

UDNF Usage and Safety Manual

Introduction

The purpose of this document is to provide information and guidance to the users of the University of Delaware Nanofabrication Facility (UDNF or Facility) on how to conduct their research in a safe manner.

Although this document attempts to cover all acceptable operating and safety policies of the Facility, it is impossible to define a policy for every conceivable situation; users should use a common sense approach when working in the Facility. Safety is everyone's responsibility. The users assume responsibility to plan and perform work in a manner which ensures their own personal safety as well as the safety of others in the Facility. The **privilege** of using UDNF will be suspended or revoked as a result of failing to act in a responsible manner, follow rules and regulations, and apply common sense.

Users are encouraged to make suggestions regarding the Facility, the way it is operated, its tools/systems, and its staff. Please feel free to direct your suggestions to any of the Facility's staff or its Director.

Facility Access

To obtain access to the Facility, prospective users must complete the following steps:

1. Provide information about themselves on the UDNF website (<http://udnf.udel.edu/access/>)
2. Sign agreement and complete EHS Safety Training
 - (a) Execute the User Agreement (agreement template will be provided once all the information requested in Step 1 is supplied)
 - (b) Attend EHS Safety Training
3. Attend a Facility Orientation provided by a UDNF staff member.

UDNF staff is available to meet with the users to discuss the feasibility of their projects; an invitation to meet will be generated after the completion of Step 1 above.

The Environmental Health & Safety (EHS) Department offers a NanoFab-specific training; details can be found at <http://www.udel.edu/ehs/training/NanoFab.html>.

The Facility Orientation will be scheduled once the first two steps above are completed. The Orientation consists of a Facility walkthrough conducted by a UDNF staff member during which important safety and operational topics are covered.

Once the Facility Orientation is completed, the user's UD card will allow access to the Facility. Users who do not have a UD card will be provided with instructions and assistance on obtaining

one. Everyone must swipe their UD IDs to enter and exit the cleanroom. Please do not unlock the cleanroom door for anyone but yourself.

Users must keep their EHS training current; UDNF will provide friendly reminders to the users about the need to complete the annual safety training. Users who fail to keep current on their safety training will have their access suspended until all EHS training requirements are met.

Please note that access to the Facility does not grant users the right to use any chemicals or operate any equipment. The Facility Management System (currently FOM) allows the users to make requests for training on individual pieces of equipment and chemicals. Once the staff member providing training determines to her/his own satisfaction that the user is qualified to operate a piece of equipment or handle a chemical, that user will be given access to that piece of equipment or chemical in FOM. The user can then make reservations and use the equipment or chemical.

Access to FOM will be granted upon completion of the Facility Orientation.

Hours of Operation

The Facility is **open** Monday-Friday from 8:30 am until 7:00 pm; the Facility is **staffed** from 8:30 am until 5:00 pm. The Facility is closed when the University is closed (holidays, snow days, etc).

New users start with staffed hours access and have the opportunity to apply for extended hours (5:00 pm to 7:00 pm) access after three months of consistent and responsible use of the Facility. The users and their supervisors execute an extended hours access agreement.

Please note that the Facility is closed for preventive maintenance for one week in the Spring and one week in the Fall; the users will be given ample prior notice as well as reminders regarding the maintenance weeks.

The Facility is not staffed during the extended hours of operation. On occasion, the Facility may not be staffed during the typical staffed hours due to meetings, conferences, etc; advance notice will be provided in those situations.

The buddy system (described below) is in effect when the Facility is open but is not staffed.

No hazardous processes may take place while the facility is not staffed. A hazardous process involves the use of toxic, corrosive, or pyrophoric materials. The following tools are not available while the Facility is not staffed: ALD, PECVD, Cl2 ICP. No work with acids or concentrated bases may take place when the facility is not staffed.

Buddy System

Users may not be in the Facility alone when the Facility is open but not staffed.

A minimum of two users must be fully gowned and present in the cleanroom (not in the gowning area) while the Facility is not staffed – the users may be in different clean bays but they have to check on each other every ten (10) minutes.

Only a person who is authorized to use the Facility may be a safety buddy. Keep in mind that another user present in the Facility is NOT automatically your safety buddy; you must ask and they must agree to be your safety buddy. You must notify your safety buddy when you plan to step out or leave so they are not left alone in the cleanroom.

