

Chemical Hygiene Plan Section 3: Laboratory Standard Operating Procedures

A. Laboratory Specific Information and Signatures

This plan is for the IMNI Nanofabrication Central Facility (NCF)

Building: Engineering Research Center (ERC)

Room: 010

Laboratory Director:

Prof. Domenico Pacifici

Technical Managers:

Mr. Michael Jibitsky, Senior Research Engineer

Mr. William R. Patterson, Senior Research Engineer and Senior Lecturer

By signing the NCF user agreement, users acknowledge that they will download and familiarize themselves with the NCF Chemical Hygiene Plan. User agreements are maintained by the Institute for Molecular and Nanoscale Innovation (IMNI) in the administrative offices located in Barus & Holley, 6th Floor North.

B. Preparation, Approval, Annual Review and Update

The Laboratory Director is responsible for seeing that the plan meets the regulatory requirements set forth in 29 CFR 1910.1450. He or she shall assure that the Chemical Hygiene Plan (CHP) is updated on a timely basis to include procedures for new hazards and processes as they are introduced. The CHP shall be reviewed on an annual basis and updated to accommodate changes in the 29 CFR 1910.1450, departmental procedures, Brown personnel policies and other pertinent materials. Assistance in creating the Chemical Hygiene Plan will be provided by the University Chemical Hygiene Officer in Office of Environmental Health and Safety (OEHS - x3-1737).

The Laboratory Director will see that the Chemical Hygiene Plan and updates are distributed to or made available to those who are affected by it. A copy of the entire plan in pdf format is kept on the desktop of the general purpose computer in the laboratory by the printer so it is available during all working hours.

The **Chemical Hygiene Plan: Laboratory Standard Operating Procedures** and annual updates, after being reviewed and signed by the Laboratory Supervisor, are sent to OEHS.

C. Standard Operating Procedures and Work Practices for Chemicals, Equipment, and Cleanroom Practice, Including Personal Protective Equipment

All users of this facility must be familiar with the general recommendations and requirements of the University's Chemical Hygiene Plan. This section of the plan lists the particular procedures and work practices for the IMNI Nanofabrication Central Facility as opposed to the standard procedures that apply to all University laboratories.

General Conditions of Use:

1. Access to the Facility is controlled by card access with your University ID card and you may not use another person's card or have someone else let you in. Access is a privilege and the Laboratory Director reserves the right to revoke that privilege at any time for any action that in his or her sole discretion creates a hazardous condition in the laboratory or possible damage to the equipment in or cleanliness of the Facility.
2. Access to the Facility is conditional on completing training offered by OEHS on handling Hazardous Waste, on Laboratory Safety, and on the Use of Hydrofluoric Acid. The records of course completion maintained by OEHS are used to control card access and you must remain in compliance with training requirements or you will automatically lose access. In addition access will be revoked for loss of financial support or separation from the University.
3. Users shall familiarize themselves with the locations of all emergency features of the laboratory including where the eyewashes and showers, fire extinguishers, telephones, safety glasses, chemical and waste storage cabinets, first aid kits and HF treatment materials are located. (See floorplan below.)
4. To maintain low particulate count in the air in the Facility, all users must wear appropriate cleanroom clothing, including shoe covers, cleanroom suit, boots, and hair covers. Users receive instruction on how to put on, take off, and store garments as part of initial training. **EXAMINE garments as you put them on or take them off for signs of wear and tear, particularly looking at the boots. REPLACE WORN GARMENTS!**
5. This facility is a cleanroom in which the air pressure is maintained above the pressure in the rest of the building. It has only two exits: one through the gowning area to the ERC and the other from the main Service Corridor behind the photolithography bay. The latter exit goes directly outside to Brook Street. Be aware of the existence of that exit but remember it is used only when it is unsafe to exit through the gowning area because of a large chemical spill or toxic gas release.
6. In the event of the spill of a volatile or hazardous material or the release of a toxic gas, warn other occupants of the facility, leave the Facility and then call Brown Security at X3-4111 (401-863-4111). Leave through the gowning area if possible.
7. If there is a toxic gas leak, press one of the red emergency buttons located on the walls

throughout the facility. The one by the bench at the entry to the gowning room is especially convenient. A button press turns off the toxic compressed gas supply, sends an alarm to campus security and summons the Providence Fire Department.

