

# Nano3 Facility Policies and Procedures

University  
of California  
San Diego

*The intent of the policies and procedures outlined in this document is to ensure that an environment is created in which researchers can work together safely and productively while maintaining the integrity of the class100/1000 cleanroom environment and equipment.*

*These policies and procedures will continuously adapt to changes to our facility as it evolves. We strongly encourage users to make us aware of how we can more effectively meet the goals of the facility.*

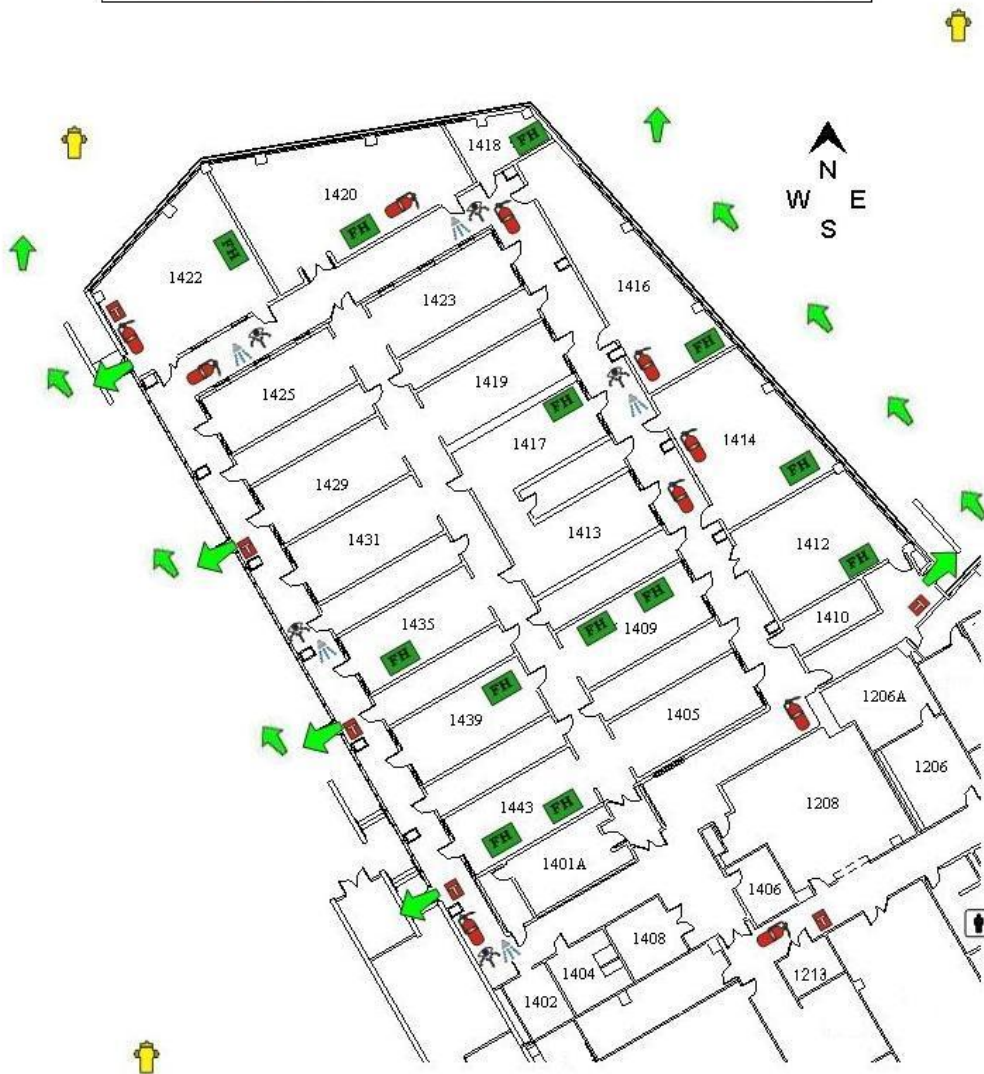
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## Nano3 Clean Room and Analytical Labs Emergency Response Resources



# 1. Safety

*The Nano3 user facility at UCSD – Calit2 is committed to the highest possible safety standards. It is our goal to operate the facility in a manner that ensures that no unacceptable risks exist for all persons operating within the space. Safety is the responsibility of everyone. We require strict adherence to all applicable Federal and State health and safety regulations, and will enforce these as necessary.*

## 1.1 Requirements

- 1.1.1 Each user must schedule and attend a general safety orientation (about 2.5 hours) with Nano3 staff.
- 1.1.2 Each user must read the Nano3 Policies and Procedures document and complete the Cleanroom Protocol and Chemical Safety test (accessible through the on line user account).
- 1.1.3 Each user must have their faculty sponsor sign the Nano3 User Agreement (accessible through the on line user account).
- 1.1.4 Each user will be required to complete an annual Nano3 safety quiz (accessible through the on line user account).
- 1.1.5 UCSD internal users must attend the EH&S general lab safety class ("Injury and Illness Prevention Program (IIPP)") and submit a copy of the certificate of completion to Nano3 staff. You can register for the class at the EH&S website: [http://enrollmentcentral.ucsd.edu/sed\\_course.cfm?&cdirs=IIPP](http://enrollmentcentral.ucsd.edu/sed_course.cfm?&cdirs=IIPP).
- 1.1.6 We invoke the buddy system for working inside the Nano3 facility. No one is permitted to work alone inside the facility. At any given time, at least two users (not visitors) must be present. The facility is open 24/day, 7 days/week, except for planned shut-downs, which will be announced one month prior.

## 1.2 Resources

- 1) <http://blink.ucsd.edu/Blink/External/Topics/Policy/0,1162,15498,00.html>  
(UCSD Environment, Health and Safety)
- 2) [http://blink.ucsd.edu/Blink/External/Topics/How\\_To/0,1260,14110,00.html](http://blink.ucsd.edu/Blink/External/Topics/How_To/0,1260,14110,00.html)  
(General Chemical Safety Guidelines)
- 3) Phone numbers:
  - a. Fire/Police 9-1-1
  - b. UCSD Poison Center (800) 876-4766
  - c. Chemical Spill (858) 534-3660  
((858) 534-4357 Evening & Weekends)
  - d. Physical Plant Trouble Desk 534-2930
- 4) Material Safety Data Sheets (MSDS):
  - a. <http://siri.org/msds/>
  - b. <http://www.cdc.gov/niosh/database.html>
  - c. [http://www.camd.lsu.edu/msds/msds\\_search.html](http://www.camd.lsu.edu/msds/msds_search.html)
  - d. <http://www.ehs.cornell.edu/lrs/internetMSDS.htm>

## 2. General Emergency Procedures

The Nano3 facility environment contains many potential hazards, posed primarily by the chemicals used. For all emergency evacuations the meeting point is across Voight Dr. and in parking lot number 502. Follow the green arrows on the map at the beginning of this document.