We encourage you to look for a safety buddy while planning your work for the times when the Facility is not staffed. You may use the [nanofab-buddy](mailto:nanofab-buddy@udel.edu) mailing list (nanofab-buddy@udel.edu) to identify a safety buddy in advance. Access to the nanofab-buddy mailing list is granted upon completion of the Facility Orientation.

A safety buddy is **always** required when handling acids and concentrated bases in the Facility. With the exception of HF described below, the safety buddy does not have to wear the additional PPEs nor stand by the person handling the acids or bases.

Only HF-trained users may act as safety buddies for HF work. The buddy must wear all the PPEs required for HF work and must stand ready to assist the person using HF. You may use the HF-buddy mailing list (hf-buddy@udel.edu) to identify a HF safety buddy in advance. Access to the HF-buddy mailing list is granted upon completion of the HF training. In case of exposure to HF, the safety buddy must accompany the exposed user to the emergency room, by riding the ambulance.

Facility Protocol and Conduct

The “amber light” half of the cleanroom meets the ISO 5 cleanliness standards and the “white light” half of the cleanroom meets the ISO 6 cleanliness standards. Humans, their behavior, and the materials they bring in are by far the largest sources of cleanroom contamination.

Proper gowning consisting of shoe covers, hair covers, face covers, coveralls, hoods, booties, gloves, and safety glasses is required at all times in the Facility.

Safety glasses are available in the gowning area and they may not be taken outside of the cleanroom. Prescription eyeglasses do not provide enough protection. If you wear glasses you have two options: (1) wear the safety glasses provided by the Facility over your glasses or (2) purchase prescription safety eyeglasses meeting ANSI standard Z87.1. Contact lenses are permitted in the Facility as long as you wear safety glasses.

Open-toed shoes, sandals, shorts, and skirts (unless pants are worn underneath) are not permitted in the Facility.

Do not bring coats, hats, backpacks, canvas bags, etc. into the Facility. Store these items in your office or in the lockers outside the Facility.

Do not wear dirty shoes or boots in the Facility.

Do not unzip the coveralls to retrieve items from your pockets while you are in the Facility; you may do so ONLY while in the gowning room.

No eating, drinking, smoking, or applying cosmetics is permitted anywhere in the Facility.

Do not bring anything into the Facility that is not absolutely necessary for the research you are conducting. Any item brought into the cleanroom must be cleanroom compatible and thoroughly cleaned/wiped down prior to entry. Cleaning supplies are available in the Gowning Room and instructions will be provided during the Facility Orientation.

Do not bring ordinary paper, cardboard, or other packing materials into the Facility. Only clean room notebooks and cleanroom paper are allowed in the Facility.

No pencils or erasers are allowed in the Facility.

Please clean up after yourself and leave your work area the way you would like to find it when you come in. Clean the spinners, bench tops, and rinse the glassware you used. There should be no liquid drops/puddles anywhere.

Be considerate. Don't use others' supplies. Share. If you reserve equipment, show up. If your experiment runs behind and you can't use the equipment, please cancel your reservation in advance of your scheduled time so someone else may use the equipment.

Everyone must contribute to maintaining the safety and cleanliness of the Facility. The staff is here to help, not clean up after you.

If in doubt, ASK!

Personal Electronic Devices

Only two types of electronic devices are allowed in the Facility: mobile phones and tablet computers (laptops are not permitted).

The Facility is fitted with a number of phones that can be used to communicate with the outside world. Each bay has a phone number as follows: Bay 1: 302-831-7471, Bay 2: 302-831-7472, **Bay 3**: 302-831-7473, **Bay 4**: 302-831-7474.

While in the Facility you are busy and should be monitoring your work at all times; limit the amount of time you spend on the phone. Don't walk while using your phone. Do not touch your phone with wet gloves and do not place your phone inside of wet benches.

Devices that interfere with your ability to hear (headphones, earbuds, etc.) are not permitted in the Facility.

Tablet computers are allowed in the Facility; however, no tablet cases or keyboards are allowed in the Facility.

The phones and tablets must be thoroughly wiped down; cleaning supplies are available in the Gowning Room and instructions will be provided during the Facility Orientation.