8. In the event of an accidental injury, call Brown Security at X3-4111.

Chemical and Compressed Gas Handling (See also additional sections on Hydrofluoric Acid and “Piranha Etch.”):

1. Lightweight disposable nitrile and vinyl gloves are used for most purposes. Typically the vinyl gloves are worn over the nitrile. **These are NOT intended as protection against chemical exposure.** They protect your samples and our equipment from the oils and alkali salts that can rub off your hands. They **DO NOT PROTECT** you in any substantial way. Use care in handling chemicals with them and do not use any large quantity of chemical or any dangerous material relying on them for protection. Some heavier gloves are available for communal use, but users who use large quantities of chemicals should acquire their own appropriate gloves. Gloves must be suitable for the chemicals you are using. A separate section of this plan and most laboratory supply catalogs, including the Fisher Scientific and VWR catalogs, have more information on glove selection. Facility personnel will be happy to assist you in making this choice.
2. There is a supply of safety glasses kept in boxes next to all fume hoods for use when working with chemicals. **You must use these at all times and return them** to the storage boxes when done. You must even wear them if you are near the fume hoods when others are using chemicals.
3. Full-face shields and heavy-duty aprons are available for working with more dangerous materials. Their use is mandatory with “piranha etch” and solutions of hydrofluoric acid and is recommended for use with any aggressive chemicals, especially acids. Facility personnel will be glad to advise on when that extra protection is needed.
4. There are also special UV-absorbing glasses that shall be worn when working with one of the mask aligners and these are kept next to the aligners.
5. When working with chemicals in one of the fume hoods, you **MUST LABEL** any working containers of chemicals for what materials are in them even as you work with them. The facility has **standard yellow labels** for this situation that must be filled out with full chemical names, your name, the date and time of setup, etc. (The purpose is to assure that anyone else using the hood knows what is there and that we know when something has stayed there too long.)
6. Large spills or spills of especially dangerous materials may only be cleaned up by EHS. We store supplies for dealing with **SMALL** spills under the right hand side of the fumehood in the main lab. These supplies include absorbents in several forms and neutralization materials. There are also several heavy-duty gloves in different materials stored there for protection of personnel cleaning up problems. There is a chart on the inside of the door to that space showing the appropriate glove for each likely type of chemical. Do not remove material from this area unless for an emergency. If you do use

these supplies, promptly inform Mr. Jibitsky so the supplies can be replaced.

7. **DO NOT ATTEMPT TO HANDLE LARGE SPILLS**, but inform other users of the facility, exit the facility, and summon help, either facility staff or Brown Security by calling x3-4111. EHS on-call personnel will respond.
8. We store all chemical wastes in labeled red trays under the fume hoods and trays are labeled to show which trays are for each type of waste. Similarly, new chemicals are kept in specific, labeled cabinets. Chemical segregation of both new and waste chemicals is important and absolutely required. Please cooperate by following the posted rules.
9. All waste chemicals go into bottles that can be used for disposal and these bottles must be labeled with the University's **standard orange waste labels**. Also, when labeling bottles for waste storage, **YOU MUST USE FULL NAMES OF THE CHEMICALS TO BE PUT IN THEM**. Do not use abbreviations, for example, write "Hydrofluoric acid" NOT "HF". (This is a requirement to avoid confusion in either disposal or emergency handling, so people unfamiliar with our usage will know what they confront.)
10. Some users store small quantities of new chemical mixtures in bottles in the new chemicals cabinets. The facility has **standard white labels** for these bottles and failure to use those labels and to fill them out fully will result in confiscation of the bottles. Storage is a strictly short term privilege and facility personnel will remove anything stored longer than 30 days.
11. Users of the facility who have been trained and authorized by Mr. Jibitsky may be given access to the gas room to change the compressed gas cylinders for oxygen and Argon in the gas room in his absence. All replacements of other gas cylinders may only be done by facility staff. This policy reflects both safety concerns and the need for care in avoiding contamination when changing cylinders.
12. Safety Data Sheets for our all chemicals in pdf format are kept in a directory on the desktop screen of the general-use computer in the lab. They are accessible to anyone logged onto that machine. These provide good general information and are there for quick and safe access in case of a spill or other emergency. However, these may not be the latest versions and you should consult with web-based sources for up-to-date information. (See, for example, the SDS link at the Brown University [Chemical Environmental Management System](#) link.