***Note: It is each user's responsibility to read through the MSDS sheets associated with the chemicals they plan to use and to familiarize themselves with their potential hazards prior to using them.***

### 2.1 Chemical Spill on Personnel

Follow these general guidelines regarding chemical spills on personnel:

- a) In case of **significant, general external exposure**, immediately exit the cleanroom using the closest emergency exit. Use a safety shower located in the corridor surrounding the cleanroom. Remove clothing while under the shower and flush for at least 15 minutes. Seek medical attention as soon as possible.
- b) In case of **localized external exposure** (small area of contact such as on an extremity (i.e., hand)) a DI spray gun, DI tap, or even a dump rinse module at a wet bench, may serve if these are the closest sources of water. Flush the affected areas with water for at least 15 minutes. Seek medical attention if necessary.
- c) If the chemical is **hydrofluoric acid (HF)** or another fluoride-ion containing solution (**BOE, PAD** etch), you must act immediately as fluorine ions will quickly penetrate skin to damage tissue underneath. Concentrated HF will immediately cause extremely painful burns on contact. However, more dilute HF solutions will not cause any pain; yet they can still cause considerable deep tissue or systemic damage. If contact with HF (or related solution) is suspected, treat the incident as an HF exposure. Calcium gluconate gel is used as an antidote for HF exposure to skin. Tubes of calcium gluconate are located at every wet bench in the lab, along with instructions on its use. Calcium gluconate is for external use only and must not be used for chemical exposure to eyes.

***Follow these specific procedures in case of HF exposure:***

1. IMMEDIATELY rinse the affected skin area with lots of water. Being careful to wash the acid away from other parts of your body, especially finger/toe nails where acid can get trapped.
2. Remove all clothing exposed to the HF.
3. Continue rinsing for 1-2 minutes. Do not rinse for more than 5 minutes. Do not dry the skin.
4. Call for help.
5. Obtain Calcium Gluconate gel (available at all wet benches in the lab and inside the first aid kits at all emergency showers around the lab).
6. Puncture the tube using the inverted tube cap. Apply gel over the entire affected area.
7. Using gloves, gently massage the gel into the skin. Take the gel with you and continue to apply fresh gel while en route to the Emergency Room.
8. Elevate burned extremities, if possible.

9. Go immediately to a local emergency medical provider.
10. Tell them you have Hydrofluoric Acid on you.
11. Continue to apply fresh gel (and gently massage it in) while waiting to be treated.
12. Following treatment, the injury must be reported to Nano3 staff.

- d) In case of **exposure of the eyes** (corrosives are especially serious!), flush immediately, either with an eyewash bottle at your bench or with the eyewash station in the wet process area. If starting with an eyewash bottle, move to the eyewash station in the wet process area and continue flushing when the bottle is emptied. Eyes should be rolled up and down, and side to side, continuously, to allow clean water to flush behind the eyeball. The eyeballs sit rather loosely in their sockets, a splashed chemical can work its way around the eye to damage the optic nerve. Flush both eyes with water for at least 15 minutes. Both eyes should be held open with the thumb and forefinger. While the victim is at the eyewash, someone else should be calling the doctor for further instructions.

Upon any **exposure to corrosives**, the victim should be taken to the emergency center for evaluation and treatment.

In addition to the eye wash equipment inside, eye wash stations are also located in the corridor surrounding the cleanroom. You may use these eye wash stations in case of any trouble with the eye wash equipment inside the cleanroom, or if you need additional flushing after the eye wash stations inside the cleanroom are emptied.

Chemicals in the facility of the hazard class "corrosive" include:

1. The following acids and their mixtures -- sulfuric ( $\text{H}_2\text{SO}_4$ ), nitric ( $\text{HNO}_3$ ), acetic ( $\text{CH}_3\text{COOH}$ ), hydrofluoric (HF), buffered oxide etchants (BOE -- pre-mixed ammonium fluoride and hydrofluoric acid), PAD etch (pre-mixed, fluoride-containing acids).
2. The following bases and their mixtures -- potassium hydroxide (KOH), tetramethyl ammonium hydroxide (TMAH.)

## 2.2 Chemical Spills

A number of chemicals are present in the Nano3 facility that pose a potential for serious injury, major equipment damage or even death. It is necessary to know how to react quickly and properly in response to any spill to avoid possibly serious consequences. The following procedures are only intended as general guidelines. Always use common sense when handling a particular situation.

- a) A **spill response kit** can be found in the air lock between the gowning room and the main cleanroom corridor. It is plainly marked and contains the following items:
  - i. Absorbent spill dam
  - ii. Absorbent pillows
  - iii. Acid neutralizer
  - iv. Caustic neutralizer
  - v. HF ointment (calcium gluconate 2.5%)
  - vi. pH paper
  - vii. Two pair of acid gloves
  - viii. Two pair of vapor-resistant goggles
  - ix. Trash bags
- b) If the chemical is hazardous and you feel you cannot handle it, alert others to its presence and evacuate the cleanroom. During the day, notify Nano3 staff. After hours, call (858) 534-4357 first, and then notify Nano3 staff.
- c) Retrieve the spill response cart:

- i. If the chemical is an acid or a base, put on acid gloves and goggles before attempting to clean up the spill.
  - ii. Isolate the area around the spill.
  - iii. Select the proper equipment for the spill. For large spills (greater than a half gallon bottle) an absorbent dam will be necessary to prevent spreading. For small spills, only absorbent pillows are necessary. Select the proper neutralizer for the chemical (note: solvents do not require a neutralizer).
- d) Attack the spill:
  - i. If you are using an absorbent dam, place the dam around the spill, approximately 4 inches from the liquid.
  - ii. Place the neutralizer bottle on the floor. Release the clamp and spray neutralizer, pushing the chemical into the spill dam. Be sure to cover the entire spill.
  - iii. Watch the color of the spill as you add neutralizer (Note that the spill can get hot during neutralization):  
 For **acids**, the color will turn from purple to yellow to red as the spill is neutralized.  
 For **bases**, the color will turn from red to blue to yellow.  
 Use pH paper to verify that a pH of 7 has been achieved, indicating complete neutralization.
  - iv. Once the spill has cooled, retrieve a wet-vac cleaner and vacuum up the spill.
  - v. In case of a **solvent** spill, do not attempt to neutralize. Soak up the chemical as quickly as possible to reduce damage to the floor. Do not use water on the floor until the chemical has been soaked up.
  - vi. Clean up:  
 Do not remove your safety equipment until you are completely finished. There may still be some active chemical on the floor. When the spill has been completely absorbed, place the absorbent dam and pillows in a double trash bag. Place the bag in a Haz-Mat bucket and apply an NFR diamond label, writing the name of the chemical on the label. Place the bucket in the cleanroom gowning area and alert Nano3 staff to its presence.  
 If glass is involved, place the glass in a separate Haz-Mat bucket and label it as "SHARPS" along with the name of the chemical the glass contained.
  - vii. Wipe down the entire spill area with a mop and DI water. When finished, place the mop head in a fume hood sink and rinse it thoroughly with DI water.
- e) Inform Nano3 staff and complete an incident report form.

### 2.3 Toxic Gas Leak

Several toxic gasses are used in the Nano3 facility. These gasses are kept in gas cabinets designed to contain leaks that might occur from the cylinders. However, it is possible that there may be a leak associated with equipment that employs these toxic gases or the gas lines running between the gas cabinets and the equipment. This would result in a release of toxic gas into the breathing space of the lab. **PLEASE SEE SECTION 3 FOR INFORMATION ABOUT THE TOXIC GAS MONITORING SYSTEM AND EMERGENCY PROCEDURES.**

### 2.4. Fire

In case of fire, evacuate the cleanroom and building immediately through the nearest emergency exits without degowning. Do not try to extinguish any fire in a fume hood. The burning polypropylene material will not be extinguishable and the resulting smoke is highly



toxic. There are three fire alarms located in the southwest hallway opposite the windows near the exits. Pull one of these fire alarms to alert the fire department.