The Facility assumes no responsibility for misplaced or lost electronic devices.

Memory sticks, flash drives, etc. are not allowed in the Facility. The Facility provides means of transferring data in/out of the Facility via a shared drive; this will be covered during the Facility Orientation. The Facility is not responsible to protect or store your data; all Facility users have access to all files on the shared drive and the computers found throughout. Please remove your sensitive data from the shared drive and the other computers as soon as possible. Remote access to the shared drive will be granted upon completion of the Facility Orientation.

Access Areas

Users are not allowed to enter the service areas (gray areas shown in Appendix A) to adjust equipment, retrieve chemicals, defeat tool interlocks, etc. The doors leading from the clean bays into the service areas are equipped with audible alarms. Users may use the service areas for evacuation purposes only. Appendix A also shows the locations of the Facility's emergency exit doors. "You-are-Here" signs located throughout the Facility indicate the closest exit. Users are expected to review that information prior to using the Facility.

Security Cameras

Security cameras are located throughout the Facility; they monitor both the bay and the chase areas. Those cameras allow the staff and the University Police to monitor the activities in the Facility from remote locations at all times. The camera feeds are also displayed on a monitor located outside of the cleanroom. The cameras are essential for assessing cleanroom occupancy during an emergency and are also used in the enforcement of all Facility protocols.

Safety Showers and Eyewash Stations

Appendix B shows the locations of the Facility's safety showers and eyewash stations.

Fire Extinguishers

Appendix C shows the location of the Facility's fire extinguishers.

Alarms and Evacuation

A toxic gas monitoring system (TGMS) and fire alarm system (FAS) monitor the safety of the Facility. Each of these systems is equipped with visual (strobe lights) and audible (horns) alarms.

Do not enter the Facility if the strobe light above the Gowning Room door flashes and the horn goes off.

Immediately evacuate the Facility if any of the horns/strobes go off. Do not finish your project or take your notebook/tablet. Walk, do not run. Do not remove your cleanroom gowning; simply walk out.

If you exit the Facility into the building hallway you have to make a decision:

- 1) If the **fire** alarm horn/strobes in the hallway outside the cleanroom are going off, you must exit the building; follow the appropriate evacuation path indicated by wall signage to exit the building. Gather in front of the Student Services (small building North of ISE Lab). Do not return to the building until you are instructed to do so by Public Safety, EHS, or Building Manager. Do not re-enter the Facility until you are instructed to do so by Facility staff.
- 2) If the **fire** alarm horn/strobes in the hallway outside the cleanroom are NOT going off, you may stay inside the building. Do not re-enter the Facility until you are instructed to do so by Facility staff.

Immediately evacuate the Facility if you smell any chemicals; this may indicate a ventilation system malfunction. Do not exit the building. Notify Facility staff or EHS (302-831-8475) if the Facility staff cannot be located. Do not re-enter the Facility until you are instructed to do so by Facility staff.

The location and operation of the fire and toxic gas detection systems are reviewed during the Facility Orientation.

Appendix D of this document provides a map of the fire alarm system. Appendix E of this document provides a map of the toxic gas monitoring system. Users are expected to review and become familiar with this information prior to using the Facility.

Emergency Response

In case of a fire or medical emergency immediately call:

- **911** from any University phone or from your cell phone
- **302-831-2222** from any University phone or from your cell phone
- By pushing the red button on an emergency phone

Report the emergency and follow the dispatcher's instructions.

An emergency phone is located in the "white light" area by the sliding door that separates it from the "amber light" area. To use it, simply push the large red button.

Life threatening situations require a visit to the Emergency Room at the Christiana Hospital (302-733-1000) located at 4755 Ogletown-Stanton Road, Newark, DE 19718. The person needing care must be transported by ambulance; UDNF does **not** provide transportation to the Emergency Room or to any other medical services location.

For situations that are not life threatening, medical care should be sought as follows:

- M-F from 8:00 am to 5:00 pm:
 - Undergraduate students report to Student Health Services (302-831-2226) located in Laurel Hall (282 The Green, Newark, DE 19716-8101). Please call in advance and let them know that you are coming.
 - Faculty, staff, postdocs, and graduate students report to the Nurse Managed Health Center (302-831-3195) located on STAR Campus (540 South College Avenue; Suite 130, Newark, DE 19713). Please call in advance and let them know that you are coming.
 - All others report to the Emergency Room at the Christiana Hospital.
- After 5:00 pm and during the weekend and University holidays **all users** should report to the Emergency Room at the Christiana Hospital.