Supplementary Handling Procedures for Hydrofluoric Acid:

1. Every year **users are required to complete the on-line training module on HF** offered by OEHS and being out of compliance with this requirement will result in automatic denial of access to the facility. A large amount of hydrofluoric acid is used in this facility, both as 48 % concentrated aqueous HF solution and as buffered oxide etchant (a mixture of concentrated HF and aqueous ammonium bifluoride solution). Mishandling HF has been the only source of a serious injury to any users of the Facility in its many years of operation. All users must be cognizant of the dangers of this material whether or not it is used in their work.

2. This acid is quite dangerous and yet may appear innocuous. Working with HF may only be done in one of the two plastic hoods. We will post advisory placards about hydrofluoric acid on the walls next to those hoods. Read that and become familiar with the dangers before starting to work. There is a special ointment, 2.5 % calcium gluconate gel, in the first aid kits by those placards for use should your skin come in contact with HF. Even minimal exposure should be treated seriously since the acid can be absorbed through the skin and do substantial biological damage before pain will make you aware of a problem.
3. Full personal protective equipment must be worn while processing with hydrofluoric acid, including full face shield, double gloves (vinyl over nitrile), and apron over cleanroom suit. The gloves are not sufficient protection for hands – careful handling to prevent contact with hands is the first line of defense.
4. If you come in contact with HF, wash vigorously with water for 5 – 10 minutes and apply the calcium gluconate gel immediately. Then seek immediate medical attention, calling Brown Security (x3-4111) if needed for transportation. Advise Mr. Jibitsky, the Laboratory Supervisor, or Mr. Patterson. (The ointment deteriorates once opened and we need to replace it. We also want to know about incipient problems.) They will require you to inform your faculty advisor and to fill out required forms for OEHS.
5. In case of a spill, DO NOT TRY TO CLEAN UP THE SPILL but seek help from facility staff and the Brown Security/Emergency Response service (x3-4111) IMMEDIATELY. They will then contact the EHS on-call personnel.
6. HF etches glass and attacks many metals so all storage containers, processing containers, tools, etc. that may come in contact with anything containing HF must be an appropriate plastic, usually Teflon or polyethylene. We keep separate plastic bottles for wastes containing HF in the secondary containment pans for acids.

Supplementary Handling Procedures for “Piranha Etch,” H₂SO₄ and H₂O₂:

1. A mixture of sulfuric acid and hydrogen peroxide attacks most organic compounds and is used for removing trace organics as part of some cleaning procedures. Because it attacks so many organic materials, it must be **kept in glass or quartz containers** both for use and for disposal.
2. Full face shield and apron are required when using this etchant.
3. Disposal of spent etchant requires care in both the selection of the waste container and in mixing waste with other waste already in the waste bottle. We use recycled glass bottles that were used for acid delivery. The mixing of this etchant with other liquid in a waste container is highly exothermic, heating the solution in the waste container. The hot mixture can create pressure that must be relieved to avoid breaking the bottle. Leave the cap slightly loose to allow the bottle to vent. Work in the sink when pouring into the waste bottle and then store it in the inorganic acid waste tray after it has cooled.
4. We keep a separate waste bottle just for this etchant in each waste storage area. Should