### **2.5. Earthquake**

In case of a large earthquake, take cover under a doorsill or sturdy table. Do not attempt to evacuate during the earthquake. Wait until the shaking has subsided and then evacuate the cleanroom and building through the nearest emergency exits without degowning. Move away from open containers of hazardous chemicals if possible as the shaking may cause them to spill and/or splash.

### 3. Description of the Nano3 Alarm Systems

The Nano3 facility is equipped with a variety of sensors that can trigger audible or visual alarms. It is important for the users to understand the various types of alarm signals, and the appropriate action to take. For certain types of alarms it will be necessary to leave the cleanroom through an emergency exit immediately without de-gowning. This will leave the cleanroom vulnerable to air borne particles from outside, but may be necessary to save lives. Alarm systems within the facility include:

#### 3.1 Toxic Gas Monitors

The Nano3 cleanroom is equipped with toxic gas monitors in all areas where toxic gases are used. Multiple alarm condition indicators are hanging from the ceiling at multiple locations in and around the cleanroom. These are commonly referred to as “Light Sticks” because there are green, yellow and red colored lights on each one. These different colors indicate varying levels of alarm. The following table describes what each color means when lit and what actions to take when they are lit:

Lit portion of the light stick	Meaning	Action to take
Green	No toxic gas leaks, normal operation.	None
Flashing green	No toxic gas leaks, sensor needs maintenance.	Inform cleanroom staff.
Yellow	<b>WARNING</b> Toxic gas detected, but at a non-hazardous level of one half the Permissible Exposure Limit.	Calmly end your process and proceed to the gowning room to de-gown and leave the cleanroom. Inform cleanroom staff immediately.
Red	<b>EVACUATION ALARM</b> Toxic gas leak detected above Permissible Exposure Limit. Hazardous levels of toxic gas are present in the breathing area.	Evacuate the cleanroom through the nearest emergency exit and leave the building immediately. Inform cleanroom staff.

Important terms to know:

**Permissible exposure level (PEL):** A maximum allowable exposure level under OSHA (Occupational Safety and Health Administration) regulations. Exposure limits are established by health and safety authorities to control exposure to hazardous substances. In California the most important exposure limits are the Permissible Exposure Limits (PELs). These are exposure limits set forth in California OSHA (Cal/OSHA) regulations. Exposure limits usually represent the maximum amount (concentration) of a chemical which can be present in the air without presenting a health hazard.

**Time weighted average (TWA):** The average concentration of a chemical in air over the total exposure time - usually an 8-hour work day. The measured level may sometimes go above the TWA value, as long as the 8-hour average stays below. All chemicals with PELs have a TWA value.

**Threshold limit value (TLV):** An exposure limit recommended by the ACGIH (American Conference of Governmental Industrial Hygienists). The maximum permissible concentration of a material, generally expressed in parts per million in air for some defined

period of time (often eight hours), to which nearly all workers may be repeatedly exposed without any adverse health effects.

All gas concentrations are measured in either parts per billion (ppb) or parts per million (ppm).

Specific TLVs and alarm settings:

Gas	TLV-TWA (ppm)	Warning (ppm)	Evacuation Alarm (ppm)
NH <sub>3</sub>	25	12	25
BCl <sub>3</sub>	5	0.3	5
Cl <sub>2</sub>	0.5	0.3	0.5
B <sub>2</sub> H <sub>6</sub>	0.1	0.05	0.1
GeH <sub>4</sub>	0.2	0.1	0.2
HCl	5	2	5
PH <sub>3</sub>	0.3	0.15	0.3
SiH <sub>4</sub>	0.3	0.15	0.3
AsH <sub>3</sub>	0.05	0.025	0.05

### 3.2 Gas Cabinet Alarms (Inside the service chases)

Several gas cabinets are located within the service chases for the cleanroom. The service chases are not accessible to general users of the cleanroom. The gas cabinets are equipped with local alarms that will sound if a variety of malfunctions (such as, for example, low exhaust flow conditions) are detected. These local alarms do not indicate an imminent danger to personnel; they are not indications of a toxic gas leak. If you hear an alarm sound within a service chase, please notify Nano3 staff.

### 3.3 Fire Alarms

In the event of a fire alarm exit the cleanroom through the gowning area **without de-gowning** and leave the building, following the evacuation plan that you received with your initial safety orientation. Do not delay.

### 3.4 Emergency Exit Door Sensors

The individual cleanroom bays, as well as either end of the main cleanroom corridor, are equipped with emergency exit doors that open from the interior cleanroom space to the perimeter corridor. All of these doors are EMERGENCY ONLY doors, and are identified as such. If these doors are opened, the integrity of the cleanroom is breached! Each of the doors is outfitted with a local alarm that will sound if the door is opened. The alarm will sound continuously, and can only be turned off using a key. Please notify Nano3 staff if an alarm sounds

### 3.5 Facility Entry Door Alarm

The front entry door into the cleanroom is outfitted with a local alarm which is interfaced with the access card reader system. The alarm will sound if the door is opened from the interior without a prior card swipe. The alarm will also sound if the door is held open for a duration exceeding approximately 30 seconds, and it will turn off once the door is closed. The intent of this alarm is to remind users to swipe their access card upon exit from the facility, since only the swiping of the card will end the clocking of user time (and charge).

### 3.6 Fume Hood Flow Alarms

All fume hoods are equipped with local flow alarms. The alarms can be silenced by pushing

a button on the hood. In case of recurring fume hood flow alarms, please notify Nano3 personnel.

## 4 Access Procedures

The Nano3 facility is a cross-departmental, general user facility, designed to support the campus research effort. The facility is open to all trained personnel on a recharge basis, including UCSD as well as external personnel. It is our mission to provide a state-of-the art facility for advanced device fabrication at the micro- and nano-scale.

In addition to providing essential microfabrication capabilities for mainstream research on electronic and optoelectronic materials and devices, this facility is intended to facilitate the pursuit of research in emerging, interdisciplinary, and rapidly growing fields such as biomedical and biochemical devices, heterogeneous integrated devices and circuits, and nanoscale science and technology.

### How to gain access:

#### 4.1 UCSD Internal Users

**4.1.1** Make an appointment with Ryan Anderson ([rranderson@soe.ucsd.edu](mailto:rranderson@soe.ucsd.edu)) to schedule the safety orientation (about 2 hours).

**4.1.2** Create a Nano3 User Account on the facility webpage and follow the directions to complete the safety requirements.

**4.1.3** Download the Nano3 Internal User Agreement form through your Nano3 user account and sign it. Have your faculty advisor sign it as well. Bring this form to the safety orientation.

**4.1.4** Print a copy of the certificate of completion of the EH&S general lab safety class (“Laboratory Safety Training Principals/IIPP”) and bring it to the safety orientation. If you have not already completed this course, enroll here: [http://enrollmentcentral.ucsd.edu/sed\\_course.cfm?&cdrs=IIPP](http://enrollmentcentral.ucsd.edu/sed_course.cfm?&cdrs=IIPP)

**4.1.5** Once you have completed all the access requirements, email Ryan to request that your card be activated for access to the facility.

#### 4.2 Non-UCSD, External Users

**4.2.1** Contact Ryan Anderson (858-822-5663) to discuss your processing requirements and to schedule the safety orientation (about 2 hours).