Please take some time to identify the shortest route to take in case you need medical evaluation. If in doubt as to what to do, call University Police (302-831-2222) or 911 for assistance.

In the event of a chemical spill notify Facility staff immediately. If a staff member cannot be reached please call EHS (302-831-8475) Monday through Friday from 8:00 am to 5:00 pm. Outside EHS' regular hours please call their on-call number at 302-540-1392. If your call is not answered, call **911**.

If there is a Facility problem, such as a water leak, notify Facility staff. If a staff member cannot be reached please contact the Building Manager at 302-831-3294/7065 (M-F, 8:00 am to 4:30 pm) or Facilities Dispatch at 302-831-1141 (after hours). Depending on the nature of the situation it may also be appropriate to call EHS.

We cannot develop rules for every possible situation – please use common sense.

Phone Numbers:

- Police/Fire/Ambulance: 911 or 302-831-2222
- EHS: 302-831-8475 (M-F, 8:00-5:00), 302-540-1392 (after hours)
- Building Manager: 302-831-7065 or 302-831-3294
- Facilities Dispatch: 302-831-1141

A list of phone numbers is posted throughout the Facility.

All injuries must reported to Facility staff. A first aid kit is available in the airlock between the gowning room and the cleanroom.

Visitors

The cleanroom is highly visible through the windows; users are allowed and encouraged to provide “window” tours. Tours that include cleanroom entry are limited and must be requested in advance by contacting the Facility (codreanu@udel.edu). Please note that all visitors who enter the cleanroom must be escorted by a staff member (in certain instances the Director may allow authorized users to escorts visitors within the cleanroom). Under no circumstances may a visitor be allowed to touch or operate equipment, handle chemicals, or be left unattended in the cleanroom.

Equipment Scheduling and Use

Scheduling time on Facility tools must be done through FOM, which can be accessed from any computer with internet access (<https://fom01.engr.udel.edu/fom/>). If you do not have an account in FOM, please contact the Facility (codreanu@udel.edu). Only users who have received proper training can schedule time on a particular piece of equipment or chemical.

Please be courteous to the next user; if you know that you won't be able to use your reservation, please cancel it as soon as you realize that. The system will send an email to that tool's mailing list so other users know that the tool has become available.

Having the ability to enter the Facility does NOT mean that you may use any chemicals, tools, systems, or wet benches found within; you will need to be properly trained and qualified before you can use any of them.

Do not use a piece of equipment that you have not been given authorization to use by its manager. Using equipment you are not authorized to use, even with the assistance of an authorized user, is strictly forbidden and will result in the suspension of your Facility access.

Once authorized to use a tool, please follow the safety and operating procedures for that tool. Keep in mind that those procedures are not meant to be a substitute for common sense.

Any problems with equipment operation must be immediately brought to the attention of the Facility staff. Do not attempt to repair a malfunctioning piece of equipment; equipment troubleshooting/repair is performed by Facility staff only. The needs of the user community are better served by waiting until a staff member responds.

Please do not change any equipment settings. If you believe any changes are warranted please contact the Facility staff.

You may not bring any equipment into the Facility without written approval from the Director.

Unattended operation of the equipment is not permitted. Users must be present in the cleanroom while equipment is running processes. If you need the step out (e.g. for a restroom break), please find another qualified user to keep an eye on the equipment while you are away.

Unattended cooling of equipment (e.g. PECVD, tube furnace) after hours is permitted; please ensure that the heat sources have been powered off before you leave the Facility.

Working with Chemicals

No work with acids or concentrated bases may take place while the Facility is not staffed.

The Safety Data Sheet (SDS) is the hazard communication tool that provides details on important aspects of chemical use, handling, storage, and disposal. Please review both the appropriate operating procedure and the specific chemical's SDS before working with a chemical.