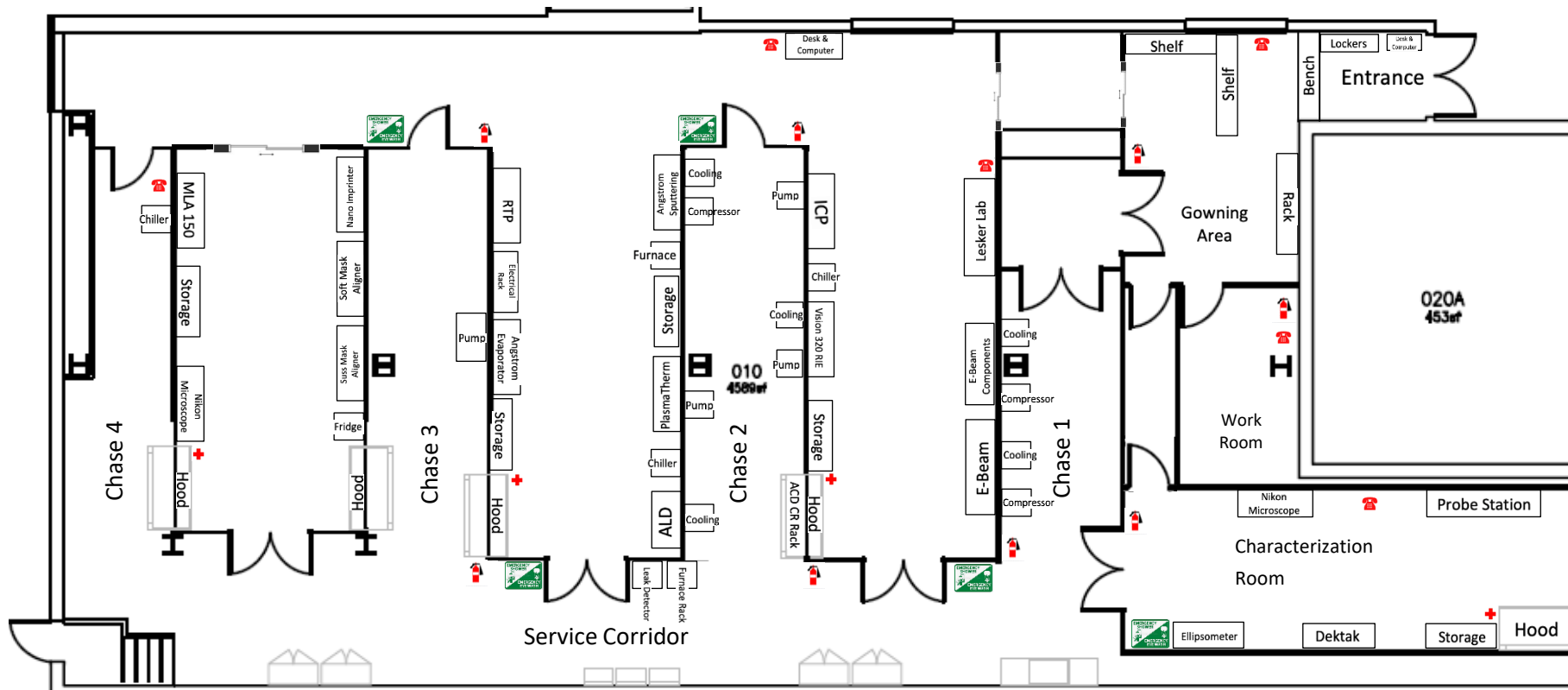
you need to start a new waste bottle, label it (orange hazardous waste label) with the full names of its constituents and the percentage of each. (Typical usage is 67% sulfuric acid and 30 % of 30% hydrogen peroxide.)





5. Even the vapors of this etchant can attack gloves so be careful not to allow your hands to linger over a beaker of hot piranha etch.

Work Restrictions:

1. No new chemicals (polymers, developers, organic compounds, gases, etc.) may be brought into the facility without approval of facility staff and the Laboratory Director. When such materials are brought in, **you MUST SUPPLY Mr. Jibitsky with pdf copies of the Safety Data Sheet** and with the quantity of material you are using. We are required to maintain a current inventory list and we want a computer- readable SDS for consultation in emergency.
2. Most of the instruments in the facility have paper logbooks and you **MUST** fill out the appropriate form for each instrument run you make. While billing is based on entry to the facility, these logs let us track the equipment usage, determine what recipes are successful and plan maintenance.
3. All user tools and containers must be kept in closed polyethylene or similar plastic boxes. Each user has rack space for these boxes allocated in the lab area just outside the working bays.

IMNI Nanofabrication Central Facility (NCF) ERC 010 Floor Plan



-  = Phone
-  = Fire Extinguisher
-  = First Aid Kit
-  = Shower & Eye Wash Station