**4.2.2** Create a Nano3 User Account on the facility webpage.

**4.2.3** Fill out the NANO3 SERVICE AGREEMENT. Bring these completed forms to the safety orientation.

**4.2.4** Submit payment in the form of a check or PO for the value stated in the service agreement prior to using the Nano3 facility. Make the check payable to “UC Regents”.

**4.2.5** User may begin working in the facility upon university approval of SERVICE AGREEMENT.

**NOTE:** Following completion of mandatory training, Non-UCSD (External) Users will have access to the Nano3 facility during regular business hours only.

#### 4.3 Staff Contact Information

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## 5 Prior to Entering the Nano3 Facility

### 5.1 Concept of the Cleanroom

A Class 10 cleanroom is defined as having less than 10 particles of .5 micron or greater in size within a cubic foot of air. Similarly, a Class 1000 cleanroom has less than 1000 particles 0.5 micron or greater in size within a cubic foot of air. This level of cleanliness is necessary to maintain the reproducibility of newly developed state-of-the-art electronic device processes. To reach this level of cleanliness, the transfer of particle and chemical contaminations must be eliminated wherever it is found. Hair and skin from people are the greatest possible sources of airborne particles within the cleanroom and thus must be covered at all times with proper cleanroom garments. Many common materials also shed particles into the air at all times and will not be allowed in the cleanroom.

Normal air contains hundreds of thousands of particles per cubic foot, to prevent these particles from entering the cleanroom the pressure inside the cleanroom is kept higher than outside by constantly pumping filtered air into the cleanroom. This results in a constant particle free air from inside to outside of the cleanroom through all openings such as between doors and doorsills and through fume hood and gas cabinet exhausts. This airflow pattern keeps all outside air and particles from entering. But even with this pressure differential we cannot commonly open the majority of the doors that lead into the cleanroom. By opening even one door the air balancing for the entire lab is compromised which allows the possibility of outside air - and particles - to enter. This compromises the entire cleanroom and jeopardizes particle sensitive processing in progress inside the lab. Thus, as cleanroom users, you may only use the main entry door and the subsequent air locks leading into the cleanroom to enter and exit under normal circumstances. All other doors to the cleanroom are emergency exits and are to be used only in the event of an emergency. Alarms will sound when any emergency exit is opened.

Even with a constant flow of filtered air from inside the cleanroom to the outside world, particles can still find their way into the space within the cleanroom. The strategy implemented to keep any particles within the cleanroom space from interfering with ongoing experiments push the particles downward. This is done by forcing filtered, particle free air into the room from above and pulling air out from below. With a constant downward flow of particle free air the resulting laminar flow around all objects in the room gives any dislodged particle only one option: down and out. But even with all the equipment used to keep the airborne particle count low, maintaining such a high level of cleanliness requires that the users strictly adhere to protocol, especially the gowning procedures outlined in this document.

***It is important for each user to understand that their individual commitment to this protocol ultimately determines the success or failure of the facility.***

All the elaborate equipment installed to provide a microscopically clean and controlled atmosphere would be to no avail if our users do not believe in and help enforce these policies. We also understand that users are a tremendous resource for new ideas. With this in mind, we strongly encourage our users to recommend changes that may make the facility safer, cleaner, easier to use, or less expensive to maintain. When in the cleanroom, please be aware of your knowledge limitations. It is extremely important that you ask someone for help if you are unsure about the operation of these facilities.

### 5.2 Materials Prohibited Inside the Cleanroom

Materials that are fibrous or likely to degrade in normal use and create particulate are not allowed in the cleanroom. Materials with textured surfaces that can trap particles and cannot be cleaned are also not acceptable. Less obvious materials are polymers that outgas and release organic contaminants. Please consult Nano3 staff if you are not sure. All non particle shedding materials that are brought into the cleanroom must be wiped with the provided isopropyl alcohol/DI water solution prior to entry. The following list of materials provides some examples of prohibited materials:

- Food or drinks
- Make-Up
- Paper (only cleanroom paper is permitted)
- Wood
- Fabrics and woven materials
- Fiberglass
- Soft plastics and elastomers that are easily abraded
- Pencils, Ballpoint pens (the ink can cake, dry, and flake)  
(Only cleanroom approved writing materials are permitted)
- Erasers
- Powders
- Foam materials including some tool handles
- Solutions or suspensions that will dry out to leave powders or particulates
- Most PVC materials
- Devices with hidden surfaces that cannot be cleaned
- Any materials that can easily shred or aerosolizes to become a source of particulate.

Taking any materials in and out of the cleanroom should be avoided whenever possible. There is storage space available in the cleanroom for users' tools and personal supplies. Once brought into the cleanroom, these tools and supplies should remain inside as long as they are needed in the cleanroom. Some common supplies such as cleanroom paper and pens will be available.

### 5.3 Card Swipe Access System

The Nano3 facility is equipped with a card system, which limits access to authorized users. Users must swipe a valid access card, typically your campus ID card, in order to be able to enter the facility. The card swipe is also used to record user hours for recharge. It is therefore also necessary to swipe the card upon exiting the facility, using the reader mounted inside the entry door. An audible alarm is positioned above the exit that sounds when the door is opened without a card swipe. The purpose of the alarm is to serve as a reminder, as time in the facility will continue to be recorded (and charged) until the card is swiped upon exit. Should a user ignore to swipe the card upon exit, time counting will end after a total of 24 hours time and the access card will be deactivated. In this case, you will need to communicate with Nano3 staff in order to reinstate your access.

**Note:** The access card is strictly for your own personal use. Please do not admit anyone other than yourself into the facility for any reason other than an emergency. Should you need to admit another person into the facility due to an emergency, both the authorized user and the person who was given access to the facility must notify Nano3 staff. Please see section 10 for visitor policy.

***Please understand that we will enforce all lab rules and that any breach of these rules can result in nullification of your access privileges.***

#### 5.4 Locker Policy

A number of lockers and a coat rack are in place in room 1410. These lockers are intended for **temporary** use for cleanroom users. Users may store items that cannot be brought into the cleanroom space during their time inside the cleanroom. Please note that locker space is limited. Please limit the amount of material that you need to store. The facility does not provide locks. User furnished locks are permitted, but may not be left in place after users swipe out of the cleanroom. ***We retain the right to periodically remove locks if we determine that they are improperly left in place.***

#### 5.5 Eye Protection

We recommend wearing eye protection at all times in the lab, except perhaps when using a microscope or other equipment with eye pieces. Acceptable types of eye protection for everyday lab wear are:

1. Impact resistant safety glasses (type B, C, D, G, or H, with side shields) which conform to ANSI standard (marked "Z87".)
2. Vented safety goggles (these may be worn over normal prescription glasses.)
3. Prescription impact-resistant safety glasses, with side shields (available from many optical shops.)

Impact-resistant safety glasses are designed to protect only against flying fragments, however, not chemical splash hazards. So full face shields should be worn in addition to glasses when handling chemicals or working at chemical wet benches.

Regarding contact lenses please follow the American Chemical Society recommendation that "contact lenses can be worn in most work environments provided the same approved eye protection is worn as required of other workers in the area." (C&E News, Vol. 76, p. 6.)

Thus, contact lens wearers should wear standard safety glasses or safety goggles when working in the lab, and full face shields in addition to safety glasses when working at chemical wet benches.