Safety Data Sheets for the chemicals used in the Facility can be found on the Facility's web page and in the yellow binders placed in the following locations: 1) on the table in the airlock between the gowning room and the cleanroom; 2) on the table along the wall in the white light corridor; and 3) on the table along the wall in the amber light corridor. Please notify staff promptly if the SDS you are interested in is missing.

The facility maintains a list of approved chemicals. If you wish to bring a new chemical into the Facility, you must obtain written permission from the Director; the first step in the process is for you to supply a SDS. Since some chemicals are extremely hazardous, not all chemicals will be approved. Please do not order any chemicals before they are approved for use in UDNF.

Please plan ahead. Even though we strive to provide prompt responses to requests for new chemicals or for mixing already approved chemicals, in certain situations we will need to consult with EHS or peer Facilities, which will lengthen the review time. We also have to develop operating procedures for certain chemicals and mixtures of chemicals.

Please do not open a new bottle of fresh chemicals until the contents of the one currently open are used completely.

Users may not transfer chemicals into the cleanroom or take chemicals out of the cleanroom; all chemical transfers must be coordinated with UDNF staff.

Users may not transport chemicals from one building to another; all chemical transport must be coordinated with EHS. Once a chemical is approved, it may be shipped to UDNF; please consult with Facility staff before having chemicals shipped to us.

Personnel Protective Equipment

Be sure to wear appropriate gloves for the chemicals/materials you will be handling in the Facility. Nitrile gloves should be worn at all times while in the Facility. Replace the gloves if they become contaminated. You may wear two pairs of nitrile gloves if you wish to.

Thick chemical resistant gloves **MUST** be worn over the regular nitrile gloves when working at the acid wet benches, at the base wet benches, when working with heated chemicals, and when cleaning chemical spills.

Face shields must be worn when working at the acid wet benches, at the base wet benches, when working with any heated chemicals, and when cleaning chemical spills.

Aprons must be worn when working at the acid wet benches, at the base wet benches, and when working with any heated chemicals.

Working at the Wet Benches

All work with chemicals must be performed inside the wet benches. The only chemical that may be used outside of a wet bench is isopropanol (in a spray bottle).

Avoid overcrowding at the wet benches; please wait until the previous user(s) finish their work. If you believe that your colleagues are not being courteous enough and community minded, please contact Facility staff; do not squeeze your way in.

Only one person may work at the Hydrofluoric (HF) Acid wet bench at any given time. HF-dedicated training is required before working at the HF wet bench. A HF-trained safety buddy must always be present when HF is used. The buddy must wear all the PPEs required for HF work and must stand ready to assist the person using HF.

Please label the chemicals you work with. The Facility provides label templates for you to fill out. Place the label under the beaker containing the chemical such that the written information is visible. Do not place the label between a beaker and a hot plate.

If you need to soak your samples for long periods of time (e.g. overnight) please move the beaker and the label to a location towards the back of the wet bench that will not interfere with your colleagues' work; you may cover the beaker with aluminum foil or with a watch glass to reduce the rate of evaporation.

While working at the acid and base wet benches you must wear the following **additional** PPE: apron, face shield (over the safety glasses), and the thick chemical resistant gloves (over the regular nitrile gloves).

Please also wear additional PPE when handling large quantities of chemicals or when heating any chemical.

To reduce splattering always add acid to water and **not vice-versa**. This can be remembered through mnemonics such as: “Always do things as you oughta, add the acid to the water”, or “Acid to water, like A&W Root Beer” or “Put the king into the water, not the water into the king”.

Please do not leave beakers, petri dishes, etc. containing acids or concentrated bases unattended. If you need to step out for a restroom break, please find someone to check on those containers for you while you are away.

Leaving a hot plate or a heated bath unattended in a wet bench poses a significant fire hazard. Do not leave hot plates or heated baths unattended in the wet benches; you must be in close proximity while the hot plates or heated baths are on. Please allow the chemical mixture you work with to cool down to room temperature before pouring it into the appropriate waste container. Unattended cooling of chemical mixtures is permitted; please remove the containers from hot plates and water baths and ensure that all heat sources have been powered off.

Do NOT move hot plates out of their designated wet benches.

Placement of materials in the wet benches is critical to your safety. Work well inside the wet bench; at least one foot from the edge. If you work too close to the front edge of the wet benches you may be exposed to the materials you are handling. Place everything you need in the wet bench before you start your work.

