.

*And/or*

A hazardous material spill clean-up would need to be done by the lab.

**----------------------------------------------------------------------------**

**High:**

Injuries or exposures would require medical treatment beyond first-aid and/or would result in lost workdays due to injury.

*And/or*

Serious equipment or facility damage would result.

*And/or*

Damage to the facility would be beyond the lab/room of origin.

*And/or*

Damage would result in more than one day of downtime.

*And/or*

External hazmat team required for hazardous material spill clean-up.

**----------------------------------------------------------------------------**

# Appendix B: EXAMPLE TASK/HAZARDS/RISKS/CONTROLS

1. **H-Termination of Silicon Substrates**

Small silicon wafers are H-terminated by immersion in a 5% HF or 40% NH4F solution for 5 minutes, or until the wafers are demonstrably hydrophobic. PTFE beakers and tweezers are used in the process to contain the HF and manipulate the Si wafers without exposure to HF.

1. Before beginning any process, wear the appropriate personal protective equipment. In this case:
   1. Standard lab attire (long pants, closed toed shoes, etc.)
   2. Lab Coat and Nitrile gloves
   3. Additional pair of HF resistant gloves (8 mil thickness gloves)
   4. HF resistant apron
   5. Face shield
2. Prepare your H-terminating solution (select *a* or *b*):
   1. Prepare a 5% HF solution in a PTFE beaker by pipetting first 22.75 mL of DI water and then 2.25 mL of stock (49%) HF solution into the beaker.
      1. Alternatively, purchase 5% HF solutions directly. This will mitigate the risks of storing and handling a more concentrated HF solution.
   2. Prepare a ~40% (w/v) NH4F solution in a PTFE beaker by adding 12 g of NH4F into the beaker, followed by adding 30 mL of water.
3. Submerge the Si wafer in the H-terminating solution for 5 minutes.
4. Pick up the substrate using PTFE tweezers and rinse the substrate with a copious amount of DI water using a squirt bottle. Be sure to contain the rinsate to a PTFE or HDPE container separate from non-HF wastes.
   1. Once fully rinsed, the Si surface should be completely hydrophobic and water droplets should fall right off the surface. If the wafer is insufficiently hydrophobic, re-immerse the wafer in the H-terminating solution for another two minutes.
   2. Rinse the H-terminated substrate with water until the pH reading on the rinse stream is neutral.
5. Transfer the rinsate and H-terminating solution to an HDPE waste container designated for HF waste only. Move the HF waste container back to a Satellite Accumulation Area.
6. Dry the substrate with air using a handheld dust puffer.

Photo of Equipment/Process if available

(See Example Hazard-Control Table on Next Page)

EXAMPLE HAZARD-CONTROL TABLE

|  |  |  |  |
| --- | --- | --- | --- |
| **Hazard: Highly toxic and corrosive chemical (Hydrofluoric acid)** | | | |
| **Risk** | **Likelihood** | **Severity** | **Risk Factors** |
| Serious burns to eyes or skin from hydrofluoric acid exposure | M | H | Chemical spill/splash  Poor housekeeping practices/contaminated surfaces  Using funnels/vessels made of material incompatible with HF. |
| **Controls** | | | |
| **Administrative [work practices]** | -Label the area where HF is stored and used; a warning sign labelled “Hydrofluoric Acid Use in This Area” must be hung on the work space to alert other group members.  -Do not work with HF when alone in lab. Notify lab mates before working with HF.  -Use an appropriately sized funnel for the size of the graduated cylinder.  -Close HF bottle immediately after pouring chemical. Do not leave the bottle open.  -Wipe the outside of the bottle with a damp paper towel after use.  -Clean up all spills immediately. Ensure that no puddles or droplets are on the work surface when done.  -Immediately remove gloves if they become contaminated.  -As soon as possible after completing task, remove gloves and wash your hands.  -Thoroughly rinse all labware immediately after use.  -Do not perform any other procedures in the fume hood until all HF work is complete, the waste has been collected, and equipment and materials have been cleaned, properly discarded, or removed from the area. | | |
| **Engineering** | -Conduct this task only inside of a designated, functioning chemical fume hood (####).  -Use the chemical fume hood sash as a barrier to shield your face and as much of your body as possible while performing this task.  -Use PTFE beakers to contain HF solutions; HF etches glassware.  -Use PTFE tweezers to manipulate silicon wafers; this avoids contact with HF residue. | | |
| **Personal Protective Equipment** | -Standard lab attire (long pants, fully-enclosed shoes)  -Single 8-mil-thickness nitrile gloves, 100% cotton lab coat, an HF-resistant lab apron, and safety goggles must be worn properly **at minimum** when conducting the reaction.  -EHRS also strongly recommends working with a face shield, HF-resistant gloves, and HF-resistant arm sleeves (if not already a part of the glove) for all work with HF.  -Neoprene is a common HF-resistant material for PPE, but always check with the manufacturer for HF resistance before purchasing. | | |
| **Other mitigating factors**  **(inherent risk reduction)** | -An HF exposure kit with non-expired calcium gluconate gel is available in the lab near fume hood #### where HF is stored and used.  -Training is provided to all lab workers on the location and use of the kit.  -The lab will routinely check the expiration date of the calcium gluconate in the exposure kit and will replace the tube as needed.  -Purchasing dilute HF solutions directly instead of diluting more concentrated ones inherently removes the risk of exposure to concentrated HF solutions. -Storing solid NH4F rather than HF solutions mitigates the severity of a chemical spill. | | |

**Link to Penn Chemical Hygiene Plan SOP for this hazard:**

Fact Sheet: Hydrofluoric Acid|<https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets/fact-sheet-hydrofluoric-acid>