## 6 Cleanroom Gowning Procedure

### 6.1 Entering the cleanroom

#### A. Entry area

1. **Using swipe access card, open and enter cleanroom entry area.**
2. **Step on tacky mat.** Take at least 6 steps, 2 for each foot.
3. **Put on shoe covers.** Get a pair of shoe covers from the labeled dispenser bin on the wire shelf. Sitting on the bench, place shoe covers completely over the sole and sides of the each shoe. Only flat or very low-heeled shoes may be worn. **No sandals or open-toed shoes are permitted.**
4. **Put on facemask.** Facemasks can be found in a labeled bin on the wire shelf.
5. **Put on bouffant cap.** Remove a cap from the bin on the wire shelf. Place on your head below the ears and to the base of the neck to contain all hair. Tuck in any stray hair.
6. **Put on gloves.** Touch ONLY the cuffs of the gloves. Do NOT touch the palms or fingers of the gloves with bare hands. Oils and particulates from your skin adhere to the gloves and subsequently contaminate everything you touch. Get a pair of gloves from one of the labeled dispenser bins. Pull on the first glove holding it only by the cuff. Pull on the second glove making sure that the first glove does not touch your skin.
7. **Wipe down all materials.** Note that some materials may be damaged by isopropyl alcohol, so you may need to use DI water instead from the squeeze bottle provided. Moisten a cleanroom wipe with isopropyl alcohol or use a pre-moistened wipe. Wipe all surfaces of materials you will be bringing into the cleanroom. Wipe the length of the wiper cloth and then fold over. Repeat folding and get new wipes as necessary. Dispose of IPA Wipes in Red Flammables Can. ALL wipes with ANY amount of isopropyl alcohol MUST be disposed of in the red flammables waste can to contain the fire hazard.
8. **Proceed to the gowning area.** Do not open door to the gowning area while the door to the entry area is open.

#### B. Gowning area

The gowning area has benches arranged in a way that subdivides the area into two areas. In order to proceed from the gowning area to the cleanroom, you will need to step over the benches. Please do so only in accordance with the procedure described below.

1. **Step on tacky mat.** Take at least 4 steps on the tack mat, 2 for each foot.
2. **Put on hood.** Align the hood so that your face will be at the opening. Pull the hood over your head, secure it with a bow knot.
3. **Put on coveralls.** DO NOT let your coveralls touch the floor because contamination from the floor will then be brought into the cleanroom on your coveralls. Always inspect your coverall for signs of contamination or wear. Hold the sleeves and zipper so that the coveralls do not touch the floor. Find a comfortable sitting position, but DO NOT allow your feet to cross the bench at this time. Put one leg in the leg of the coveralls and pull up to your ankle. Put your other leg in the leg of the coveralls and pull up to your ankle. Stand and pull the upper half of the coveralls up to your arms. Put your arms through the sleeves. Pull the coveralls up over your shoulders. Pull the zipper up halfway. Tuck in hood. Tuck the front and rear flaps of the hood under the coveralls. Pull up the zipper of your coveralls all the way.
4. **Put on boots.** DO NOT place your boots on the floor because contamination from the floor will get on the sides of the boots and be carried into the cleanroom. NEVER stand in boots on the gowning rack side of the benches. Note that boots fit either foot.

Get your boots and put them on the bench. Find a comfortable sitting position, but DO NOT allow your feet to cross the bench at this time. Raise one foot and pull on a boot, then rest this foot on top of the bench. Pull over the boot over the coverall's leg until your foot is snugly in the bottom of the boot (This will help to trap any particles falling down the coverall leg inside the boot). Swing your booted foot onto the other side of the bench. Repeat with the second foot.

5. **Check proper gowning fit in mirror.** Is your hood tucked in, front and back?
6. **Put on second pair of gloves.** NOTE: the palms and fingers of the second pair of gloves should not touch the first pair of gloves. Pull on a glove holding it only by the cuff. Pull the glove cuff up over the coverall cuff as far as it will go. Repeat with the other hand. If necessary, pull up the glove fingers for a snug, comfortable fit. While in the cleanroom, keep your hands away from your face. Oils from your face can be transferred to the gloves and subsequently to the cleanroom equipment or your samples.
7. **Enter the air lock.**
8. **Put on protective eyewear.**
9. **Enter the cleanroom.**

## 6.2 Exiting the Cleanroom

1. **Enter the gowning area from inside the cleanroom.**
2. **Remove protective eyewear.**
3. **Remove boots.** DO NOT place your boots on the floor because contamination from the floor will get on the sides of the boots and be carried into the cleanroom. NEVER stand in boots on the gowning rack side of the benches. Find a comfortable sitting position on the bench, keeping your booted feet on the cleanroom side of the bench. Swing the first foot onto the top of the bench. Slide the boot off your foot and place onto the bench so that it will not be knocked onto the floor. Swing your foot to the garment rack side of the bench. Repeat with the other foot.
4. **Remove the outer gloves.** Discard them in the trash container.
5. **Remove Coveralls.** DO NOT let your coveralls touch the floor because contamination from the floor will then be brought into the cleanroom on your coveralls. Find a comfortable standing position. Pull the zipper down. Roll the coveralls from your shoulders. Pull out your arms from the sleeves and hold the sleeves and zipper so that the coveralls do not touch the floor. Roll the coveralls below your waist and hold the sleeves and zipper so that the coveralls do not touch the floor. Sit down and remove one leg from the coveralls while holding and gathering the coveralls so they do not touch the floor. Repeat with the other leg.
6. **Soiled Garment?** If you have worn your garment for more than approximately 24 hours or it has become soiled, the garment should be laundered. Place garments into the appropriate containers.
7. **Hang up coveralls.** The hangers cannot be removed from the garment rack. Avoid touching the coveralls with your clothes or bare skin. Hold the coveralls by the shoulders and lift them so they do not touch the floor. Hang them on your assigned hanger. Close the zipper.
8. **Remove and hang up hood.** Pull the hood over your head. Secure the hood to the coverall.
9. **Store the boots.** Place the soles of your boots together. Roll the tops of the boots around the soles. Place your boots inside a leg of your coveralls.
10. **Gather your swipe card, protective eyewear and other materials.**
11. **Proceed to the entry area.**
12. **Return protective eyewear to the bin.**

13. **Remove pre-entry garments.** Remove bouffant cap, face mask, shoe cover, gloves and place them in the trash.
14. **Swipe your access card.** Before exiting the entry area you must swipe your access card to stop the time count.
15. **Gather any materials and exit the entry area.** Please make sure the door latches properly behind you.

## 7 Using the Fume Hoods

The fume hood allows users to handle materials that generate hazardous vapors by containing and venting these vapors out of the breathing space of the lab. The fume hood is the only place that hazardous chemicals should be handled in open containers. Each hood is clearly labeled as to what chemicals may be used in each hood. The stainless steel fume hoods are for the use of flammable chemicals since the steel will not burn. However; we cannot use acids and bases in the stainless steel hoods because, over time, these chemicals will corrode the metal. For this reason we must use the polypropylene fume hoods for acids and bases. Use of the wrong type of chemical in a given fume hood presents a serious safety hazard for all users in the area since incompatible chemicals may mix and create a dangerous reaction. Please use the proper chemicals in the proper fume hoods at all times. If you are unsure about which hood to use, please ask Nano3 staff.