The array of holes at the front of the wet bench is part of its ventilation system; please do not block them with paper, clean room wipers, glassware, equipment, etc. The Facility ventilation is designed to work with the wet benches always on. Please stop working with chemicals and contact Facility staff if you suspect that your wet bench is malfunctioning.

Each wet bench has a list of approved chemicals posted on it; please do not use any chemical not listed for the wet bench.

The bottles containing fresh chemicals should be uncapped only when pouring out of them. Bottles containing fresh chemicals may not be stored inside the wet benches. Return those bottles to their storage locations (chemical cabinets or the cabinets located under the wet benches) as soon as possible.

Please clean up after yourself. Do not leave beakers, chemical bottles, spills, wipers, labels, stains, etc. behind. The wet bench surfaces should be clean and dry before you start and after you finish your work.

You are encouraged to talk to your colleagues if you believe they do not work/act professionally; it is everyone’s responsibility to make the Facility a safe and productive working place.

Liquid Chemical Waste

Do not rinse samples over the sinks with anything but water. When chemicals are used for rinsing, please rinse your samples over a large beaker then dispose of its contents into the appropriate waste bottle.

Please dispose of chemicals in the appropriate waste bottles when you finish your work. Do NOT pour any chemicals down the drain.

Bottles that used to contain fresh chemicals may not be used to collect waste. The Facility provides two types of waste bottles: (1) the wide-mouth jugs can be used to collect solvent and developer waste, (2) the narrow-mouth jugs can be used to collect acid and concentrated base waste. The narrow-mouth jugs come with vented caps. Empty waste bottles are located throughout the Facility; please ask staff to help you identify their location.

To avoid spills, please use a funnel when pouring the chemical waste into the bottle. Rinse the funnel with water before and after you use it.

Do not write on the chemical waste bottles. Pre-printed labels for waste bottles are available in the Facility. If you cannot find a labeled bottle or a label for the waste stream you plan on generating please contact Facility staff before you start your work; either we have run out of that label or that chemical/mixture is not approved for use in the Facility.

Only pour chemical waste into properly labeled waste bottles. Please identify the appropriate waste bottle before you start your work.

A waste bottle that is less than $\frac{3}{4}$ filled is referred to as “in-use” waste bottle. “In-use” chemical waste bottles must be stored in secondary containers inside the wet benches. They must be capped while chemical waste is not poured into them.

Do not overfill waste bottles; the empty space at the top of the bottle is needed for thermal expansion in case a chemical reaction takes place. An overfilled chemical waste bottle may lead to overflow or rupture.

Fresh bottles and waste bottles of HF solutions may not be used outside of the HF wet bench and HF cabinet.

Allow any heated solutions to cool to room temperature before disposal; they will melt the plastic waste bottles when hot.

A waste bottle that is more than $\frac{3}{4}$ filled is considered full. Once “full” the waste bottle must be capped securely and moved to its storage location (cabinet under the wet bench) and a new waste bottle must be made. To start a new waste bottle: (1) find the appropriate waste label, (2) write down the ‘Started on’ date, (3) find an empty waste bottle, (4) affix the label to the bottle, and (5) place the bottle into its designated secondary container.

Facility staff is responsible for removing the full waste bottles from the Facility.

Caution: Mixing acids, bases, solvents, or even water with Purestrip (mixture of sulfuric acid and hydrogen peroxide solution) may cause the mixture to run out of control with disastrous consequences.

After you use all the contents of a fresh chemical bottle, please cap the bottle and place it in its designated storage location; Facility staff will triple rinse and dispose of the empty bottles.

Solid Waste

All solid waste generated in the Facility is considered hazardous. There are a number of solid waste containers throughout the Facility. The small bins located in the wet benches should be used for solid waste contaminated with the chemicals used in that bench. Please do not place resist-contaminated solid waste into the large bins located outside of the wet benches; doing so will cause the Facility to be evacuated because of the smell.

Broken glassware containers are located throughout the Facility; please use them for broken glassware, wafer pieces, glass slides, etc. Do not place anything that has uncured resist or wet chemicals in those containers.

Note*: Glassware and wafers contaminated with unbaked resists must be disposed of into the dedicated containers located inside the wet benches in Bay 4.