The proper functioning of the fume hood depends on the user correctly positioning the sash at or below the marks on left and right sides of the hood. It is also essential to make sure that the vent openings in the bench top are left unobstructed by cleanroom wipes, hotplates, waste bottles, etc.. With these two conditions met, the fume hood will function properly. If they are not met the fume hood will release vapors into the breathing space which may cause injury.

### 7.1 Handling Hazardous Chemicals

Users must employ the utmost caution when handling any and all hazardous chemicals. It is the user's responsibility to review the MSDS and become familiar with the hazards associated for all chemicals involved in his or her processing. Near each fume hood the necessary protective gear is readily available and it is the user's responsibility to utilize it. Available near each fume hood are the following protective items:

- Aprons
- Face mask
- Heavy nitrile gloves
- Acid sleeves
- Goggles

When using the heavy nitrile gloves, always make sure your regular nitrile gloves are clean before putting the heavy ones on. If you spill a small amount of any chemical on the surface of your heavy nitrile gloves, immediately rinse it with water. Always rinse the heavy nitrile gloves when you are finished using them. If you spill a small amount of any chemical on the surface of your normal nitrile gloves, immediately rinse them with water and replace the gloves with a new pair, discarding the dirty pair. This is to avoid spreading chemicals and chemical residue to things like door handles, buttons, etc. Remember, part of the gowning procedure is to put on two pairs of gloves. This allows you to change the external glove within the cleanroom. Never take off both pairs of gloves inside the cleanroom.

ALWAYS label your beakers so that you and other users know which beaker contains what chemical. Proper labeling is essential since most chemicals are colorless and it is not difficult to confuse them. If your process requires a long period of time you may properly cover your beaker with a watch glass and leave a note with the following information:

- Your name
- Your phone number
- Chemical identification

- When you will be back to finish your process and clean up  
All chemicals left out without a note containing this information will be disposed of, no questions asked.

## 7.2 Using Hydrofluoric Acid

Extra caution must be employed when using HF (hydrofluoric acid). Users **MUST** wear an apron, heavy nitrile gloves and face mask when using any chemical containing HF. In addition, there are polypropylene bins labeled “Secondary Containment for HF Use” located on the shelves near the acid wet benches. These should be placed on the wet bench surface and all beakers or bottles containing HF must be placed within the secondary containment. HF waste is disposed of in separate waste containers labeled specifically for HF.

HF is particularly dangerous because, unlike other acids which cause immediate pain upon contact with skin, HF contact can cause latent burns that may take hours before they start to cause pain. Thus if the user is not aware that HF has come into contact with the skin, there may be nothing to alert the user of the need to take action to remedy the affects of the acid. This would allow the fluorine ions to migrate through the flesh eventually reaching the bone causing serious bodily harm. Calcium Gluconate Gel is located in the first aid kits near each emergency shower as well as at each HF wet bench. **Please follow all the required precautions and use utmost care when handling HF!!**

## 7.3 Hazardous Waste Disposal

In the back of each fume hood there is an opening, clearly labeled for chemical waste disposal. It is imperative that users only put the correct chemicals in these receptacles. Failure to do so will result in a possibly violent reaction between incompatible chemicals. A list of chemicals is posted near the receptacle that indicates which chemicals may be disposed of there. This is a major part of the segregation of the fume hoods according to chemical use. It is safe to dispose of chemicals of similar properties together, thus, in the solvent fume hoods all solvents may be put in the receptacle towards the back of the fume hood. Similarly, in the acid fume hoods, all acids may be put in the receptacle towards the back of the hood. But this is only two of the many different types of chemicals used in the facility. For disposal of all other types of chemicals there will be clearly labeled bottles stored in the cabinet below the counter top of the fume hood. **For your own safety and the safety of other users, always double check to be sure that the chemical you are disposing of is on the list attached to the receptacle into which you are pouring the chemical.** If one of the waste receptacles fills up please use a pre-labeled waste container on the nearby shelf and the spare secondary container. Leave the full waste bottle in the fume hood in the original secondary container.

When using **Piranha Etch** (concentrated sulfuric acid and hydrogen peroxide), please be sure to wear apron, heavy nitrile gloves and face mask. The Piranha solution will remain reactive and produce gaseous byproducts and heat for several hours after the mixture is made. For this reason Nano3 uses special waste bottles with vented caps to store the waste. These bottles are also coated with a polymer for extra strength against explosion in case of pressurization. **Please be very careful not to confuse the cap labeled “Piranha” with a normal non-vented cap.** Doing so will result in very high pressure within the waste bottle which could lead to an explosion.

## 7.4 Bringing Non-Stock Chemicals into Nano3

Nano3 supplies a wide variety of chemicals to the users (please see section 11.2). **YOU MUST NOTIFY NANO3 STAFF BEFORE BRINGING ANY NON-STOCK**

**CHEMICAL INTO THE FACILITY.** We will need to examine the MSDS in order to provide proper storage and disposal for all non-stock chemicals. Users that bring in chemicals without notifying Nano3 staff create a safety hazard for all users.

### **7.5 Glassware and Keeping the Fume Hoods Neat**

The Nano3 facility does not supply glass wear. Users must bring in their own glass wear and store it in the lab. The fume hoods are not a place for glass wear storage. All glass wear left in the fume hoods will be removed each morning unless it is properly labeled with a name, date, phone number **where you can definitely be reached** and time that the user will return. There are bins located near each fume hood where left out glass wear will be put by Nano3 staff. All glass wear in these bins is considered up for grabs.

### **7.6 Fume Hood Features**

#### **7.6.1 Photoresist spinners**

The fume hoods in the photolithography areas are equipped with photoresist spinners. The spinner controls are located on the front of the bench below the counter top. These spinners are equipped to handle runoff from liquids spun off the substrate, but it is preferable to line the spinner bowl with aluminum foil to catch the liquid. This aids the clean up process and keeps the drains clear and clean with little maintenance. Please line the spinner bowls with aluminum foil for each use. The Nano3 facility will provide a variety of spinner chucks to fit varying sample sizes. If you need a different size chuck, please ask Nano3 staff. It is ok for users to purchase their own chucks to keep with their personal supplies in the cleanroom. If you would like to purchase your own spinner chuck, please ask Nano3 staff about specifications and part numbers to insure that you purchase the correct chuck.

#### **7.6.2 Hot plates**

When using the hotplates, always remember to turn them off when you are done. Never set a hotplate to higher than the flash point of the material you are heating. Always familiarize yourself with the properties of the materials you are working with by examining the MSDS before using them. Some hotplates are resting on leveling tables. Feel free to adjust the leveling of the hotplate to insure that your photoresist does not flow to one side during softbake. When you are finished with the hotplate, allow it to cool and place it back in the storage location, unplugged.

#### **7.6.3 Sash/splash guard**

Each hood is equipped with a see-through sash that freely slides up and down. The proper functioning of the fume hood depends on the correct positioning of the sash. If the sash is open too far the hood will fail to effectively contain and vent chemical vapors from the breathing area. When you are using the fume hood the sash should be as low as possible. This also provides you with a splash guard as well. It does not, however, replace the necessity of eye protection.

#### **7.6.4 Ultrasonic baths**

Some fume hoods have ultrasonic baths. No beaker should ever come in contact with the bottom of the bath, this will prevent the transducers from transmitting the vibration into the water. The water should be one inch from the top of the bath during operation.