Chemical Spills

You are not required to clean chemical spills.

Never attempt to clean up a hydrofluoric acid spill, no matter how small. Please contact Facility staff or EHS for help.

Chemical spills greater than 250 ml or any size spill of hydrofluoric acid must be reported to EHS for cleanup.

Never attempt to clean up a spill if you are not familiar with the hazards associated with the chemical or if you are unsure of how to clean up the spill. Evacuate the Facility if you spill a large quantity of chemicals (1 gallon or more); you may push any of the yellow TGMS push buttons (the TGMS horns and strobes will go off causing an evacuation).

Never clean a chemical spill alone; call the Facility staff or EHS if you cannot identify anyone to help you.

Always wear chemical resistant gloves, safety glasses, and a face shield when cleaning chemical spills.

Small spills (less than 250 ml) except hydrofluoric acid may be absorbed with cleanroom wipers or the pads found in the spill response kits located throughout the Facility. Do NOT dispose of the cleaning materials directly into the waste containers; place all those items into the bag found in the spill kit, label it appropriately (use the labels provided in the spill kit), then place it in the appropriate waste container.

Caution: Oxidizers such as sulfuric acid, nitric acid, hydrogen peroxide, Purestrip will ignite cleanroom wipers and the items contained in the chemical spill kit. Please wet those items with water before cleaning oxidizer spills.

All chemical spills must be reported. Notify Facility staff first. If a staff member cannot be reached please call EHS. Call 911 if you cannot reach EHS.

Exposure to Chemicals

If the chemical comes into contact with the eye(s), the eye wash stations should be used. Ensure your hands are clean, then hold open your eye(s) using your thumb(s) and finger(s), and rinse for several minutes.

If the chemical reaches other parts of the body, remove contaminated clothing and rinse with copious amounts of water using the eye wash, a sink, or the safety shower. Please keep in mind that your health is more important than modesty.

HF exposures require a five minute-long rinse; all other chemicals currently approved for use in the Facility require a 15 minute-long rinse.

All chemical exposures must be reported to the Facility staff or EHS if staff cannot be located.

Medical evaluation is required for all chemical exposures. Please refer to the Emergency Response section for instructions.

Gas Cylinders

Users are not allowed to move or replace any gas cylinders.

Cryogenic Hazards

There are no cryogenic hazards at this time in the Facility.

Other Hazards

Please exercise caution when using any piece of equipment; most of them use/generate high voltages/currents or RF radiation.

Do not attempt to modify in any way the tool you find in the Facility. Do not remove panels or make changes to the tools.

Do not operate a tool if any of its protective shields/panels are missing.

Some tools use lasers; please do not operate tools with covers/enclosures removed and avoid looking directly into the laser beam.

Disciplinary Actions

As mentioned at the beginning of this manual, using the Facility is a privilege, not a right. That privilege comes with responsibilities.

Users are written up (for a warning or a violation, at staff's discretion) every time they fail to follow the Facility protocols. At staff's discretion, a certain number of warnings will be counted as a violation. Generally, three violations result in a one week access suspension (please note that blatant violations will result in access suspension before three "strikes" are accumulated). After three violations, one does not get a "clean slate"; any additional violation generally results in a two week suspension. The nature and severity of the violations determine whether access is reinstated or not.

Facility Use Acknowledgment

Please acknowledge the use of the Facility in your publications by including text such as "The work reported here was partially carried out in the Nanofabrication Facility at the University of Delaware". Staff contributions above and beyond training and equipment troubleshooting should also be acknowledged. Please email a copy of the publication or the publication information to codreanu@udel.edu.

Closing Remarks

Please follow procedures and use common sense.

Remember that:

- Rules are in place to protect you and your work.
- Your actions affect other people's safety and work.
- We're in this together.
- The staff's job is to keep you safe while supporting your research efforts.

Remember to **always** ask for help when in doubt.

Please speak up when you notice anything that is out of order.

We strive to make the Facility a safe and clean place for you to work and, to that end, your cooperation is essential. Paying attention, taking notes, following procedures, and treating the chemicals, tools, and people you encounter in the Facility with respect will help you develop work habits that will benefit you throughout your career.

Happy fabrication!