#### **7.6.5 Hot baths**

Some fume hoods have reservoirs with heaters. These may be filled with DI water and

heated using the controller on the front of the bench below the counter top.

## 8 Using Nano3 Equipment

***No user is allowed to operate any piece of Nano3 equipment without supervision until he or she has completed sufficient training AND authorization by Nano3 staff.***

Each instrument in the Nano3 facility has one Superuser, a Nano3 Staff Member in charge of maintenance and repair, and Authorized Users. To become an authorized user, please follow the procedure below. Note that these procedures apply to most pieces of instrumentation inside the facility. However, there are a number of more complex instruments that require more extensive training procedures.

Every piece of Nano3 equipment has a log book. **It is essential that users make a log book entry for every equipment usage.** These log book entries enable Nano3 staff to track equipment malfunction and/or equipment abuse. In addition, they also provide a record of process parameters and results for previous usage which can be valuable to new users.

### **Training and Authorization**

Make an appointment with Nano3 staff or any authorized user of the particular piece of equipment to obtain training on the operation of the machine. A list of authorized users for individual equipment in the Nano3 facility can be found on the wall near the specific instrument. Nano3 staff will inform you if the equipment you wish to use requires extra training.

Go through as many hands on training sessions as necessary until you feel comfortable operating the equipment. You are not permitted to use any equipment alone before being officially authorized. An authorized user **MUST BE WITH YOU** at all times while you are learning/practicing. Users must not only “push buttons”, they should have a good understanding of everything that happens with each part of the process.

When you feel you understand the process thoroughly and can operate the machine independently, you may make an appointment with the superuser for authorization. To obtain the superuser's name and email address, you can either contact a Nano3 staff member or you can get the superuser's e-mail address from the Authorized Users List posted at each instrument. Be sure to review your notes prior to authorization.

Have your samples and/or materials ready for the authorization procedure. During the authorization procedure, the superuser will watch you use the system while you explain the operation of the instrument.

If you demonstrate that you are sufficiently knowledgeable with the operation of the instrument, the superuser will give you authorization to independently use the instrument and your name will be added to the authorized user list.

***To insure the safety of people in the lab and to minimize equipment down time, it is absolutely necessary that all Nano3 users follow this procedure. Equipment authorization will only be done by Nano3 staff.***



## 8.2 Equipment Scheduling

The Nano3 equipment reservation calendar can be accessed through your on line user account. Users are responsible for reserving equipment for training time as well. Please make your reservations as far in advance as possible. If you make a reservation and then will not use the equipment for any reason, please be sure to remove the reservation so that other users can schedule time.

**Please be prompt.** You must begin your process within 20 minutes of the start of your reserved time slot. After 20 minutes you will loose your reservation privileges and the equipment is considered available to other authorized users.

The maximum reservation time for general equipment is three hours. However, please reserve your time slots according to your needs. Most processing can be finished in less than three hours. In the rare occasion that you need a piece of equipment for more than three hours you must come in early and be finished before 12:00 noon, i.e., if you need the equipment for five hours, you must start at 7:00am. This ensures that other users are not blocked out during peak usage times.

There are some instruments that will commonly require reservations of more than three hours. This information will be posted on the on line reservation calendar.

## 9 General Behavior Inside the Cleanroom

We strive to keep the user rates for our facility as low as possible. Please help us by being committed to **preservation of resources**, and to keeping to a minimum the necessity for facility staff to spend time on cleaning up after users, repairing things, etc. **Never, however, hesitate to request staff time to help you with things that you are unsure about.**

The following bullets are meant as a brief reminder of appropriate general behavior while inside the cleanroom. The list is by no means comprehensive, but contains items we believe are of particular importance.

- **Eating, drinking and gum chewing are prohibited** while inside the lab.
- Avoid sudden and fast movements (i.e., **NO RUNNING**). Approach corners and turns slowly, to avoid collisions with others. Remember that other users may be handling sensitive materials.
- **Never open your suit** while inside the cleanroom.
- **Never touch your skin** with your gloves. If you do, immediately put on a new pair of gloves.
- **Do not walk around** unnecessarily and be cautious when approaching another work area. Personnel movement is to be restricted to minimize disturbing settled particulate matter.
- **If you turn it ON, remember to turn it OFF.**
- If you make a mess, **clean it up**. Return everything to its original condition, or ideally, leave conditions a little better than you found them. This includes your entire set-up for experiments or projects.
- **Excess storage** in the cleanroom is not permitted.
- Be aware of **supplies**. If quantities of stock appear to be low, report it to the Nano3 staff.
- Use special care to keep **fume-hoods** in ultra-clean conditions.
- **Hot plates** (one of the main causes of cleanroom fires):
  1. Never leave on when unattended
  2. Make **sure** that the temperature is: 20°C BELOW flash point of contents and 20°C BELOW melting point of beaker materials.
  3. Ask for help if you are unsure of any part of the process.
- Any work or tools **dropped on the floor** shall be considered contaminated, and must be cleaned.
- **ANYTHING left unattended** MUST be labeled with your NAME, PHONE NUMBER WHERE YOU REALLY CAN BE REACHED (**not** the number of your department's front office), WHAT IT IS THAT IS SITTING THERE, and the DATES AND TIME of when you left it AND when you will return to get it. We will **THROW OUT** anything not appropriately labeled....no questions asked.
- **Disposal of solvent and/or photoresist-soaked materials:**

We have several containers in the cleanroom built specifically for the disposal of solvent-soaked materials, and require that they be used for the disposal of all such materials. The cleanroom is constantly recirculated, so all released vapors will find their way back into the space eventually for everyone to breathe. The following materials should be put in the solvent cans:

Any alcohols (ethanol, methanol, isopropanol, etc.)  
Acetone  
TCE (Trichloroethylene)

Chlorobenzene (especially hazardous)

Photoresist and related products

- **Disposal of acid-soaked materials:**

We have several containers in the cleanroom built specifically for the disposal of acid-soaked materials, and require that they be used for the disposal of all such materials. The following materials should be put in the acid cans:

Acetic acid

Buffered Oxide Etch (HF)

Chrome Etch

E-6 Metal Etch

Hydrochloric acid

Hydrofluoric acid

Nitric acid

Phosphoric acid

Hydrobromic acid

Sulfuric acid

## **10 Visitor Policy**

No user is allowed to bring any person into the cleanroom that has not completed the Nano3 Cleanroom Orientation unless permission to do so is granted by Nano3 staff.

A cleanroom qualified faculty/staff member or staff authorized user must escort the visitor AT ALL TIMES. The escort is responsible for ensuring that the visitor adheres to gowning requirements and follows the facility policies and procedures.

Whenever possible, visitors should remain outside the cleanroom (the entire facility may be viewed through the windows in the corridor).

## 11 Explanation of Charges

The Nano3 facility is a campus recharge facility open to all UCSD affiliated students and researchers as well as users from companies outside the university. We charge by the hour for time spent in the lab plus surcharges for certain special pieces of equipment.

### 11.1 Nano3 Services

The Nano3 facility is designed to promote research in a wide range of fields ranging from physical to biomedical sciences. Even if you have little or no experience with the types of equipment found in the Nano3 facility, we will guide you through the process of determining which equipment is necessary for your process and provide detailed training for that equipment. Throughout your usage of the Nano3 facility Nano3 staff will be there to help. We will be available to discuss your process needs and give advice to help you achieve your research goals. We will do what we can to make sure that each Nano3 user understands the operation of the equipment to a degree which will insure the safety of the users, the well being of the equipment and that the user can effectively use the tool to achieve, and perhaps go beyond, the desired results. Nano3 staff will do its best to keep equipment on line and minimize downtime. We are aware that many users are operating under strict deadlines and we will do our best to help you meet them.

### 11.2 Materials Provided

The facility is equipped with ultra-high purity, electronics grade DI water and ultra-high purity nitrogen gas. In addition, the chemicals and materials listed below are typically supplied. Please note that the availability of the items on the following lists is subject to change depending on user demand.

#### **Sputter targets:**

Al (99.999%)  
Al (1% Cu) (99.999%)  
AlN (99.8%)  
Al<sub>2</sub>O<sub>3</sub> (99.99%)  
Au (99.99%)\*  
Cr (99.95%)  
Cu (99.99%)  
Ge (99.999%)  
ITO (99.99%)  
Ni:Cr (8:2) (99.9%)  
Si (99.999%)  
SiN<sub>x</sub> (99.9%)  
SiO<sub>2</sub> (99.995%)  
Ta (99.95%)  
Ti (99.995%)  
W (99.95%)  
W (99.999%)  
W:Ti (9:1) (99.995%)  
ZnO/Al<sub>2</sub>O<sub>3</sub> (98/2) (99.999%)  
Zr (Grade 702)  
ZrO<sub>2</sub>

\*Certain restrictions may apply for Au depositions. Please enquire with Nano3 staff for details.

**Materials for e-beam and/or thermal evaporation:**

Al (99.99%)  
Au (99.99%)\*  
Ag (99.99%)  
Co (99.95%)  
Cr (99.998%)  
Ge (99.999%)  
Ni (99.995%)  
Pd (99.95%)  
Pt (99.99%)\*\*  
SiO<sub>2</sub> (99.999%)  
Ti (99.995%)  
Vn (99.7%)

\*Certain restrictions may apply for Au depositions. Please enquire with Nano3 staff for details.

\*\*Pt will be provided at cost.

**Photoresists:**

Futurex NR7 1500PY  
Futurex NR9 1500PY  
MicroChem Nano SU8 - 25  
MicroChem Omnicoat for lift off applications with SU8 photoresists  
MicroChem PMGI- SF - 13  
Shipley S1805  
Shipley S1813  
Shipley S1818  
Shipley SPR 220 4.5  
Shipley SPR 220 7.0

**E-beam resists:**

MicroChem Copolymer Nano MMA (8.5) MAA EL12  
MicroChem Nano 950PMMA C4  
MicroChem PMMA A 11  
Negative E-beam Resist AR-N 7500

**Developers:**

Futurex RD6  
Microposit MF 319, 321, 354, 454  
Microposit MF24A  
Microposit Developer Concentrate  
PLSI  
MicroChem Nano XP SU-8 Developer  
MicroChem Developer 101  
Methyl Isobutyl Ketone

**Strippers and thinners:**

Futurex RR2 Remover  
MicroChem Nano PG Remover  
Shipley 1165 Stripper

Shipley Thinner P

**Oxidizers:**

Hydrogen Peroxide  
Nitric Acid

**Bases:**

Ammonium Hydroxide  
Potassium Hydroxide (Solid)  
Gallium Phosphide Etch (KOH)

**Acids:**

Acetic  
Buffered Oxide Etch (HF)  
Chrome Etch  
E-6 Metal Etch  
Hydrochloric  
Hydrofluoric  
Nitric  
Phosphoric  
Hydrobromic  
Sulfuric

**Solvents/Flammables:**

Acetone  
Ethanol  
Isopropanol  
Methanol  
Toluene  
Methyl Isobutyl Ketone  
Microposit Primer  
Chlorobenzene  
Trichloroethylene  
Toluene  
Hexamethyldisilazane (HDMS)  
Xylene

***Please note:***

Nano3 staff approval is required to bring any **additional chemicals** into the facility. Make sure to supply an MSDS for the chemical in question. No chemical can be brought into the facility until an MSDS sheet is on file in the MSDS binder in the main hallway of the facility.

Any chemical being brought into the facility must be properly labeled. Clearly identify the lab user and date on the container. Any lab user chemical that does not have the required identification is subject to disposal.

Chemicals for a dedicated user must be labeled as “special chemicals” and will be inventoried either separately or if space is available with some of the Nano3 standard chemicals. Special chemicals should be ordered in minimum volumes, reducing high disposal costs.

Lab member “formulations” must bear a “Special Chemical Formula” detailing content

percentages.

Nano3 users must familiarize themselves with the chemicals that they plan to use in the facility. As a start, users should review the Materials Safety Data Sheets (MSDS) Notebook available in the main hallway of the facility.



## 12 Enforcement

We embrace the idea of a user facility and recognize that the success of the facility depends on making it a friendly and accessible environment for the users. Although we hope to never have to penalize users for not following the policies outlined above, the user must recognize that the successful operation of the facility depends on strict adherence to these policies. Adherence to these policies is essential for maintaining a clean environment; it is in everyone's best interest to follow them. Unfortunately we must prepare for breaches of cleanroom policy. We reserve the right to invoke the following penalties for the listed transgressions:

- Failure to create an entry in the logbook for a particular piece of equipment:
  - First offense: Verbal warning
  - Second offense: Written warning
  - Third offense: Suspension from the cleanroom for 3 weeks.
- Failure to properly label chemicals:
  - First offense: Verbal warning
  - Second offense: Written warning
  - Third offense: Suspension from the cleanroom for 3 weeks.
- Not wearing proper safety equipment or not following proper gowning/de-gowning procedure (Safety glasses, face shield while working with acids/bases at hoods, cleanroom attire):
  - First offense: Verbal warning
  - Second offense: Written warning
  - Third offense: Suspension from the cleanroom for 3 weeks.
- Not cleaning up after use of the facility.
  - First offense: Verbal warning
  - Second offense: Written warning
  - Third offense: Suspension from the cleanroom for 3 weeks.

Suspension from the cleanroom for 3 weeks without prior warning:

- Use of any cleanroom equipment without being an authorized user for the equipment.
- Granting access to an unauthorized user to use equipment. No user can grant access to an unauthorized user to use equipment without his/her **constant** supervision. Authorized users are allowed to train other users on the equipment.
- Using the facility without swiping your access card.
- Using the facility with someone else's access card without being an authorized user and/or not under supervision.
- Using equipment reserved for another user. A user may not use any equipment reserved by another user for the first 20 minutes of the first hour the equipment is reserved. After that time, the equipment may be used until the next reservation. If a user's run exceeds a scheduled time, the next user who has reserved the equipment should try to reach a compromise with the previous user. The machine does, however, belong to the user who reserved it, and he/she may ask the previous user to terminate their run.
- Using equipment when it is undergoing maintenance and is marked not to be used or "Machine Down". Under no circumstances is a user allowed to perform any maintenance on any equipment. Any abnormalities while using the equipment must promptly be reported to Nano3 staff.
- Not leaving the cleanroom during an emergency. During an emergency, the emergency

lights and/or siren will go off. The lights are located in visible places throughout the cleanroom. In such a situation, every user must immediately leave the cleanroom. Users should not take time to de-gown.

- Installing software on any computers or modifying equipment settings on equipment dedicated computers.
- Removing supplies and/or equipment from the facility.